Proceedings of the WABER 2017 Conference

16-18 August
University of Ghana
Accra, Ghana

Editors
Samuel Laryea
Eziyi Ibem



978-0-620-76913-6

WEST AFRICA BUILT ENVIRONMENT RESEARCH (WABER) CONFERENCE
Knowledge, Interaction, People & Leadership

PROCEEDINGS OF THE WABER 2017 CONFERENCE

16th-18th August 2017

University of Ghana, Accra, Ghana

EDITORS

Sam Laryea
Wits University, South Africa

Eziyi Ibem
Covenant University, Nigeria

WABER conference
West Africa Built Environment Research Conference
Knowledge, Interaction, People & Leadership

Accra, GHANA
2017
16-18 AUG.
University of Ghana

Proceedings of the West Africa Built Environment Research (WABER) Conference 2017

16th - 18th August 2017

University of Ghana, Accra, Ghana

© Copyright. WABER Conference.
The copyright for papers in this publication belongs to authors of the papers. Refer to copyright statement in publication for more details

ISBN 978-0-620-76913-6

The ISBN for this publication was provided by the National Library of South Africa. Legal deposits of the publication have been supplied to the National Library of South Africa, Library of Parliament, and other places of Legal Deposit.

First published in August 2017

Published by:
West Africa Built Environment Research (WABER) Conference
C/o Sam Laryea
School of Construction Economics and Management
University of the Witwatersrand
1 Jan Smuts Avenue, Johannesburg, South Africa
Tel: +233 545 204 300 / +27 78 172 6106
Email: info@waberconference.com / samuel.laryea@wits.ac.za
Website: www.waberconference.com

Editors

Sam Laryea, Wits University, South Africa
Eziyi Ibem, Covenant University, Nigeria

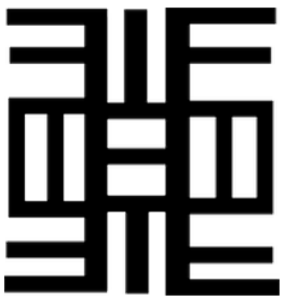
Cover design by Streak Design

Declaration

All papers in this publication have been through a review process involving initial screening of abstracts, review of full papers by at least two referees, reporting of comments to authors, revision of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.

TABLE OF CONTENTS

Table of Contents	iii
Foreword	v
Copyright Statement	ix
Declaration of peer review and scientific publishing policy	xi
Scientific Committee and Review Panel	xiii
WABER Committee	xv
Sponsors and Partners	xvii
Prizes to be awarded at the WABER Conference 2017	xix
WABER interacts with previous winners of Best Paper Prize	xxi
Profile of Keynote Speakers	xxv
Programme for WABER 2017 Conference	xxxi
Programme for Academic Writing and Publication Workshop	xliii
Programme for Workshop for Research Supervisors	xlv
List of Papers in WABER 2017 Conference Proceedings	xlvii
Keynote Addresses	1
Conference Papers	11
Index of Authors	1463
Index of Keywords	1467



NEA ONNIM NO SUA A, OHU

"He who does not know can know from learning"

This is the Adinkra symbol of knowledge, life-long education and continued quest for knowledge. The Akan people in West Africa believe that the search for knowledge is a life-long process. This is evident from the Akan saying "Nea onnim sua a, ohu; nea odwen se onim dodo no, se ogyae sua a, ketewa no koraa a onim no firi ne nsa" which translates into "He who does not know can become knowledgeable from learning; he who thinks he knows and ceases to continue to learn will stagnate".

FOREWORD

It is my pleasure to welcome each of you to our 7th West Africa Built Environment Research (WABER) Conference taking place on the campus of University of Ghana in Accra, Ghana.

Thank you for coming and a very warm welcome to Accra and the beautiful campus of the University of Ghana. When you have some time, I recommend a visit to the upper campus of University of Ghana to enjoy the full beauty of this university. You will find buildings of architectural significance and you will also be able to see from there an aerial view of parts of Accra.

The delegates at this year's conference come from Chad, Ghana, Ethiopia, Hong Kong, Kazhakstan, Nigeria, South Africa, Sweden, Uganda, UK and USA. I welcome each of you personally. Please take every opportunity to interact, exchange ideas and develop collaborations with colleagues from other places. To everyone who has come from outside Ghana, we extend a very special welcome to you by saying "*Akwaaba*" which means "*Welcome*" in our local language.

I know many of you have travelled long distances to get here. I also know that many of you have made considerable sacrifices by drawing on your own resources in order to be at this conference. We appreciate your efforts and hope your expectations will be met as we progress through the conference programme. It is always my hope that this conference provides each of us with a valuable professional development experience and opportunities for a productive and rewarding career.

I am delighted that we have some excellent keynote speakers this year who will interact with delegates on a range of important topics on the programme but also on issues that you may wish to discuss with them during breaks. Feel free to discuss professional issues on your mind with them. It is a credit to our three keynote speakers that all of them kindly agreed to come and share their time, knowledge and expertise with us. So I would like to welcome and honour our three keynote speakers: Professor Jason D. Shaw (Chair Professor of Management at Hong Kong Polytechnic University & Editor-in-chief of Academy of Management Journal); Professor Oluwole Morenikeji (Professor of Urban and Regional Planning & Deputy Vice Chancellor (Academic) at Federal University of Technology, Minna, Nigeria) and Professor Will Hughes (Professor of Construction Management and Economicsat University of Reading, UK). I thank each of you profoundly for accepting our invitation. I hope everyone here benefits from the illumination your presence provides. Have a nice stay in Ghana and enjoy your interaction with delegates.

From an initial submission of 181 abstracts, we eventually accepted 94 papers for publication in the conference proceedings. About 84 of the accepted papers have been scheduled for presentation at this conference. Some authors opted for the publication only route and their papers have not been scheduled for presentation. We congratulate all authors of published papers in our WABER 2017 conference proceedings. Thank you for your commitment to scientific research, professional development, and the hard work put into doing the research and writing of the papers.

On that note, I must also thank the members of our scientific committee and review panel. Peer review is essential to good science; credit must be given to our expert reviewers from 17 countries who have so generously given their time and knowledge to contribute to the peer review process for this year's conference. I wish to thank each reviewer for your effort, contribution and essential service as gatekeepers for the scientific integrity of published research papers. Without the expert contribution of our referees, this conference will not enjoy its high reputation. So thank you once again to all reviewers particularly Assoc. Prof. Eziyi Ibem, Dr Carmel Lindkvist, Assoc. Prof. Emmanuel Essah and Prof Will Hughes for your significant contributions in this regard.

I look forward to the paper presentations. Some of you would have noticed that we have introduced a new format into our paper presentation system. In previous years, all paper presentations were done using traditional conference style presentation. This year, we have a

combination of traditional conference style presentation and poster presentation which we are adopting for the first time. We have designed the format of the poster presentation session to be as interactive as possible for authors and the audience. We want every presentation to be seen, every author to be heard, and audience interaction with each author. That is the basis for our design of the poster presentation session. This change has not been easy for some authors to accept. I know some authors still prefer traditional style conference presentation. However, I ask for your cooperation and support in making the poster presentation session a success. Please embrace the change we have introduced in order to realise and enjoy its benefits. I can assure you that your poster presentation will be seen by everyone in the audience and you will be fully heard. A poster presentation is one of the most effective and most widely used ways to present research. I hope that all of us adapt well to this new system and we use our poster presentation session as an opportunity to enjoy an alternative way of presenting our research.

The successful preparation and organisation of this conference is backed by the support of our sponsors and partners. I would like to say a big thank you to our sponsors and partners. I particularly wish to thank Pinsent Masons who have provided us with significant support this year. Pinsent Masons supported us to initiate our Construction Law Seminar in April (26-27) this year. The April event was attended by more than 200 people. We just finished a 2nd Construction Law Seminar (14-15 August) and that one too was attended by more than 200 people. Rob Morson who represents Pinsent Masons at this conference was instrumental in the planning and success of the Construction Law Seminars. Rob, thank you so much for your contribution to the work we are doing here. I hope you enjoy your time at this conference. Our other sponsors/partners have also been extremely supportive and generous. Procurement and Project Management Consultancy (PPMC) Ltd have been regular sponsors of WABER Conference – Thank you for your financial support over the years. Dataware Consult became our official IT partner earlier this year – Thank you for providing various forms of IT support for our events. Finally, I thank Excelsis Ltd (our Videography partner) who are doing video recording and documenation of this conference.

I must conclude by acknowledging and appreciating the roles and efforts of the following people for the significant contributions you have made towards the successful organization of the conference: Florence Laryea, Assoc. Prof. Eziyi Ibem, Solomon Kwofie, Emmanuel Ansah, Georgina Bediako, Assoc. Prof. Emmanuel Essah and Dr Afolabi Dania. Organising a conference of this scale is always a enormous task so I thank each of you for your dedication and important contribution.

On the whole, I am pleased to say that this year has been a successful and productive one for WABER Conference. To all of you who have contributed in various ways, I thank you very much. To all delegates at this year's conference, I thank you once again for your participation. Enjoy the conference, engage in the exchange of ideas, build new relationships for the future, and have a safe journey back home.

We wish everyone at this conference the very best for all of your endeavours and hope to see you again in the future.

Sam Laryea, PhD, PGCAP, FHEA, MSCLA, MASAQS, MRCIS, MCIOB, PrCPM
Chairman of WABER Conference

Accra, Ghana, 16th August 2017

CONNECT WITH US

Visit our websites and social media sites for more information about our activities:

West Africa Built Environment Research (WABER) Conference
info@waberconference.com
www.waberconference.com
@WABERConference
West Africa Built Environment Research Conference
WABER Conference

WABER Professional Education
info@waberprofessionaleducation.com
www.waberprofessionaleducation.com
@WABERProfEd
WABER Professional Education

African Journal of Built Environment Research
info@waberjournal.com
www.waberjournal.com

For more information please email us at info@waberconference or Call/SMS/WhatsApp us on +233 545 204 300

COPYRIGHT STATEMENT

The copyright for papers published in the WABER Conference Proceedings belongs to authors of the papers.

Authors may reproduce and distribute papers published in the WABER Conference Proceedings for personal and educational purposes without written permission but with a citation to this source. No unauthorised reproduction or distribution, in whole or in part, of work published in the WABER Conference Proceedings by persons other than authors is allowed without the written permission of authors or organisers of the WABER Conference, whichever is applicable.

All authors of papers published in the WABER Conference Proceedings retain the right to re-publish their work in any format without the need for further permission from organisers of the WABER Conference. This includes making copies the final published pdf version of papers available on personal websites and institutional repositories and bibliographic databases. However, we ask authors to acknowledge that the original paper was first published by WABER Conference as part of the Conference Proceedings.

We have taken reasonable steps to comply with copyright obligations in the production of this Conference Proceedings. However, we make no warranties or representations that material contained in the papers written by authors does not infringe the intellectual property rights of any person anywhere in the world.

We do not authorise infringement of copyrights / intellectual property rights by authors. If you believe that any material in any paper published in this Conference Proceedings has been inappropriately used, please contact us by email: info@waberconference.com

Our authors are responsible for ensuring good academic practice when conducting and reporting scientific research. It is the responsibility of authors to abide by the norms of academic ethics and integrity. WABER Conference accepts no liability for copyright infringements or inappropriate use of material in any paper published.

Correspondence relating to copyrights / intellectual property rights or requests for permission to use material from the WABER Conference Proceedings should be made to the Chairman of WABER Conference by email: info@waberconference.com

PEER REVIEW AND SCIENTIFIC PUBLISHING STATEMENT

16th August 2017

TO WHOM IT MAY CONCERN

The scientific information published in peer-reviewed outlets carries special status, and confers unique responsibilities on editors and authors. We must protect the integrity of the scientific process by publishing only manuscripts that have been properly peer-reviewed by scientific reviewers and confirmed by editors to be of sufficient quality.

I confirm that all papers in the WABER 2017 Conference Proceedings have been through a peer review process involving initial screening of abstracts, review of full papers by at least two referees, reporting of comments to authors, revision of papers by authors, and re-evaluation of re-submitted papers to ensure quality of content.

It is the policy of the West Africa Built Environment Research (WABER) Conference that all papers must go through a systematic peer review process involving examination by at least two referees who are knowledgeable on the subject. A paper is only accepted for publication in the conference proceedings based on the recommendation of the reviewers and decision of the editors.

The names and affiliation of members of the Scientific Committee & Review Panel for WABER 2017 Conference are published in the Conference Proceedings and on our website www.waberconference.com

Papers in the WABER Conference Proceedings are published open access on the conference website www.waberconference.com to facilitate public access to the research papers and wider dissemination of the scientific knowledge.

Yours Sincerely,



Sam Laryea, PhD
Chairman of WABER Conference

SCIENTIFIC COMMITTEE AND REVIEW PANEL

WABER Conference is very grateful to each the following persons for your contribution to the peer review process. Thank you so much.

Assoc. Prof. Sam Laryea, Wits University, Johannesburg, South Africa
Assoc. Prof. Eziyi Offia Ibem, Covenant University, Nigeria
Assoc. Prof. Emmanuel Essah, University of Reading, UK
Dr Obinna Ozumba, Wits University, Johannesburg, South Africa
Prof Will Hughes, University of Reading, UK
Dr Carmel M. Lindkvist, Norwegian University of Science and Technology, Norway
Dr Natalya Sergeeva, University College of London, UK
Prof Koshy Varghese, Indian Institute of Technology (I.I.T.) Madras, India
Dr Cynthia Adeokun, Colman Architects Ltd, UK
Dr Joy Maina, Ahmadu Bello University, Nigeria
Assoc. Prof. Taibat Lawanson, University of Lagos, Nigeria
Dr Sarfo Mensah, Kumasi Technical University, Ghana
Dr Moses Ogunbiyi, Osun State University, Nigeria
Dr Pippa Boyd, University of Reading, UK
Dr Marcellinus Okafor, Imo State University, Owerri, Nigeria
Dr Naa Adjeley Ashiboe-Mensah Doamekpor, Pentecost University College, Ghana
Mr Goodenough Dennis Oppong, Hong Kong Polytechnic University, Hong Kong
Dr Ibrahim Saidu, Nelson Mandela Metropolitan University, South Africa
Dr Titus Kwofie, University of Johannesburg, South Africa
Dr Sazoulang Douh, University of N'Djamena, Chad
Dr. Adedapo A Oluwatayo, Covenant University, Ota, Nigeria
Assoc. Prof. Abraham A. Taiwo, Federal University of Technology, Akure, Nigeria
Dr. Olumuyiwa Adegun, Wits University, Johannesburg, South Africa
Assoc. Prof. Clinton Aigbavboa, University of Johannesburg, South Africa
Dr Gabriele Lobaccaro, Norwegian University of Science and Technology, Norway
Prof Godwin Idoro, University of Lagos, Nigeria
Dr. Julius A. Fapohunda, Cape Peninsula University of Technology, South Africa
Dr. Adetokunbo O. Ilesanmi, Obafemi Awolowo University, Ile-Ife, Nigeria
Dr. Nwabueze M. Anosike, Federal University of Technology, Owerri, Nigeria
Prof Ola Uduku, Edinburgh University, Scotland, UK
Dr. Kola Ijasan, Wits University, Johannesburg, South Africa
Assoc. Prof. M. Ajibola, Covenant University , Ota, Nigeria
Dr. Kola Akinsomi, Wits University, Johannesburg, South Africa
Prof. Musibau A. Shofoluwe, North Carolina Agricultural and Technical State University, USA
Dr Akunnaya P. Opoko, Covenant University, Ota, Nigeria
Dr Lekan M. Amusan, Covenant University, Ota, Nigeria
Mr Jacob Ofori-Darko, University of Reading, UK
Dr Afolabi Dania, University College of Estate Management, UK
Dr Ambituuni Ambisisi, Coventry University, UK
Dr Hiral Patel, University of Reading, UK
Dr Karen Blay, Loughborough University, UK
Dr Adesoji D Jiboye, Obafemi Awolowo University, Ile-Ife, Nigeria
Dr. Anthony Edeh, Covenant University, Ota, Nigeria
Dr Gabriel Fadairo, Federal University of Technology, Akure, Nigeria
Mr Bert Young, London South Bank University, UK
Dr. Amna Shibeika, United Arab Emirates University, UAE
Dr Humphrey Danso, University of Education Winneba, Ghana
Dr Adebanji Ogbiye, Covenant University, UK
Dr Franklin Obeng-Odoom, University of Technology Sydney, Australia

Dr Cletus Moobela, University of Portsmouth, UK
Dr Mutale Katyoka, University of the West of England, UK
Dr. Isidore C. Ezema, Covenant University, UK
Assoc. Prof. Abimbola Windapo, University of Cape Town, South Africa
Dr. Obuks A. Ejohwomu, University of Manchester, UK
Dr Joseph Buertey, Pentecost University College, Ghana
Dr Jasper Mbachu, Massey University, New Zealand
Chipozya Kosta Tembo-Silungwe, Copperbelt University, Zambia
Dr Kulomri Adogbo, Ahmadu Bello University, Nigeria
Dr Yewande Adewunmi, University of the Witwatersrand, South Africa
Dr Stephen Allen, University of the Witwatersrand, South Africa
Mr Maxwell Fordjour Antwi-Afari, Hong Kong Polytechnic University, Hong Kong
Prof. Dolapo Amole, Obafemi Awolowo University, Nigeria
Assoc. Prof. Oluseyi Ajayi, Covenant University, Nigeria
Assoc. Prof. Fidelis A. Emuze, Central University of Technology, South Africa
Assoc. Prof. Salman Azhar, Auburn University, USA
Assoc. Prof. A Adebiyi, Covenant University, Nigeria
Dr Folake Ekundayo, St Marks Hospital, UK
Dr Bekithemba Mpofu, Wits University, Johannesburg, South Africa
Dr Gabriel Nani, KNUST, Kumasi, Ghana
Assoc. Prof. Ochie Ikpefan, Covenant University, Nigeria
Prof. Olabosipo Fagbenle, Covenant University, Nigeria
Dr. Timothy Tunde Oladokun, Obafemi Awolowo University, Nigeria
Dr. Justus Agumba, Durban University of Technology, South Africa
Professor Immaculata Nwokoro, University of Lagos, Nigeria
Dr. Haruna Musa Moda, Manchester Metropolitan University, UK
Dr Norhayati Mahyuddin, University of Malaya, Malaysia
Dr Nongiba Kheni, University of Education, Kumasi, Ghana
Assoc. Prof. Stephen Oluigbo, Ahmadu Bello University, Nigeria
Dr Damilola Ekundayo, Oxford Brookes University, UK
Assoc. Prof. James O.B. Rotimi, Auckland University of Technology, New Zealand
Dr Tumellano Sebeha, University of the Witwatersrand, South Africa
Dr Patience Tunji-Olayeni, Covenant University, Nigeria
Dr Fadeyi Moshood Olawale, Singapore Institute of Technology, Singapore
Dr Johan Nyström, The Swedish National Road and Transport Research Institute, Sweden
Assoc. Prof. Yomi M.D. Adedeji, Federeal University of Technology, Akure, Nigeria
Assoc. Prof. Okoh Ameh, University of Lagos, Nigeria
Dr Solomon Olusola Babatunde, Obafemi Awolowo University, Ile-Ife, Nigeria
Dr Nnezi-Uduma-Olugu, University of Lagos, Nigeria
Dr. Timothy Oluseyi Odeyale, Federal University of Technology, Akure, Nigeria
Alexander Adeyemi, Fakare, Federal University of Technology, Akure, Nigeria
Assoc. Prof. Yomi Michael D. Adedeji, Federal University of Technology, Akure, Nigeria
Dr. Olatunde F. Adedayo, Federal University of Technology, Minna, Nigeria
Assoc. Prof. Remi Olagungu, Federal University of Technology, Minna, Nigeria
Dr. Oluwafemi Kehinde Akande, Federal University of Technology, Minna, Nigeria
Dr Ehsan Saghatforoush, MehrAlborz University, Iran
Dr Sitsabo Dlamini, Wits University, South Africa
Prof George Intsiful, Kwame Nkrumah University of Science and Technology, Ghana

WABER COMMITTEE

Assoc. Prof Sam Laryea, Wits University, South Africa (Conference Chair)
Assoc. Prof Eziyi Ibem, Covenant University, Nigeria (Conference Secretary)
Assoc. Prof Emmanuel Essah, University of Reading, UK (Financial Director)
Dr Jasper Mbachu, Massey University, New Zealand
Dr Sarfo Mensah, Kumasi Technical University, Ghana
Assoc. Prof. Taibat Lawanson, University of Lagos, Nigeria
Dr Cynthia Adeokun, Colman Architects Ltd, UK
Prof Kabir Bala, Ahmadu Bello University, Nigeria
Dr Damilola Ekundayo, Oxford Brookes University, UK
Prof George Intsiful, KNUST, Kumasi, Ghana
Dr Noah Karley, Anglia Ruskin University, UK
Prof George Ofori, London South Bank University, UK
Prof Anny Nathaniel Aniekwu, University of Benin, Nigeria
Dr Sena Agyepong, Ashesi University College, Ghana
Prof D. R. Ogunsemi, Federal University of Technology, Akure, Nigeria
Dr Obinna Ozumba, University of the Witwatersrand, South Africa
Dr Roine Leiringer, University of Hong Kong, Hong Kong
Dr Afolabi Dania, University College of Estate Management, UK
Prof Stella Zubairu, FederalUniversity of Technology, Minna, Nigeria
Dr Gabriel Nani, KNUST, Kumasi, Ghana
Prof Immaculata Nwokoro, University of Lagos, Nigeria

The main responsibility of the WABER Committee is to provide the infrastructure and academic leadership for developing the WABER Conference.

SPONSORS AND PARTNERS

Thank you to all sponsors and partners of the WABER Conference.

The following conference items are proudly provided by Pinsent Masons (the world's best law firm 2016 & best infrastructure law firm in 2016) to support this conference and human development on the African continent – USBs, Lanyards and name badge holders, Notepads and Pens.
Website: https://www.pinsentmasons.com

IT support and services is proudly provided by Dataware Consult Ghana – WiFi internet, printing and photocopying services.
Website: https://www.datawareghana.com

PPMC Ltd have been a regular sponsor of WABER Conference. We appreciate PPMC's financial contribution towards our conference costs.
Website: http://www.ppmcgroup.com

McOttley Capital are our newest partner. We appreciate your financial contribution and look forward to the start of a great relationship between WABER and McOttley.
Website: https://capital.mcottley.com

DATAWARE CONSULT

OFFICIAL IT PARTNER FOR WABER CONFERENCE



PRIZES TO BE AWARDED AT THE WABER 2017 CONFERENCE

- Best Research Paper

This prize is awarded to recognize the author(s) of an original piece of research which contributes a better understanding of the research question/problem investigated and demonstrates a high degree of scientific quality and innovative thought. This prize was created to acknowledge the continuing importance of high quality research to academic institutions, a researcher's reputation and the development of the built environment field.

- Best Oral Presentation

This prize is awarded to recognise the presentation which is the most coherent, clearly enunciated, well-paced, easy to understand, and effective. The award is given on the basis of quality of the presentation and not the written paper. It recognizes the best presentation based on communication of the content of a paper and the ability of the speaker to deliver an impactful, authoritative and engaging presentation. The award looks to encourage researchers to put as much effort as possible into the presentation of their work.

- Best Poster Presentation

This prize is awarded to recognise the poster which presents the most effective snapshot of the work being reported. The award is given on the basis of the quality of the poster presentation and not the written paper. The award is to be presented to the poster that provides the best snapshot of researcher's work, which engage colleagues in a dialogue about the work, and provides a summary that will encourage the reader to want to learn more about the study. The award looks to encourage researchers to put as much effort as possible into their poster presentation.

- Gibrine Adam Promising Young Scholar Award

This prize is awarded to recognize and encourage exceptional young researchers. The recipient should be a young academic who demonstrates promise, such that he/she is likely to become established as a research leader. The prize is provided by Mr Gibrine Adam – President of Zenith University College and CEO of EPP Books Services – who has made significant contributions to the education sector through his educational establishments and philanthropic work. Awarding this prize each year will serve as an important inspiration for young African built environment academics.

WABER INTERACTS WITH WINNER OF BEST PAPER PRIZE AT OUR LAST CONFERENCE

We are constantly interested in the development of each and every WABER Conference delegate. We always aim to make the conference a valuable experience and developmental opportunity for each delegate regardless of where you are on the career ladder.

We recently interacted with the most recent winner of our Best Paper Prize, Dr Joy Maina, about her experiences and current activities. We are delighthed to share the interview with Dr Joy Maina from Ahmadu Bello University with you in this section.

We wish Dr Maina success in her future endeavours. We hope she continues to be a shinning example of academic and professional excellence and sustain her contribution to the development built environment research on our continent.

Dr Joy Maina
Department of Architecture, Ahmadu Bello University, Nigeria



Dr Joy Maina receiving her Best Paper Prize in August 2015.

The title of her paper that won the award was "Architects and interdisciplinary research: reflections from ethnographic and measured fieldwork".

Q. Can you please tell us a bit about yourself – including where you work, academic background, research interests, and personal interests?

A: I am an architect trained at Ahmadu Bello University (ABU) and the University of Nottingham, UK. I lecture at ABU where I teach mainly Research Methods and Basic Design at undergraduate and postgraduate levels alongside managing other administrative posts. My research interests include Spatial qualities of the Built Environment, Human behaviour and spatial cognition, Housing research as well as Architecture Education. I enjoy music and sewing.

Q: How would you describe your academic/professional experiences so far? How did you get into academia? What courses do you teach and what does your job entail? What is your typical day in the office like?

A: My academic experiences have been interesting but slow by my personal yardstick. I underestimated the amount of hard work one needs to truly become grounded in research after the doctorate. Am still learning.

I got into academia by serendipity I guess. I should however mention that my mother was an English teacher, so I sort of grew with an academic background.

As mentioned earlier, I teach Basic Design Studio in the first year and Research Methods in the final undergraduate class. This is further extended and refined in the MSc Thesis Design Report class. I also teach Quantitative research approaches for PhD. The main thrust of my work involves postgraduate supervision at both MSc and PhD levels.

My typical day in the office: I go in between 7:30-8:00am when I have lectures, otherwise it's an hour later as I use the morning to catch up on my personal research. The rest of the day usually proceeds with either supervisory or administrative meetings until closing time at 4pm. There's rarely a proper break in between. To keep from burning out, I usually take an academic day off each week.

Q: How did you first hear about the WABER Conference and why did you decide to attend?

A: I learnt about the conference from colleagues on returning from my doctorate in 2013. I decided to attend because of the high accolades it received from previous participants.

Q: What was your experience of attending the WABER Conference? How did you benefit from attending the conference? How was the experience of arranging funding to attend the conference?

A: I had a fabulous time. I learnt a lot from listening to other participants. It's amazing what one learns when open to new ideas. It also reveals the depth of intelligent people around. My experience with funding was personal . . . My colleagues and I self-sponsored ourselves. My mom was travelling to Ghana so that made things a bit easier as I detest travelling alone.

Q: You won the best paper prize. Can you describe how you felt when you won the prize?

A: To be honest, it was a complete surprise! I didn't see that coming. It is humbling to think what I wrote had that much merit. Interestingly, the paper accrues from discussions with my external examiners during my viva. In essence it wasn't part

of my initial thesis. Am forever indebted to Dr. Ian Cooper and Dr. Nicole Porter who insisted that was perhaps one of my greatest contributions to knowledge. I acknowledge this at the end of the paper. It was also so gratifying to have my mother with me in Accra. Parents, I find are deeply sentimental about such achievements. It's my first paper prize, and I cherish it a lot.

Q: What impact has it had on you? How has the recognition and winning the prize influenced your academic development since the award?

A: Impact . . . I can't rest on my oars. So much is expected. The influence on my academic development has been gratifying in that one's colleagues take you seriously. It has also meant that am given more responsibilities because of the perception of a high capacity to deliver quality work especially in teaching and admin work involving production of technical reports and editorial reviews. Am currently a reviewer of several journals/conferences as well as the secretary and assistant editor of ARCHISEARCH, International Journal of Architecture and the Built Environment.

Q: What current research papers / projects are you working on at the moment?

A: Am currently looking into qualities of informal learning spaces, human movement and behaviour patterns around complex institutional buildings as well as human behaviour in terms of energy savings in housing.

Q: What are your future aspirations and what do you need to do to get there?

A: I aspire to mentor and pass on as much as I've learnt to my students and younger colleagues. This has often meant taking on more work and going the extra mile to prod students in writing good quality research papers which I review and scrutinise. I find that writing papers with younger colleagues exposes them faster to the tenets of research. It is also a beautiful way to mentor someone in life away from academic pursuits. As my way of mentoring, one of my students usually presents a joint paper at any conference I attend.

Q: What advise will you give to early career academics aspiring to develop their academic profile to an international level?

A: Know your onions, know your stuff… Obtaining a higher degree especially a doctorate isn't the end of the world. In fact, it's just the beginning. Ground yourself firmly in the research area of your choice as soon as possible because the higher one goes, the less time one has for research and personal development. It's embarrassing to reach the top empty where it matters.

Q: From your experience what are the most difficult challenges facing you and other built environment academics in Africa?

A: Lack of adequate sponsorship and mentoring. The first is unfortunate, truly a crippling factor. Most of the conferences I have attended were from personal savings and effort. I find it very sad that Africa is yet to fully recognise and embrace research as the key to national development in part because of the second issue, poor mentoring. Those ahead of us can only give what they have in ways they've been taught. The onus rests with us the younger generation to blaze paths for the future generation in terms of high quality research and forays into policies at national levels that influence better funding for research.

Q: Can you suggest some of the practical ways you have used to overcome the challenges?

A: Writing research proposals for national grants, ensuring high quality research in international journals, networking with other like minded professionals.

Q: What is your idea of good research and how can our universities in Africa support their academics in doing and publishing good research?

A: My idea of good research is one that is underpinned by theory from literature and offers practical/pragmatic recommendations towards the improvement of daily life. Good research ought to be well grounded in existing literature, otherwise, how does one justify the problem? My problem with many papers I review from Nigeria in particular and Africa in general is that the problem statement is not made clear in part because of weak theoretical and literature reviews. Consequently, we often miss important theoretical implications and practical recommendations. Hopefully, we will improve in this regard…

-End-

PROFILE OF KEYNOTE SPEAKERS

We would like to thank our keynote speakers for accepting our invitation to come and interact with delegates at the WABER Conference 2017. A brief profile of each keynote speaker is given in this section.

PROFESSOR JASON D. SHAW

Editor-in-chief of Academy of Management Journal & Chair Professor Of Management at Hong Kong Polytechnic University, Hong Kong



PROF JASON D. SHAW is Chair Professor of Management, Head of Department of Management and Marketing, and Director of the Centre for Leadership and Innovation in the Faculty of Business at The Hong Kong Polytechnic University. He received his Ph.D. from the University of Arkansas in 1997. He is the Editor-in-chief of Academy of Management Journal (2016-2019). His research has appeared or been accepted for publication in the Academy of Management Journal, Academy of Management Review, Journal of Applied Psychology, Organization Science, Strategic Management Journal, Organizational Behavior and Human Decision Processes, Personnel Psychology, and Journal of Management, among other scientific outlets. He has served or is serving on the editorial boards of Academy of Management Journal, Academy of Management Review, Journal of Applied Psychology, Personnel Psychology, and Journal of Management, among others. He has been invited for visiting scholar positions and other speaking engagements in China, Finland, Austria, Denmark, Norway, England, Germany, Hong Kong, Spain, Israel, Macau, Taiwan, Singapore, Australia, Canada, Belgium, Thailand, and the USA. Prior to his appointment at PolyU, he was the Curtis L. Carlson School-wide Professor in the Carlson School of Management at the University of Minnesota, the Clark Material Handling Company Professor at the University of Kentucky, an assistant professor at Drexel University, and an analyst for the Boeing Company.

PROFESSOR OLUWOLE MORENIKEJI

Commonwealth Fellow, Professor of Urban and Regional Management & Deputy Vice Chancellor (Academic) at the Federal University of Technology, Minna, Nigeria



PROF OLUWOLE MORENIKEJI joined the Federal University of Technology, Minna in 1990 as an Assistant Lecturer and rose to become a Professor of Urban and Regional Planning in 2006. He obtained his B. Sc in Geography and Regional Planning from the University of Calabar in 1983 and M. Sc Urban and Regional Planning from the University of Benin in 1998. He enrolled for his Ph.D in Transport Planning in 1992 at FUT Minna and won a Nigerian-Italian Ph.D scholarship which enabled him to do part of his Ph.D work at the University of Trieste, Italy. He bagged his Ph.D in 1998 and utilized his post-doctoral Commonwealth Fellowship at the Instrumented City, Institute for Transport Studies, University of Leeds, UK (2004/2005). Morenikeji served as the Head of Department of Urban and Regional Planning from 1995 – 2002 and later, Director of the Centre for Human Settlements and Urban Development established in collaboration with the UN-Habitat in FUT, Minna. He was also the Dean of the School of Environmental Technology from 2008-2012. He has also participated in a number of internationally funded research projects and published several papers in learned journals. His areas of interest include transportation planning, human development studies, spatial analysis and Research Methods. He is currently participating in a collaboratory research between The Construction and Property Research Centre, University of the West of England (CPRC-UWE), Bristol, UK and the Federal University of Technology (FUT), Minna being funded by DFID. He was appointed in April 2016 by the West African Science Centre on Climate Change and Adapted Land Use (WASCAL) as a visiting Professor teaching Research Methodology at the Joint Facility for Language and Common Courses (JFLCC) 2016 which is a collaborative programmes for Masters (MRP) and Doctoral Research Programme (GRP) students from 10 participating Universities.

PROFESSOR WILL HUGHES

Professor of Construction Management and Economics, University of Reading, UK



PROF WILL HUGHES is Professor in Construction Management and Economics in the School of Construction Management and Engineering, University of Reading, UK. He was Editor-in-chief of Construction Management and Economics for many years. He is also former Head of the School of Construction Management and Engineering. He is widely acknowledged as a leading academic in the built environment field and has an international reputation in the field of procurement and commercial management in construction. His PhD was on organizational analysis of building projects and he has researched and published extensively in this topic. His research interests include the control and management of building contracts, the management of design in construction, the analysis of organizational structure, and the analysis of procurement systems. The focus of his work is the commercial processes of structuring, negotiating, recording and enforcing business deals in construction. He has co-authored several books on construction management and contractual issues, including a best-selling text book, Construction Contracts: Law and Management that is an essential text in most universities running such courses. He is editor of the international refereed journal Construction Management and Economics, a member of the editorial boards of the Journal of Construction Research and the Journal of Asian Architectural and Building Research, as well as an editorial adviser to Taylor and Francis. He is an active member of ARCOM (Association of Researchers in Construction Management), having completed two years as chairman 1998-2000. Professor Hughes has recently contributed an entry to the Oxford Encyclopaedia of Economic History and to a book on Procuring Complex Performance

PROGRAMME FOR WABER 2017 CONFERENCE

WEDNESDAY 16 AUGUST 2017 (DAY 1)

07:30-9:00	**REGISTRATION**
09:00-10:05	**OPENING SESSION (AUDITORIUM)**
09:00-09:05	Welcome remarks, acknowledgment of sponsors and partners, Introduction of speakers and invited guests – Sam Laryea, Chairman of WABER Conference & Associate Professor at Wits University, Johannesburg, South Africa
09:05-09:15	An address on current developments in the West African higher education sector and what it means for us as researchers – Professor Oluwole Morenikeji, Deputy Vice Chancellor (Academic), Federal University of Technology, Minna, Nigeria
09:15-09:25	Remarks by a representative of Pinsent Masons, Partners of WABER 2017 Conference and sponsors of collateral materials for WABER 2017 Conference (USBs, notepads, pens, lanyards, name badges) – Mr Rob Morson, Partner, Pinsent Masons (Africa)
09:25-09:45	Address by the Guest of Honour
09:45-09:55	Presentation of a Citation to Prof Kabir Bala (Deputy Vice Chancellor (Admin), Ahmadu Bello University, Nigeria) in recognition o his distinguished contribution to the development and mentoring of early career built environment academics in Nigeria
09:55-10:00	Vote of thanks
10:00-10:05	Official WABER 2017 Group Photograph
10:05-10:30	**REFRESHMENTS AND NETWORKING BREAK**
10:30-10:55	**KEYNOTE SESSION (AUDITORIUM)** **Professor Will Hughes, Professor of Construction Management and Economics, University of Reading, UK** **TOPIC: CONCEPTUALISING A RESEARCH PROJECT** **Chairperson: Prof Oluwole Morenikeji, Deputy Vice Chancellor (Academic), FUTA, Minna, Nigeria**
11:00 – 13:00	**PRESENTATION AND FEEDBACK SESSION (AUDITORIUM)** PhD/Early career researchers present their work and receive constructive feedback from panel of experienced academics. The issues discussed by the panel often have relevance for all researchers **Panel: Prof Jason Shaw, Prof Oluwole Morenikeji, Prof Will Hughes**

	Chairperson: Dr Cynthia Adeokun, Colman Architects Ltd, UK	
11:00-11:10	An international experts' opinion on the objectives of stakeholder management in construction projects - Goodenough D. Oppong, Albert P. C. Chan, Ernest E. Ameyaw, D. Owusu-Manu	
11:10-11:20	Client relationship management in architectural firms in southwest Nigeria - Adedeji Adebola Adepeju, Ezıyı Offıa Ibem, Adedapo Adewunmi Oluwatayo	
11:20-11:40	Feedback / Q&A session	
11:40-11:50	Comparative analysis of investment attributes of commercial and hotel properties in South-Western Nigeria - Nurudeen Akinsola Bello, Babatunde Jolaoso, Olusegun Olaopin Olanrele	
11:50-12:00	Power sector development reforms in Nigeria: the roots to the challenges - Abdullahi D, Suresh S, Renukappa S, Oloke D	
12:00-12:20	Feedback / Q&A session	
12:20-12:30	Influence of power on client-contractor relationships in collaborative construction procurement - Ladi Kevin and Samuel Laryea	
12:30-12:40	Effects of quadriceps muscle fatigue on balance control and falls injuries following repetitive squat lifting task in construction workers - Maxwell Fordjour Antwi-Afari, Heng Li, Joon Oh Seo, Arnold Yu Lok Wong	
12:40-13:00	Feedback / Q&A session	
13:00 – 14:00	**LUNCH BREAK**	
14:00 – 15:15	**RESEARCH SKILLS WORKSHOP (AUDITORIUM)** **Professor Jason D. Shaw, Editor-in-chief of Academy of Management Journal (AMJ) ‖Chair Professor and Head of Department of Management and Marketing ‖ Director, Center for Leadership and Innovation at The Hong Kong Polytechnic University** **TOPIC: DOING AND PUBLISHING HIGH QUALITY RESEARCH : A LOOK AT ISSUES PERTAINING TO THEORY, RESEARCH DESIGN, GROUNDING HYPOTHESES/RESEARCH QUESTIONS** **Chairperson: Prof Kabir Bala, Deputy Vice Chancellor (Admin), Ahmadu Bello University, Nigeria**	
15:15 – 15:30	**REFRESHMENTS AND NETWORKING BREAK**	
15:30 – 17:00	**PARALLEL SESSION (AUDITORIUM)** **Theme: Sustainability / environment / Building Science**	**PARALLEL SESSION (SEMINAR ROOM)** **Theme: Architecture & Design** **Chairperson: Prof GWK Intsiful, Department of Architecture, KNUST, Kumasi, Ghana**

	Chairperson: Dr Emmanuel Essah, School of Construction Management and Engineering, University of Reading, UK	
15:30-15:40	A critical evaluation of the sustainable building assessment tool (SBAT) - Jeremy Gibberd	Designing for old age in Nigeria - Folake Ekundayo
15:40-15:50	Thermal climate and residents' perceptions in part of southwest Nigeria - Eludoyin Oyenike Mary	Rethinking design solutions to homelessness: A review of planning space standards - Cynthia Adeokun, A. Pearl Opoko
15:50-16:00	Analysis of green building strategies for hot-dry climatic conditions in north-western cities in Nigeria; Lesson from Botswana, Burkina Faso & South Africa - A. A. Yakub, A.O Salawu, S.D Gimba, Abubakar Ahmad, Abdulhakim Jolaoye	Assessment of light levels and visual comfort in a lecture hall of a university in Akure, Nigeria – Afolami, A. J., Akeremale, I. D. and Ikudayisi, A. E. - 3
16:00-16:15	Q&A	Q&A
16:15-17:00	**Chairperson: Dr Jeremy Gibberd, Council for Scientific and Industrial Research (CSIR), South Africa**	**Chairperson: Dr Folake Ekundayo, NHS Estates Design and Technical Services Department, UK**
16:15-16:25	Are LEED® certified buildings better in performance? A comparison of LEED® v. non-LEED® certified institutional buildings - Erika Crews, Salman Azhar, Amna Salman	Design of an automated staircase climber trolley for general hospitals in developing countries: case of an anonymous hospital in Zimbabwe - Tawanda Mushiri, Tariro Kadzunge, Charles Mbohwa
16:25-16:35	Impact of rating systems on the construction of green buildings in South Africa - Masego Leburu, Christopher Allen	Design innovation in structural engineering - Olawale, Simon O, Ogunbiyi, Moses Adebowale
16:35-16:45	An evaluation of indoor thermal conditions of residential buildings with different fabric finishes at Okigwe, Nigeria - Marcellinus U. Okafor	Implications of social practices and literacy on wayfinding design strategies in Nigerian hospitals Joy Joshua Maina, Abdulhamid Dauda
16:45-17:00	Q&A	Q&A
17:00	**CLOSE**	

THURSDAY 17TH AUGUST 2017 (DAY 2)

08:45-08:55	VIDEO HIGHLIGHTS OF DAY 1 (AUDITORIUM)	
09:00 – 10:15	**RESEARCH SKILLS WORKSHOP (MAIN AUDITORIUM)** **Professor Jason D. Shaw, Editor-in-chief of Academy of Management Journal (AMJ) ‖Chair Professor and Head of Department of Management and Marketing ‖ Director, Center for Leadership and Innovation at The Hong Kong Polytechnic University** **TOPIC: DOING AND PUBLISHING HIGH QUALITY RESEARCH: A LOOK AT ISSUES PERTAINING TO CRAFTING THE METHODS AND RESULTS, DISCUSSING THE IMPLICATIONS, MAKING A CONTRIBUTION** **Chairperson: Associate Professor Eziyi Ibem, Department of Architecture, Covenant University, Nigeria**	
10:15-10:30	**REFRESHMENTS AND NETWORKING BREAK**	
10:30-13:00	**PARALLEL SESSION (AUDITORIUM)** **Theme: Real Estate and Housing** **Chairperson: Mr Sammy Amegayibor, Executive Director Ghana Real Estate Developers Association (GREDA)**	**PARALLEL SESSION (SEMINAR ROOM)** **Theme: Construction Materials / Technology** **Chairperson: Prof. Dr. Abid Nadeem, Department of Civil Engineering, Nazarbayev University, Kazakhstan**
10:30-10:40	Analysis of residents' preference for residential neighbourhood in Ilorin, Nigeria - Adeogun, A.S., Raheem, W.M., Shittu, W. O., Bako A.I.	Effect of granite, washed and un-washed gravel aggregate sizes o engineering properties of concrete - Moses Adebowale Ogunbiyi, Simon O. Olawale, Oluwaseyi Ajayi
10:40-10:50	Socio-economic determinants of housing satisfaction among middle-income households in Owerri, Nigeria - Chinwe Ugochi Okpoechi	Evaluation of cocoa pod ash on the characteristic strength of sandcrete block produced in Oshogbo, Nigeria - Simon O. Olawale Moses Adebowale Ogunbiyi
10:50-11:00	Challenges of public-private partnership (PPP) in urban housing in Nigeria - Paschal C. Onyemaechi	Effects of sugar as admixture in concrete made with different brands of cement in Nigeria - Lawal Aliyu Muhammad, Musa Aminu Alhaji, Tukur Almustapha Lailaba
11:00-11:15	Q&A	Q&A
11:15-11:25	Valuation for compensation purpose: the need for global uniformity - Rosli Said, Anuar Alias, Olusegun Olaopin Olanrele, Nurudeen Akinsola Bello	Lessons learnt from the 2012 flood disaster: implications for building design and construction in high-risk flood prone areas of Bayelsa State, Nigeria - Warebi Gabriel Brisibe

11:25-11:35	Home equity capitalisation: analysis of influencing factors - Stephen Ameyaw, Elvis Attakora-Amaniampong, Frederick Polukuu, Alhassan Tahiru, Victor Azindow Wumboribi	An assessment of building collapse characteristics and suspected causes of collapse in Lagos State and Abuja - Nigeria - Okosun Blessing, Abdulganiyu Oke, R. E. Olagunju
11:35-11:45	Identifying the factors influencing real estate pricing in Kumasi metropolis - Aloysius Sam, Sarfo Mensah	Study of wood as a sustainable material for climate change mitigation using Athena EcoCalculator and System Dynamic Models - Bernard Effah
11:45-12:00	Q&A	Q&A
12:00-13:00	**Chairperson: Dr Olusegun Olanrele, Department of Estate Management and Valuation, Moshood Abiola Polytechnic, Nigeria**	**Chairperson: Dr Moses Ogunbiyi, Osun State University, Nigeria**
12:00-12:10	The impact of the Van Stadens wind farm on the surrounding community – a case study - Nicole O'Connor, Christopher Allen	Investigating the quality of rice husk ash produced using locally fabricated incinerator in concrete mix - Dadu, D. W., Stanley, A. M., Ehoche, E. P.
12:10-12:20	Intangible assets valuation in Nigeria: a review of the concept and practice - Abiodun K. Sodiya, Olaseni O. Adetokunboh, Samson E. Agbato	Improving the water resistance of compressed earth blocks enhanced with natural fibres - Humphrey Danso
12:20-12:30	Market fires and risk accumulation in Ghana's built environment - Ebenezer Owusu-Sekyere, Elvis Attakora-Amaniampong, Robert Adjuik Yakubu	Effect of small transverse service holes on flexural strength of reinforced concrete slender beams - Olanitori Lekan Makanju, Tifase Taiwo Oladayo
12:30-12:40	The shared ownership tenure and its applicability to the African affordable housing market - Cynthia Adeokun, Folake Ekunday	Effect of plasticizers on properties of concrete with pit sand: case study from Akure, Nigeria - Olanitori Lekan Makanju, Otuaga Moses Philips
12:40-13:00	Q&A	Q&A
13:00-13:45	**LUNCH BREAK**	
13:45-15:45	**POSTER PRESENTATION SESSION (AUDITORIUM)** The poster presentation session is an opportunity to showcase some of our interesting research papers and provide an opportunity for our authors to share their research with a combined audience of conference delegates and industry practitioners. We have designed this session to be as interactive as possible and we will ensure that everyone's work is seen and discussed by those assigned to the papers in each cluster/theme. Members of the audience will be divided into groups. Time will then be allocated for each group to view and discuss the poster presentations in each cluster/theme and also complete a feedback sheet that will be provided to everyone in the audience. The completed feedback sheets will be given to authors.	

POSTER PRESENTATION SESSION MODERATORS

Dr Cynthia Adeokun, Colman Architects Ltd, UK

Dr Obinna Ozumba, School of Construction Economics and Management, Wits University, South Africa

THEMES AND PAPERS

Real estate / housing / facilities management

- Challenges in the management of hostel accommodation in higher institutions of learning in north-western Nigeria – A. A Yakub, Z.M Zaid
- Factors affecting adoption of computerized maintenance management system among public organisations in Nigeria - AbdulHafeez, Ibrahim, Mustapha, Tasiu
- Alternative dispute resolution techniques in real estate commercial and contractual disputes: the case of Akure, Nigeria - M. B. Ogunleye, U. Y. Ajani

Sustainability / environment

- A critical evaluation of the built environment sustainability tool (BEST) - Jeremy Gibberd
- Review of theories; methodologies and analytical tools applied in sustainable construction research - K. Agbesi, T. Adjei-Kumi, F.D.K Fugar
- A conceptual framework for ethical sourcing of construction materials in Nigeria - Kabir Ibrahim, Winston M. W. Shakantu, Ibrahim Saidu
- Investigation into green attitudes towards shopping malls' design in Minna, Nigeria - R. E. Olagunju, O. K. Akande, J. N. Metu, S. C. Aremu
- Challenges and opportunities of sustainable infrastructure development in developing economies - Sitsabo Dlamini
- Key elements for sustainable infrastructure design in developing countries - Denamo A. Nuramo, Theodore C. Haupt

Construction industry organisation and development / procurement

- An investigation into the efficiency of classification of construction firms in Ghana - Alex K. Eyiah
- A review of public procurement act and its implementation in Ondo State, Nigeria - Abimbola Omotola, Timothy 'Seyi Odeyale, Kayode Fagbemi
- A conceptual model for mediating the effects of conflict of interest in construction procurement tendering processes in Nigeria – Zadawa, A. N., Dahiru, A., Jimoh, A. A. and Muhammed, M. A.

	Project Management • Influence of project management tools and techniques on performance of building construction projects in Lagos State - Olajide Julius Faremi, Barakat Temitope Lawal, Iniobong Beauty John, Kudirat Ibilola Zakariyyah, Aderemi Aderogba • Readiness of Nigerian contractors to adopt Building Information Modeling (BIM) technologies - Abdulfatai Salawu Oyebode, Idowu Faruq Ayobami • Readiness of Nigerian construction firms to adopt lean construction principles – O. Olamilokun, T. Samuel Fawale • Review of critical success factors for the implementation of total quality management in the construction industry - Ansah S.K., Aigbavboa C.O., Thwala W. • Ascertaining importance of project team performance to construction project success - Godfred Fobiri, Sarfo Mensah, Ayirebi Dansoh • An assessment of cost impacts of building elements on the overall contract sum - Victor Ikechukwu Opara, Emmanuel O. Fatoye, Raymond C. Enenmoh • The prevalence of leadership over management features amongst construction project managers in the UAE Hamad A AlShamisi, Ezekiel Chinyio, David Oloke, Sabah Mushatat, Paul Wilson, Nii Ankrah, Zoya Evans Kpamma • Challenges and remedies of application of cost planning techniques in construction projects in Nigeria – Enenmoh, R. C. and Anosike, N. M. **Urban Planning and Governance** • Framework for integration of community squares in urban governance of emerging cities in Nigeria - Agoha, Basil Onyekozuru • Impact of soil erosion on farmers livelihoods in Iwaro Oka Akoko, Ondo State, Nigeria - Olorunlana, Folasade Aderonke • Influence of socio-spatial factors on traditional markets in Kano State, Nigeria - Muhammad Abdulazeez Abba, Joy Joshua Maina, Musa Lawal Sagada **Waste Management** • Material waste causes and cost overrun in Abuja, Nigeria: a materials-procurement stage perspective - Ibrahim Saidu, Winston MW Shakantu, Kabir Ibrahim • Predicting the volume of material waste: a case of ongoing building projects in Abuja, Nigeria - Ibrahim Saidu, Winston MW Shakantu **Professional Practice**

	• Challenges facing construction professionals' compliance with Continuing Professional Development (CPD) in South Africa - Titus Ebenezer Kwofie, Clinton Ohis Aigbovboa, Johannes Siabatho Mpambela • Contemporary architectural practice in Nigeria: A review of issues and challenges – Abdullahi Abubakar **Human Resources / Ergonomics / Construction education** • Development of framework for application of ergonomics in building construction in Nigeria - AbdulHafeez, Ibrahim • Perceptions of construction management students about their career paths to become construction superintendent - Darrian Robinson, Salman Azhar, Abid Nadeem • Informal space-use in formal learning environments: case study of architecture department at Ahmadu Bello University - Joy Joshua Maina **Organisational Management** • An assessment of organizational culture for total quality management implementation in the Nigerian construction industry - Yetunde Olanike Olaleye, Yahaya Mohammed Ibrahim, Ahmed Doko Ibrahim, Kolomri Jaule Adogbo • Succession planning and continuity of family-owned business: perception of owners in the Wa municipality, Ghana - Rhoda Saan, Remy Faadiwie Nyewie • An assessment of organisational culture of construction organisations in Nigeria - Yetunde Olanike Olaleye, Yahaya Mohammed Ibrahim, Ahmed Doko Ibrahim, Kolomri Jaule Adogbo
15:45-16:00	**BREAK**
16:00 – 16:10	Brief remarks by a representative from McOttley Capital
16:10-17:00	**KEYNOTE SESSION (AUDITORIUM)** **Professor Will Hughes, Professor of Construction Management and Economics, University of Reading, UK** **TOPIC: PRACTICAL APPROACHES TO REVIEWING RESEARCH PAPERS FOR YOUR RESEARCH** **Chairperson: Dr Gabriel Nani, Department of Building Technology, KNUST, Kumasi, Ghana**
17:00	**CLOSE**
17:00 – 18:30	**COCKTAIL AND SOCIALISATION**

FRIDAY 18TH AUGUST 2017 (DAY 3)

08:30-08:40	VIDEO HIGHLIGHTS OF DAY 2 (AUDITORIUM)	
08:45-12:30 **(Refreshments break is at 10:30 – 10:50)**	**ACADEMIC WRITING AND PUBLICATON WORKSHOP (AUDITORIUM)** The purpose of this workshop is to provide opportunity for experienced academics to provide international guidance on current developments in the academic publication space and how to prepare and get manuscripts successfully published in good journals and research publication outlets **Topics** • Overview of current international developments in academic research and publication practices • What can we learn from the best research papers in elite journals? • Key elements of a good academic writing style • Becoming an established researcher and internationally cited author **Speakers** **Prof Jason Shaw, Editor-in-chief of Academy of Management Journal** **Prof Will Hughes, University of Reading, UK**	**WORKSHOP FOR RESEARCH SUPERVISORS (Supervisors of Bachelors, Masters and PhD research projects) (SEMINAR ROOM)** The purpose of this workshop is to provide opportunity for experienced international academics to share their knowledge and experience from Supervising students with colleagues who are also involved in the supervision of bachelors, masters and doctoral students. The primary goal is capacity building and knowledge sharing on effective supervision practice **Topics** • Key issues pertaining to getting students started and developing the art of listening • Guiding students on issues pertaining to conceptualisation and application of theory • Guiding research design and execution **Speakers** **Prof Will Hughes, University of Reading, UK** **Prof Jason Shaw, Editor-in-chief of Academy of Management Journal**
12:30-13:20	**LUNCH BREAK**	
13:30-15:30	**PARALLEL SESSION (AUDITORIUM)** **Theme: Construction economics / Cost and financial management** **Chairperson: Prof Kwabena Anaman, Institute of Statistical, Social and Economic Research (ISSER), University of Ghana, Ghana**	**PARALLEL SESSION (SEMINAR ROOM)** **Theme: Procurement / risk / contract management** **Chairperson: Prof John Smallwood, Department of Construction Management, Nelson Mandela Metropolitan University, South Africa**

13:30-13:40	The relationship between construction sector and economic growth in Nigeria: 1981-2013 - Moses A. Ogunbiyi, Simon O. Olawale, Rasheed Oyaromade	Risk management framework for Build Operate and Transfer (BOT) infrastructure projects in Nigeria - Baba Shehu Waziri, Yusuf Isa
13:40-13:50	A conceptual framework for promoting economic growth in crud oil dependent economies - a model for Nigeria - Nuruddeen Usman, Ahmadu S. Bustani, Nuru Gambo, Gambo Ibrahim	Unethical professional practices in tendering of public building procurement in Bauchi Metropolis, Nigeria - Ibrahim Ibrahim Inuwa, S.M. Maleka, S.U. Kunya
13:50-14:00	Comparison between construction projects cost overrun in publi and private sectors of Lagos State, Nigeria - Emmanuel O. Fatoye, Nwabueze M. Anosike	Using Analytic Hierarchy Process (AHP) to assess effectiveness of competitive tendering process - Dr Sazoulang Douh
14:00-14:10	IFC schema extensions for construction cash flow management: a proposed methodology - M. Abdullahi, Y.M Ibrahim, A.D. Ibrahim, P.G. Chindo	A study of the factors causing delay of rural roads and bridge construction projects in Ghana - Theophilus Adjei-Kumi, Gabriel Nani, Isaac Mensah
14:10-14:25	Q&A	Q&A
14:25-15:20	**Theme: Quality management / Health and Safety** **Chairperson: Mr Christopher Allen, Nelson Mandela Metropolitan University, South Africa**	**Theme: Procurement / risk / contract management** **Chairperson: Associate Professor Salman Azhar, College of Architecture, Design and Construction, Auburn University, USA**
14:25-14:35	Quality culture orientation of construction firms as driver of project performance in Nigeria - Godwin Iroroakpo Idoro, Olutayo Ajibola Akinkumi	Comparative study of causes of Variations in Public Building Projects in Tanzania and Uganda - Yusuph Mhando, Ramadhan Mlinga, Henry Alinaitwe
14:35-14:45	Assessment of fire safety provisions in selected public buildings in Minna, Nigeria - Shittu, Abdullateef Adewale; Okechukwu, Blessing Ijeoma; Tsado, Abel John; Shehu, Muhammad Aminu	Methods of duration estimation at the rural road agency in Ghana Theophilus Adjei-Kumi, Gabriel Nani, Isaac Mensah
14:45-14:55	The significance of health and safety of construction industry personnel in Lagos State (CCECC case study) - Adesanya Adekunbi, Amusu O.R.O., Salvador K. A.	"Evaluating delays in execution of public sector construction projects: a study of roads and highways in Ghana - Natasha Narh, Corrine Shaw, Abimbola Windapo
14:55-15:05	Construction Health And Safety Agents' (CHSAS') contribution to health and safety in South Africa - John Smallwood, Claire Deacon	Expatriate and indigenous consultants' involvement in construction project delivery in Nigeria - Godwin Iroroakpo Idoro, Emmanuel Olutide Bamidele
15:05-15:20	Q&A	Q&A

15:20-15:45	**REFRESHMENTS AND NETWORKING BREAK**
15:45-16:30	**PANEL DISCUSSION AND CONCLUDING THOUGHTS OF KEYNOTE SPEAKERS (AUDITORIUM)** **Theme: Striving for methodological rigour, theoretical consistency and industry impact in our research** **Panel: Professor Will Hughes & Professor Oluwole Morenikeji** (Main points of speakers will be summarized and highlighted as part of the conference outcomes) Chairperson: Sam Laryea
16:30-17:00	**CLOSING SESSION (AUDITORIUM)** Conference Summary – 5 minutes Presentation of certificates and prizes – Sam Laryea (20 minutes) Vote of thanks –5 minutes
17:00	**CLOSE**

PROGRAMME

ACADEMIC WRITING AND PUBLICATION WORKSHOP

Date: 18th August ‖ Venue: Auditorium ‖ Time: 08:45am – 12:30pm

The purpose of this workshop is to provide opportunity for experienced academics to provide international guidance on current developments in the academic publication space and how to prepare and get manuscripts successfully published in good journals and research publication outlets.

PROGRAMME

Time	Topic	Speaker(s)
08:45 – 09:00	Overview of current international developments in academic research and publication practices	Prof Jason D. Shaw
09:00 – 10:30	What can we learn from the best research papers in elite journals?	Prof Jason D. Shaw
10:30 – 10:50	REFRESHMENTS BREAK	
10:50 – 11:45	Key elements of a good academic writing style	Prof Will Hughes
11:45 – 12:00	Becoming an established researcher and internationally cited author	Prof Will Hughes
12:00 – 12:30	General Q&A on matters covered	Prof Will Hughes & Prof Jason D. Shaw
12:30 – 13:20	LUNCH	

ABOUT THE SPEAKERS

Professor Jason D. Shaw, Editor-in-chief of the Academy of Management Journal (AMJ) ‖ Chair Professor and Head of Department of Management and Marketing ‖ Director, Centre for Leadership and Innovation at The Hong Kong Polytechnic University

Professor Will Hughes, Professor of Construction Management and Economics, University of Reading, UK & Former Editor-in-chief of Construction Management and Economics journal

The speakers will provide participants with certain keys that that you can use to "open the door" to success and increase your effectiveness in the area of academic writing and publication

PROGRAMME

WORKSHOP FOR RESEARCH SUPERVISORS

Date: 18th August ‖ Venue: Seminar Room‖ Time: 08:45am – 12:30pm

This workshop provides an opportunity for experienced international academics to share their knowledge and experience from Supervising students with colleagues who are also involved in the supervision of bachelors, masters and doctoral students. The primary goal is capacity building and knowledge sharing on effective supervision practice

PROGRAMME

Time	Topic	Speaker(s)
08:45 – 09:30	Key issues pertaining to getting students started and developing the art of listening	Prof Will Hughes
09:30 – 10:30	Guiding students on issues pertaining to conceptualisation and application of theory	Prof Will Hughes
10:30 – 10:50	REFRESHMENTS BREAK	
10:50 – 12:00	Guiding research design and execution	Prof Jason D. Shaw
12:00 – 12:30	General Q&A on matters covered	Prof Jason D. Shaw & Prof Will Hughes
12:30 – 13:20	LUNCH	

ABOUT THE SPEAKERS

Professor Will Hughes, Professor of Construction Management and Economics, University of Reading, UK & Former Editor-in-chief of Construction Management and Economics journal

Professor Jason D. Shaw, Editor-in-chief of the Academy of Management Journal (AMJ) ‖Chair Professor and Head of Department of Management and Marketing ‖ Director, Centre for Leadership and Innovation at The Hong Kong Polytechnic University

The speakers will provide participants with certain keys that that you can use to "open the door" to success and increase your effectiveness in the area of supervising Bachelors, Masters and PhD research students

CONTENTS

SECTION 1: KEYNOTES

Current developments in the West African higher education sector and what it means for us as researchers– Prof Oluwole Morenikeji - 1 -

Conceptualising a research project – Prof Will Hughes - 3 -

Doing and publishing high quality research - a look at issues pertaining to theory, research design, grounding hypotheses/research questions – Prof Jason D. Shaw - 5 -

Doing and publishing high quality research - a look at issues pertaining to crafting the methods and results, discussing the implications, making a contribution – Prof Jason D. Shaw - 7 -

SECTION 2: CONFERENCE PAPERS

'Choosing by advantages' to select concrete tasks: a project team's perception - Mollo, L. G., Emuze, F. A. - 13 -

A conceptual framework for ethical sourcing of construction materials in nigeria – Ibrahim, K., Shakantu, W. M. W. And Saidu, I. - 25 -

A conceptual framework for promoting economic growth in crude oil dependent economies - a model for Nigeria – Usman, N., Bustani, A. S., Gambo, N., Ibrahim, G. - 38 -

A conceptual model for mediating the effects of conflict of interest in construction procurement tendering processes in Nigeria – Zadawa, A. N., Dahiru, A., Jimoh, A. A. and Muhammed, M. A. - 49 -

A critical evaluation of the Built Environment Sustainability Tool (BEST) – Gibberd, J. - 62 -

A critical evaluation of the sustainable building assessment tool (SBAT) – Gibberd, J. - 76 -

A review of public procurement act and its implementation in Ondo State, Nigeria – Omotola, A., Oyedale, T. and Fagbemi, K. - 90 -

A study of the factors causing delay of rural roads and bridge construction projects in Ghana – Mensah, I., Nani, G., Adjei-Kumi, T. - 121 -

Access to land as a constraint to homeownership in Kaduna State, Nigeria – Nwuba, C. C - 140 -

Alternative dispute resolution techniques in real estate commercial and contractual disputes: the case of Akure, Nigeria – Ogunleye, M. B., Ajani, U. Y. - 160 -

An assessment of building collapse characteristics and suspected causes of collapse in Lagos State and Abuja - Nigeria – Okosun, B., Abdulganiyu, O. and Olagunju, R. E. - 178 -

An assessment of cost impacts of building elements on the overall contract sum – Opara, V. I., Fatoye, E. O. and Enenmoh, R. C. - 195 -

An assessment of organisational culture of construction organisations in Nigeria – Olaleye, Y. O., Ibrahim, Y. M., Ibrahim, A. D. and Adogbo, K. J. - 208 -

An assessment of organizational culture for total quality management implementation in the Nigerian construction industry – Olaleye, Y. O., Ibrahim, Y. M., Ibrahim, A. D. and Adogbo, K. J. - 219 -

An evaluation of indoor thermal conditions of residential buildings with different fabric finishes at Okigwe, Nigeria – Okafor, M. U. - 230 -

An international experts' opinion on the objectives of stakeholder management in construction projects – Oppong, G. D., Chan, A. P. C., Ameyaw, E. E. and Owusu-Manu, D. - 243 -

An investigation into the efficiency of classification of construction firms in Ghana – Eyiah, A. K. - 260 -

Analysis of green building strategies for hot-dry climatic conditions in north-western cities in nigeria; lessons from Botswana, Burkina Faso & South Africa – Yakub, A. A., Salawu, A. O., Gimba, S. D., Ahmad, A. and Jolaoye, A. - 271 -

Are LEED® certified buildings better in performance? A comparison of LEED® v. non-LEED® certified institutional buildings – Crews, E., Azhar, S. and Salman, A. - 287 -

Ascertaining the importance of project team performance to construction project success – Fobiri, G., Mensah, S. and Dansoh, A. - 302 -

Assessment of fire safety provisions in selected public buildings in Minna, Nigeria – Shittu, A. A., Okechukwu, B. I., Tsado, A. J. and Shehu, M. A. - 314 -

Assessment of light levels and visual comfort in a lecture hall of a university in Akure, Nigeria – Afolami, A. J., Akeremale, I. D. and Ikudayisi, A. E. - 337 -

Assessment of precedent analysis process in architectural design pedagogy in Nigerian universities – Goshi, S. K., Isah, A. D., and Onuwe, J. O. - 347 -

Challenges and opportunities of sustainable infrastructure development in developing economies – Dlamini, S. - 364 -

Challenges and remedies of application of cost planning techniques in construction projects in Nigeria – Enenmoh, R. C. and Anosike, N. M. - 380 -

Challenges facing construction professionals' compliance with continuing professional development (CPD) in South Africa – Kwofie, T. E., Aigbavboa, C. O. and Mpambela, J. S. - 394 -

Challenges in the management of hostel accommodation in higher institutions of learning in north-western Nigeria – Yakub, A. A. and Zaid, Z. M. - 410 -

Challenges of public-private partnership (PPP) in urban housing in Nigeria – Onyemaechi, P. C. - 430 -

Client relationship management in architectural firms in southwest Nigeria – Adepeju, A. A., Ibem, E. O. and Oluwatayo, A. A. - 443 -

Comparative analysis of investment attributes of commercial and hotel properties in south-western Nigeria – Bello, N. A., Jolaoso, A. B. and Olanrele, O. O. - 444 -

Comparative study of causes of variations in public building projects in Tanzania and Uganda – Mhando, Y. B., Mlinga, R. S. and Alinaitwe, H. M. - 465 -

Comparison between construction projects cost overrun in public and private sectors of Lagos State, Nigeria – Fatoye, E. O. and Nwabueze, M. A. - 479 -

Construction Health and Safety Agents' (CHSAs') contribution to health and safety in South Africa – Smallwood, J. and Deacon, C. - 494 -

Contemporary architectural practice in Nigeria: a review of issues and challenges – Abubakar, A. - 506 -

Design innovation in structural engineering – Olawale, S. O. and Ogunbiyi, M. A. - 516 -

Design of an automated staircase climber trolley for general hospitals in developing countries: case of an anonymous hospital in Zimbabwe – Kadzunge,T. M., Mushiri, T. and Mbohwa C. - 524 -

Designing for old age in Nigeria - Folake Ekundayo - 543 -

Development of framework for application of ergonomics in building construction in Nigeria – Ibrahim, A. - 565 -

Effect of granite, washed and un-washed gravel aggregate sizes on engineering properties of concrete – Ogunbiyi, M. A. and Olawale, S. O. - 579 -

Effect of plasticizers on properties of concrete with pit sand: case study from Akure, Nigeria – Olanitori, L. M. and Otuaga, M. P. - 589 -

Effect of small transverse service holes on flexural strength of reinforced concrete slender beams - Olanitori L. M. and Tifase, T. O. - 599 -

Effects of quadriceps muscle fatigue on balance control and falls injuries following repetitive squat lifting task in construction workers – Idoro, G. I. and Ajibola, O. - 607 -

Effects of sugar as admixture on concrete made with different brands of cement in Nigeria – Mohammed, L. A., Musa, A. A. and Tukur, A. - 616 -

Employability of built environment graduates in Nigeria: determinant factors – Dalibi, S. - 628 -

Evaluating delays in execution of public sector construction projects: a study of roads and highways in Ghana – Narh, N., Shaw, C. and Windapo, A. - 642 -

Evaluating the success factors for green building projects in the Nigeria's built environment: the project professionals' perspective - Dalibi, S. G., Feng, J. C., Sadiq, A., Bello, B. S. and Kumo, H. A. - 655 -

Evaluation of cocoa pod ash on the characteristic strength of sandcrete block produced in Oshogbo, Nigeria – Olawale, S. O. and Ogunbiyi, M. A. - 674 -

Expatriate and indigenous consultants' involvement in construction project delivery in Nigeria – Idoro, G. I. and Bamidele, E. O. - 682 -

Exploring ICT education in South African schools of the built environment - Ozumba, A., Adeyemi Akintola, A., Dlamini, T., Rashekula, A. and Mathe, P. - 698 -

Factors influencing sustainability of rural sanitation project outcomes: a pilot study on the perceptions of implementers – Ozumba, A. O., Zukani, M., Shakantu, W. and Ozumba, C. - 730 -

Framework for integration of community squares in urban governance of emerging cities in Nigeria – Agoha, B. O. - 750 -

Hindrances to the development of green residential buildings: the end-users' perceptions in Abuja, Nigeria - Dalibi, S.G., Auduga, J.B.M., Danja, I.I., Balarabe,H., Saleh, I., Jalam, A.A. and Muhammad, A.Y. - 761 -

Home equity capitalisation: analysis of influencing factors – Ameyaw, S., Attakora-Amaniampong, E., Polukuu, F., Tahiru, A. and Wumnoribi, V. A. - 773 -

Identifying the factors influencing real estate pricing in Kumasi metropolis – Sam, A. and Mensah, S. - 803 -

IFC schema extensions for construction cash flow management: a proposed methodology – Abdullahi, M., Ibrahim, Y.M., Ibrahim, A. D., and Chindo, P.G. - 814 -

Impact of rating systems on the construction of green buildings in South Africa – Leburu, M. and Allen, C. - 827 -

Impact of soil erosion on farmers livelihoods in Iwaro Oka Akoko, Ondo State, Nigeria – Olorunlana, F. A. - 843 -

Impact of tendering procedure on price formation in construction contracts: case study of the competitive negotiation procedure – Laryea, S. - 853 -

Implications of social practices and literacy on wayfinding design strategies in Nigerian hospitals – Maina, J. J. and Dauda, A. - 870 -

Improving water resistance of compressed earth blocks enhanced with natural fibres – Danso, H. - 886 -

Influence of power on client-contractor relationships in collaborative construction procurement - 897 -

Influence of project management tools and techniques on performance of building construction projects in Lagos State – Faremi, O. J., Lawal, B. T., John, I. B., Zakariyyah, K. I. and Aderogba, A. - 898 -

Informal space-use in formal learning environments: case study of architecture department at Ahmadu Bello University – Maina, J. J. - 930 -

Intangible assets valuation in Nigeria: a review of the concept and practice – Sodiya, A. K., Adetokunboh, O. O. and Agbato, S. E. - 945 -

Investigating the quality of rice husk ash produced using locally fabricated incinerator in concrete mix - Dadu, D. W., Stanley, A. M. and Ehoche, E. P. - 961 -

Investigation into green attitudes towards shopping malls' design in Minna, Nigeria – Olagunju, R. E., Akande, O. K., Metu, J. N. and Aremu, S. C. - 978 -

Key elements for sustainable infrastructure design in developing countries – Nuramo, D. A. and Haupt, T. C. - 994 -

Lessons learnt from the 2012 flood disaster: implications for building design and construction in high-risk flood prone areas of Bayelsa State, Nigeria – Brisibe, W. G. - 1009 -

Market fires and risk accumulation in Ghana's built environment – Owusu-Sekyere, E., Attakora-Amaniampong, E. and Yakubu, R. A. - 1027 -

Material waste causes and their implications on cost overruns in Abuja, Nigeria: a materials-procurement stage perspective – Saidu, I., Shakantu, W. M. W. and Ibrahim, K. - 1048 -

Methods of duration estimation at the rural road agency in Ghana – Mensah, I., Adjei-Kumi, T. and Nani, G. - 1063 -

Nature and features of tenders processed by a UK contractor in 2010 – Laryea, S. and Lubbock, A. - 1079 -

Perceptions of construction management students about their career paths to become construction superintendents – A Robinson, D., Azhar, S. and Nadeem, A. - 1097 -

Power sector development reforms in Nigeria: the roots to the challenges – Abdullahi, D., Suresh, S., Renukappa, S. and Oloke, D. - 1111 -

Predicting the volume of material waste: a case of ongoing building projects in Abuja, Nigeria – Saidu, I. and Shakantu, W. M. W. - 1123 -

Quality culture orientation of construction firms as driver of project performance in Nigeria – Idoro, G. I. and Akinkumi, A. O. - 1144 -

Readiness of Nigerian construction firms to adopt lean construction principles – Olamilokun, O. and Fawale, T. S. - 1160 -

Readiness of Nigerian contractors to adopt Building Information Modeling (BIM) technologies – Abdulfatai, S. O. and Idowu, F. A. - 1171 -

Rethinking design solutions to homelessness: a review of planning space standards – Adeokun, C. O. and Opoko, A. P. - 1189 -

Review of critical success factors for the implementation of total quality management in the construction industry – Ansah, S. K., Aigbavboa, C. O., Thwala, W. - 1211 -

Review of theories; methodologies and analytical tools applied in sustainable construction research – Agbesi, K., Adjei-Kumi, T. and Fugar, F.D.K. - 1225 -

Risk management framework for Build Operate And Transfer (BOT) infrastructure projects in Nigeria – Waziri, B. S. and Isa, Y. M. - 1239 -

Socio-economic determinants of housing satisfaction among middle-income households in Owerri, Nigeria – Okpoechi, C. U. - 1254 -

Study of wood as a sustainable material for climate change mitigation using Athena EcoCalculator and System Dynamic Model – Effah, B., Nti Asamoah, J. and Antwi, K. - 1274 -

Succession planning and continuity of family-owned business: perception of owners in the Wa Municipality, Ghana – Saan, R., Enu-Kwesi, F. and Nyewie, R. S. - 1281 -

The impact of the Van Stadens wind farm on the surrounding community – a case study – O'Connor, N. and Allen, C. - 1300 -

The prevalence of leadership over management features amongst construction project managers in the UAE – AlShamisi, H. A., Chinyio, E., Oloke, D., Mushatat, S., Wilson, P., Ankrah, N. and Kpamma, Z. E. - 1314 -

The relationship between construction sector and economic growth in Nigeria: 1981-2013 – Ogunbiyi, M. A. and Olawale, S. O., and Oyaromade, R. - 1327 -

The shared ownership tenure and its applicability to the African affordable housing market – Adeokun, C. and Ekundayo, F. - 1344 -

The significance of health and safety of construction industry personnel in Lagos State: CCECC case study - Adekunbi, A., Amusu, O. R. O. and Salvador, K.A. - 1366 -

Thermal climate and residents' perceptions of sultry conditions in rural and semi-urban settlements in southwestern Nigeria – Eludoyin, O. M. - 1374 -

Unethical professional practices in tendering of public building procurement in Bauchi Metropolis, Nigeria – Inuwa, I., Maleka, S. M. and Kunya, S. U. - 1397 -

Using analytic hierarchy process (AHP) to assess effectiveness of competitive tendering process – Douh, S. J. - 1417 -

Valuations for compensation purpose: the need for global uniformity – Said, R., Alias, A., Olanrele, O. O. and Bello, N. A. - 1433 -

Analysis of preference for residential neighbourhood in Ilorin, Nigeria – Adeogun, A. S., Raheem, W. M., Shittu, W. O. and Bako A. I. - 1448 -

INDEX OF AUTHORS - 1463 -

INDEX OF KEYWORDS - 1467 -

SECTION 1: KEYNOTES

CURRENT DEVELOPMENTS IN THE WEST AFRICAN HIGHER EDUCATION SECTOR AND WHAT IT MEANS FOR US AS RESEARCHERS

Professor Oluwole Morenikeji[1]
Commonwealth Fellow
Professor of Urban and Regional Planning
Deputy Vice Chancellor (Academic), Federal University of Technology, Minna, Nigeria

This keynote address will be delivered during the opening session of the conference. The purpose is to provide delegates with some high level insights into current developments in the higher education sector in West Africa and the adaptation researchers must embrace in order to succeed in a changing higher education environment. Ongoing changes and future directions in the higher education sector requires an informed, innovative and appropriate response from researchers. Appropriate ways of responding positively to current and future directions in the higher education environment will be highlighted.

Keywords: higher education

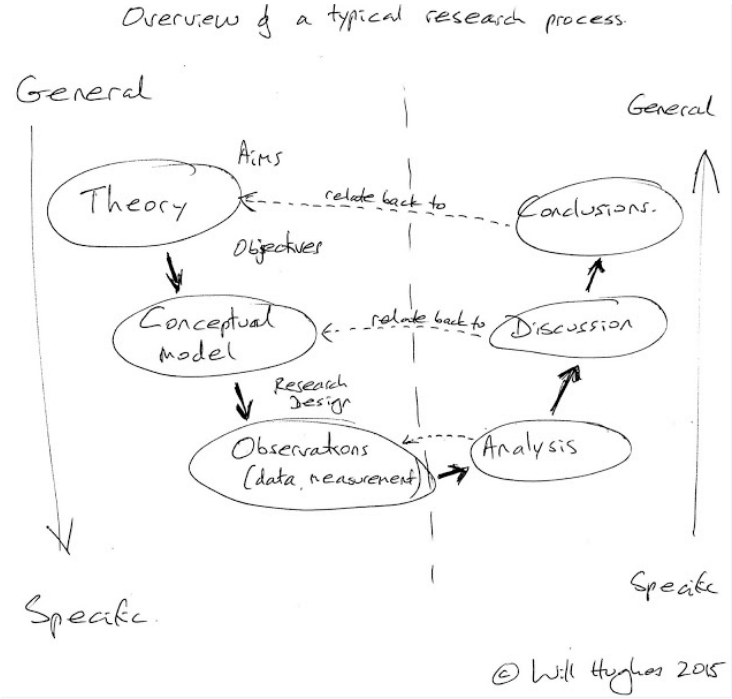
[1] wolekeji@yahoo.com

Morenikeji, O. (2017) Current developments in the West African higher education sector and what it means for us as researchers In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 1

CONCEPTUALISING A RESEARCH PROJECT

Professor Will Hughes[1]
Professor of Construction Management and Economics
School of Construction Management and Engineering, University of Reading, UK

This keynote address will provide guidance on conceptualising research projects. Without conceptualising a research project properly, it would be hard to ground it appropriately in theory and make a contribution. The keynote address is organised around the pen-sketch graphic below which can be seen at at will-hughes.blogspot.com.



The diagram shows how the conclusions of a research project relate back to the theory, how the discussion chapter relates to the conceptual model and how the analysis relates to the observation. It also shows how the aims inform the theory, the theory informs the objectives, the objectives drive the literature review to provide the conceptual model, the conceptual model leads to the research design and so on. Finally we can also see how the general issues lead to increasingly specific issues in the first half, and the second half involves moving back to generalized statements for the conclusions.

Keywords: conceptualising research projects

[1] w.p.hughes@reading.ac.uk

DOING AND PUBLISHING HIGH QUALITY RESEARCH - A LOOK AT ISSUES PERTAINING TO THEORY, RESEARCH DESIGN, GROUNDING HYPOTHESES/RESEARCH QUESTIONS

Professor Jason D. Shaw[1]
Editor-in-Chief, Academy of Management Journal
Yeung Kin Man Professor of Business Administration
Chair Professor and Head of Department
Director, Centre for Leadership and Innovation
Department of Management and Marketing, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

Every academic practitioner should aspire to publish high impact research papers that will be cited by peers in their field all over the world. To be able to do this successfully, it is important to use theory appropriately, craft appropriate research designs, and ground research questions in appropriate theoretical frameworks. The Academy of Management Journal has long been a focal point for sound and high impact research. Professor Jason Shaw who is the current Editor-in-chief will talk delegates through key issues that need to be addressed in the foundational stages of scientific research, and how to address them, in order to produce high quality research papers that will generate international recognition and impact.

Keywords: theory, research design, research question

[1] jason.shaw@polyu.edu.hk

Shaw, J. D. (2017) Doing and publishing high quality research - A look at issues pertaining to theory, research design, grounding hypotheses/research questions In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 5

DOING AND PUBLISHING HIGH QUALITY RESEARCH - A LOOK AT ISSUES PERTAINING TO CRAFTING THE METHODS AND RESULTS, DISCUSSING THE IMPLICATIONS, MAKING A CONTRIBUTION

Professor Jason D. Shaw[1]
Editor-in-Chief, Academy of Management Journal
Yeung Kin Man Professor of Business Administration
Chair Professor and Head of Department
Director, Centre for Leadership and Innovation
Department of Management and Marketing, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

This second session by Professor Jason Shaw builds upon the first session on dealing effectively with the foundational stages of high quality research. In this second session, Professor Jason Shaw will proceed and speak on other issues pertaining to the appropriate use of research methods, generating meaningful research results, and being able to discuss the theoretical and practical implications. Making a useful contribution to the existing literature and getting published in strong journals requires competence and know-how for dealing with all of the six areas addressed by Professor Shaw. The keynote sessions will essentially provide some of the keys required to open the doors to success.

Keywords: crafting research methods, crafting research results, discussing research results, making a research contribution

[1] jason.shaw@polyu.edu.hk

Shaw, J. D. (2017) Doing and publishing high quality research - A look at issues pertaining to Crafting the Methods and Results, Discussing the Implications, Making a contribution In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 7

PRACTICAL APPROACHES TO REVIEWING RESEARCH PAPERS FOR YOUR RESEARCH

Professor Will Hughes[1]
Professor of Construction Management and Economics
School of Construction Management and Engineering, University of Reading, UK

In this keynote session, Professor Will Hughes will take delegates through a few papers and show some practical ways to review and make critical evaluations of published papers. The most essential prerequisite for a successful piece of academic research is the establishment of what is already known about the topic. While it is important to be able to produce a critical review of a research paper, it is just as important to be able to string together all the bits of information from the individual readings into a coherent critique of what previous research has shown, and where we are up to, collectively, in our understanding of the issues.

Keywords: literature review, reviewing research papers.

[1] w.p.hughes@reading.ac.uk

Hughes, W. (2017) Practical approaches to reviewing research papers for your research In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 9

SECTION 2: CONFERENCE PAPERS

‘CHOOSING BY ADVANTAGES’ TO SELECT CONCRETE TASKS: A PROJECT TEAM’S PERCEPTION

L.G Mollo[1] and F.A Emuze[2]
Department of Built Environment, Central University of Technology, Free State

In most cases, the project team’s decision-making outcomes are criticized for failing to meet client needs when working with concrete task. The purpose of this study was to examine how Choosing by Advantages (CBA) would affect the choice of concrete alternatives for civil engineering and building projects. Case study research design was used in this study and three case projects were identified to discover the project team’s decision-making process when choosing concrete type in civil engineering and building projects. The research question is, *‘how can the project teams use CBA decision-making mechanism to choose a concrete task?’* The project teams are the key driver of CBA mechanism when choosing concrete type from two alternatives: ready mixed concrete and site batched concrete. The results showed that ready-mixed concrete has less probabilities of causing concrete defects and rework when used or applied per the correct specifications or methods which are detailed in the structural or engineering drawing. CBA mechanism could be introduced and applied by the project teams during the initial stage of the construction project. The study proposes that the project teams should try CBA to improve their decision-making process on site when working with concrete. The CBA Frame Model would help the project teams to make sound decision when choosing alternatives.

Keywords**:** choosing by advantages concrete, decision-making, performance, project teams

INTRODUCTION

Project performance is influenced by the project teams decision-making outcomes in several ways: positively or negatively. A negative influence implies the possibility of poor performance. Emuze and Smallwood (2012) explains that South African construction is subject to poor project performance because of the project team’s decision-making outcomes. The project teams often fail to address the subject of poor performance broadly in the construction activities and stages (Mollo, Emuze and Geminiani,

[1] lmollo@cut.ac.za
[2] femuze@cut.ac.za

Mollo, L. G. and Emuze, F. A. (2017) ‘Choosing by advantages’ to select concrete tasks: a project team’s perception In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 13-24

2016). Poor performance is dependent on the project team's decisions related to time delays, change in design, cost overruns, payment problems, material shortage and defects and rework (Meng, 2012). The results of poor performance may be generated either externally or internally. External factors pertain to weather conditions, unforeseen site conditions, market fluctuation and regulatory changes, while internal factors pertain to the outcomes of the project team's decisions adopted for the project (Meng, 2012).

During the planning stage of the project, the project team examines and calculates the performance of the required design and construction activities. It is at the planning stage that the utility of Choosing by advantages (CBA) is evident. The CBA mechanism is a decision-making system that comprises methods for almost all kinds of decisions during the construction process regardless of the scope of work (Arroyo, Tommelein and Ballard, 2014). In specific terms, the evidence of constraints at various stages of the project necessitates the use of CBA at the planning stage (Abraham, Lepech, and Haymaker, 2013). For example, the scope of work in a project may require special understanding that is underpinned by the involvement of highly informed consulting professionals and construction teams (Zhang, 2013). Previous studies illustrate that CBA is conducted through case study project for example; Arroyo, Tommelein and Ballard (2014), and Karakhan, Gambatese, and Rajendran (2016), the analysis from both studies were discovered through case projects.

The choice of actions to be taken by the project teams impacts on the project outcome. Parrish and Tommelein (2009) stated that when determining the advantages of the construction process alternatives to improve performance, subjective judgement should not be ignored because the advantages might rest on the subjective. It is evident that projects are challenged by poor performance influenced by the project team's decisions.

In this study, Tabular Method of Choosing by Advantages (CBA) was adopted to understand the project teams decision-making process and to overcome the challenges of choosing a concrete type between ready mixed concrete and site batched concrete, with the aim to reduce and eliminate defects and rework related to concrete on projects.

Case examples of decision-making mechanisms

Baron (2008) described decision as an act of choosing between two or more possibilities of action, of what to do or not do. Decisions are executed by the project team to achieve project goals, and they are grounded in the belief of the project team actions regarding the achievement of project goals. The project team constantly need to make project decisions and the need to make project decisions arises out of the fact that knowledge of relevant existing facts is inadequate and that the future of the project is uncertain (Senior, 2012). Ariely (2009) said the project team often struggle to choose between two actions that are similarly attractive.

According to Young, Hosseini, and Ladre (2016), the state of construction industry is changing from time to time and the project team are expected to

make project decisions which will meet the need of the project. The project decisions could be improved through the principle of lean thinking (lean construction), due to the reasons that lean thinking provides comparatively more autonomy in the project decisions and enrich the project team by distributing the decision-making, multi-skilling and pursuit perfection (Senior, 2012). Furthermore, lean construction makes the project team to better understand a project decision-making process through CBA, which is a component of lean construction (Schöttle, and Arroyo 2016). CBA is a decision-making method which weights the importance of advantages between the alternatives of the project (Suhr, 1999).

Choosing by advantages (CBA)

CBA is a decision-making method that assists project parties in deciding a course of action among competing alternatives (Arroyo, Ballard, and Tommelein, 2014). The idea of CBA began in the United State of America (USA) in the 1980's by Suhr (1999), but it is only recently making way into the Architecture, Engineering and Construction (AEC) industry (e.g. Parrish and Tommelein 2009, Lee, Tommelein, and Ballard 2010, Abraham, Lepech and Haymaker 2013, Arroyo, Tommelein and Ballard 2014, Schöttle, and Arroyo 2016,). CBA mechanism is characterized by the following terms; alternative, factors, criterion, attributes, advantages and importance of advantages (Suhr, 1999).

Table 1: CBA Vocabulary

Terms	Definition
Alternative	Either one or more project decision adopted by the project teams in terms of the use of materials, and other project inputs
Factors	A section, parts, or mechanism chosen from the alternative. When assessing performance, factors should represent period, cost and quality.
Criterion	A policy or decision law regulated by the project teams. A 'must' criterion symbolizes circumstances each alternative must please. A 'want' criterion symbolizes favorites of one or several decision-makers.
Attributes	Type of quality, results or characteristics of one alternative
Advantages	The beneficial factors between alternatives in the project

Source: Arroyo et al. (2014).

Abraham *et al.* (2013) states that CBA is one of the best decision-making system, because it differentiates decisions relating to money and non-money. In this study, CBA is introduced through Tabular Method (TM), which is suitable for complicated projects, mostly when the project decisions comprise of multiple alternatives, when there are different information's to be judged and the entire project teams are involved in the decision-making process (Arroyo *et al.*, 2014). For all three case projects, the project teams were the key drivers in the concrete decision-making process between two alternatives.

Figure 1 highlights the CBA Frame Model that constitute the outline of the research process. Step 1 in the figure, which is a green boundary, represent the project team's problems about poor performance influenced by concrete defects and rework as the outcome of the project team's decisions when placing or casting concrete. Step 2, which is the Yellow boundary, represent

the decision-making methods that provided the guidance to reduce and eliminate concrete defects and rework. The subsequent steps (3,4,5 and 7), which is the blue boundaries, were carried out or developed by the project teams, while the CBA practitioners analyses the results as outlined in Step 6,8, and 9. These constitute the red boundaries carried out by the researchers. These steps were also examined and discussed by the project team.

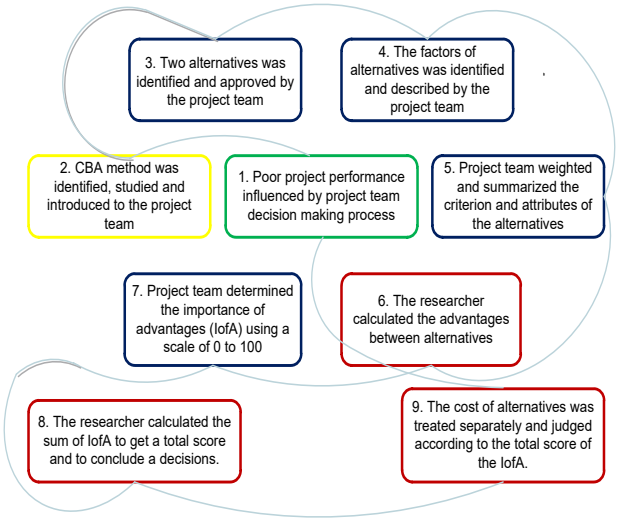


Figure 1: CBA Frame Model of Choosing an Alternative

RESEARCH METHODS

This study is based on the case study research design, because it supports the nature of the research question, which asked the 'How' questions, *'how can the project teams use CBA decision-making mechanism to choose a concrete task?'* as illustrated by Yin (2014). In this case, case study design helped to gain an in-depth understanding concerning the project team decision-making process when choosing a concrete type. The case study research design was chosen because it allowed the researcher to look at a phenomenon in context as recommended by Yin (2014). The design is defined as the practical reviews that explore an existing issue in detail and within its actual setting, particularly when the border between phenomena is not apparent (Yin, 2011). The design of this study is a multiple case study due to the three case projects that were conducted in Bloemfontein, South Africa. The projects involve:

- Case project 1: New North-Eastern Waste Water Treatment Works (civil engineering project),
- Case project 2: N8 Road Rehabilitation: Bloemfontein to Sannaspos: Bridge no, B286 (A & B): Bloemspruit River Bridge (civil engineering project), and
- Case project 3: Construction of MOTHEO TVET Artisan Development Academy (building project.

The projects were selected based on their nature, which require extensive use of concrete. The unit of analysis determined the research design and identified the type of data which were collected as described by Yin (2014). The study was conducted between June and September 2016 as part of the master's study. A semi-structured interview was carried out among 22 project team members, which were made up of the contractors and consulting engineers for all three cases. Cross case analysis was used to analyze the data as recommended by Yin (2014). Therefore, the project team's decision-making process when choosing a concrete type was the unit of analysis for this study.

RESULTS ON CBA: CONCRETE TYPE FROM CASE PROJECT 2

This study determines the procedures, which were followed to explore the project team's decision-making when choosing concrete type in case project 2. The nature of the project for case project 2 was civil engineering project and the title of the project: *N8 Road Rehabilitation: Bloemfontein to Sannaspos: Bridge no, B286 (A & B): Bloemspruit River Bridge*.

Figure 2 shows the picture of the project. The study focused on the project teams decision-making process during the bridge construction. The data for this case study were collected through semi-structured interviews, a total number of eight (8) interviews were conducted for this case: two construction managers, two foremen's and four resident engineers (RE). However, the client did not form part of the interviews because the consulting engineers managed the project for the client, as the principal project agent. The client was not part of the teams making concrete decisions. The details of the project were retrieved from South African National Road Agency South Africa Limited (SANRAL) database.



Figure 2: Bridge construction

The CBA mechanism proved to be suitable decision-making mechanism to be adopted by the project teams when making project decisions, but they expressed that it would be difficult to introduce this mechanism in their project because of the construction procurement method that is dominant in

South Africa. The design-bid-built procurement method that is mostly used in South Africa ensures that the construction team (contractors) does not form part of the project teams until project implementation stage. However, for this case project, the teams had already chosen ready mixed concrete for their project.

Steps to introduce CBA

The procedures or steps to introduce the application of CBA mechanism has been illustrated in Figure 1. The CBA Frame model regarding this project is explained as follows: step 1: Classifies the project team's problems. For this case, it was discovered that project teams decision-making process when choosing a concrete type often lead to concrete defects and rework. In step 2: The decision-making method was selected, CBA mechanism was studied, and introduced to the project teams. In Step 3: The project teams identified two concrete alternatives: ready mixed concrete and site-batched concrete. In step 4, the project teams named and described 7 relevant factors shown in Table 2.

Table 2: Description of Factors

Factors	Description
Quality Control	Are the procedures intended to ensure that a mixed concrete adheres to the mix design and compressive strength designed by the structural engineers
Consistence	Is the mobility of the concrete, is related to the wetness of the concrete mixture
Handling concrete	Refers to the methods adopted on site activities relating to concrete transportation, placing, compaction, finishing and curing
Concrete strength	Is the capacity of concrete material to withstand loads tending to reduce size, as opposite to tensile strength
Formwork	Is the temporary structure used to contain poured concrete until it settles to adopt the designed shape
Labourer	Are workers employed to work with the concrete task on the project
Health and Safety (OHS	Is the law which entitles the workers to work in environment where risks to the OHS are properly controlled

In Step 5: The project teams analyzed and defined the criterion and attributes of each factors relating to the concrete alternatives as indicated in Table 4. The CBA practitioner adopted the information (results), which were presented from step 1 to step 5 to conclude step 6 and 8 by choosing the advantages of attributes within alternatives and in step 7, the importance of advantages (Imp) was determined by the project teams through a scale of 0 to 100 as indicated in Table 3.

The Importance of advantages score (IofA) is determined by the project teams through a scale of 0 to 100, where 100 is given to the most important advantages. To give the IofA to the other advantages, the CBA practitioner compared the advantages (Adv) to the most important advantage (Imp). The project teams calculated the IofA score by comparing criterion of the factors with the attributes of the factors. Table 3 shows an example which was used to calculate the IofA score. In step 9, the CBA practitioner evaluated and

compared the cost of ready mixed concrete and site batched concrete with the project teams as recommended by Schöttle and Arroyo (2016) that cost of the alternatives should be analyzed separately.

Table 3: Importance of Advantages (IofA) Score

		Alternative 1: Ready mixed concrete	Alternative 2: Site batched concrete
Factors	Quality Control		
Criterion	Easier is better		
Attributes		The slump test and cube test are taken before placing the concrete	Concrete mix design and aggregates must be inspected before batching and slump test and cube test must be taken before placing the concrete
	Interviewees 1&2: IofA Score (0 to 100)	40	10
	Interviewees 3: IofA Score (0 to 100)	50	15
	Interviewees 4: IofA Score (0 to 100)	20	23
	Interviewees 5, & 6: IofA Score (0 to 100)	30	12
	Advantages (Adv)	(40+50+20+30)/4 = 35 Imp	(10+15+23+12)/4 = 15 Imp

Note, the highlighted attributes have the advantage over the other attributes of the alternative. CBA mechanism is determined by the advantages between alternatives. The preferred attribute is determined by the advantage between attributes of two alternatives. CBA mechanism compares advantages between ready mixed concrete and site batched concrete and allocates scores only to the alternative that shows an advantage in a factor as illustrated in Table 4. The advantages between alternative is calculated per this formula:

A= (PA-LPA)

A: Advantages
PA: Preferred Attributes
LPA: Least Preferred Attributes

Equation: Advantages Calculation Formula (adapted from Arroyo *et al*, 2014)

An example of how the advantages between alternatives were calculated:
Factors: Labourer
Criterion: Fewer is better
Attributes: Alternative 1: *5 labourer are needed to work the concrete per cube.*
Alternative 2: *10 labourer are needed to work the concrete per cube.*
Calculation of the advantages for Alternative 1.

A = (PA-LPA)

A =?
PA = 5 Labourer
LPA: 10 Labourer
A = (5-10)
A.= 5Labourer

Calculation of the advantages for Alternative 2

A = *(PA-LPA)*

A =?

PA = 10 Labourer

LPA: 10 Labourer

A = *(10-10)*

A. = 0 Labourer

The calculations and the IofA score (Table 4) are grounded based on the criterion rule of the factors, in this calculations example fewer labourer are better. This is the reason why alternative 1scored better result than alternative 2 judging from the alternatives attributes.

Table 4: Choosing Concrete type

		Alternative 1 Ready mixed concrete		Alternative 2 Site batched concrete	
Factors	Quality Control				
Criterion	Easier is better				
Attributes		Concrete Quality is controlled by taking the visual approved concrete test (slump and cube test)		Concrete Quality is controlled by studying the concrete materials (aggregates, water, cement etc), next testing the concrete strength	
Advantages		Adv.: Better than Site-batched	Imp: 35	Adv.: No	Imp: 15
Factors	Consistence				
Criterion	Faster is better				
Attributes		The ready mixed truck takes 5 minutes to be parked close to the crane		The truck will take 15 minutes from the batching plant to get to the site	
Advantages		Adv.: 10 min	Imp: 50	Adv.: 0 min	Imp: 20
Factors	Handling Concrete				
Criterion	Fewer is better				
Attributes		It takes 40 minutes to handle the concrete per six cubes		It takes 55 minutes to handle the concrete per six cubes	
Advantages		Adv.: 15 min	Imp:45	Adv.: 0 min	Imp:15
Factors	Compressed strength				
Criterion	Higher than 30 Mpa				
Attributes		30 Mpa concrete strength are crushed 7 days after placement		30 Mpa concrete strength are crushed 7 days after placement	
Advantages		Adv.: Cannot be compared	Imp: 40	Adv.: Cannot be compared	Imp: 40
Factors	Formwork				
Criterion	Stronger is better				
Attributes		The formwork shutter is aligned an stiffened to support the concrete		The formwork shutter is aligned and stiffened to support the concrete	
Advantages		Adv.: Cannot be compared	Imp: 100	Adv.: Cannot be compared	Imp: 100
Factors	Labourer				
Criterion	Fewer is better				
Attributes		5 labourer are needed to work the concrete per cube		10 labourer are needed to work the concrete per cube	
Advantages		Adv.: 5 labourer	Imp: 50	Adv.: 0labour	Imp: 25
Factors	Health and Safety				
Criterion	Lower risk is better				
Attributes		The risk of health and safety to workers is medium		The risk of health and safety to workers is medium	
Advantages		Adv.: Cannot be compared	Imp: 30	Adv.: Cannot be compared	Imp: 30
Sum of IofA			350		245

Step 9: concrete cost data evaluation

The decision-maker compared the IofA vs. cost of the alternatives (CoA) in Figure 3. Figure 3 illustrates 30 mpa concrete price comparison between site-batched concrete which is estimated at $ 152.42per cubic meter (m^3),

and ready-mixed concrete which is estimated at $ 209.59per m^3. This are the average concrete rate per m^3 in Bloemfontein between June and September 2016. Figure 3 also shows that site-batched concrete is less economical when compared to ready-mixed concrete. However, the project teams support their decision to choose ready-mixed concrete because they believe that it reduces cost in a long run, while site-batched concrete requires or compels the contractor to employ a concrete specialist; also, there is often a problem relating to material theft, materials wastage, and more labourer are employed on site. These factors need money to be maintained and ready-mixed concrete helps the contractor to avoid this cost. The ready-mixed concrete reduces the construction risk for the contractor because the supplier is responsible for the concrete delivered or supplied to the site. The ready mixed concrete is subject to South African National Standard (SANS) 878 requirement, and the concrete supplier was approved by South African Ready-mix Association. SANS 878 compel the ready mixed company to transport the concrete to the site within the permissible range of slump for a period of 30 minutes from the arrival at the site.

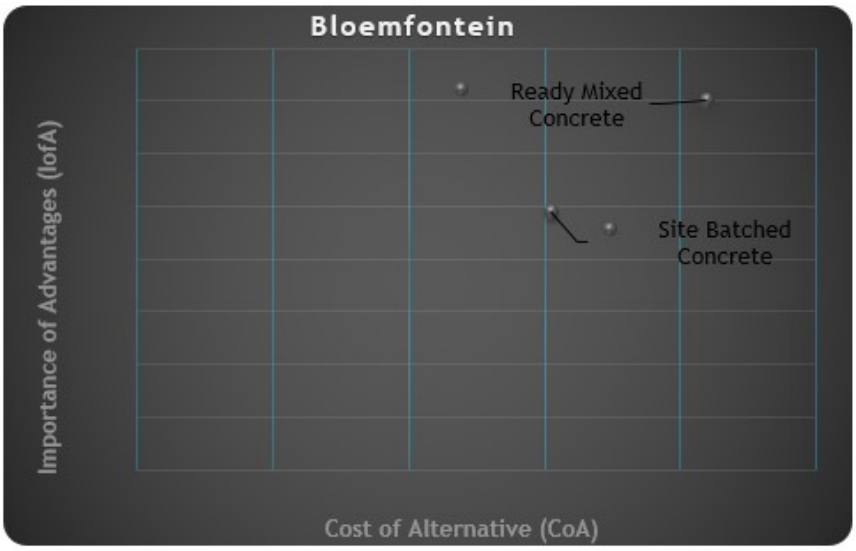


Figure 3: IofA vs. CoA

DISCUSSION

Emuze (2012) emphasize that project performance is very unsatisfactory and is often influenced by the project team decisions outcomes. The reviewed literature in this study presented evidence that project team decision outcomes often leads to poor performance, especially when working with concrete task. Concrete is a critical material which must be chosen by a concrete specialist or professional who has gained extensive knowledge and experience in the construction industry. The outcomes of the project team decisions when choosing a concrete type often causes defects and rework related to concrete project, which can be eliminated through CBA mechanism. Karakhan *et al.* (2016) described CBA as an element of lean thinking adopted by the project teams to improve their project decisions to sound decisions and congruent to eliminate concrete defects and rework.

The application of CBA was based on a well-defined vocabulary relating to the two concrete alternatives (ready mixed concrete and site batched concrete), which were determined by the project teams as illustrated by Suhr (1999).

The case study analysis shows that CBA could help the project team to make sound decision when choosing concrete alternatives. The application of CBA is not influenced by the cost of alternatives rather the importance of advantage scores. This is the reason why ready mixed concrete is preferred more than site batched concrete even though site batched concrete is less economical when compared to ready mixed concrete. The case analyses further show that ready mixed concrete has less chances of causing concrete defects and rework when compared to site batched concrete, if applied correctly.

CONCLUSIONS

This study has confirmed the application of CBA mechanism when making project teams decisions to improve project performance. This study provides insight about the rationale over the choice between ready mixed concrete and site batched concrete by providing questions that the project teams should ask in discovering the best alternatives. The project teams identified and described factors, which influenced concrete works either positively or negatively, depending on the project teams work experience. The concrete alternatives were judged per the IofA score rate issued by the project teams. It was discovered that ready-mixed concrete had a better score than site-batched concrete. The cost of the concrete was judged separately as recommended by Legmpelo (2013), that the goal of the project teams is to determine the best alternatives, which was ready mixed concrete without over emphasizing initial cost of the concrete and that concrete cost should be addressed after the implementation of CBA. This realization resonates within the CBA literature.

Furthermore, the project teams stated that even though site batched concrete is less economical when compared to ready mixed concrete, they favor the IofA score. Previous CBA studies already shows that CBA continues to be a preferred decision-making method when choosing the best alternative from multiple alternatives. So, the application of CBA should be adopted during the pre-tendering phase of the project due to the reason that critical decisions are taken during the design of a project. This exploratory work, however, needs to be conducted on a longer period to examine, analyze and define the CBA Frame Model in detail.

ACKNOWLEDGEMENT

The researcher acknowledges the financial support of the National Research Foundation(NRF)–Thuthuka Funding Instrument.

REFERENCES

Ali Karakhan, A., Gambates, J., and Rajendran, S. (2016) "Application of choosing By Advantages Decision-Making System to Select Fall-Protection Measures." *In: Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction*, Boston, MA, USA, sect.11 pp. 33–42.

Abraham, K., Lepech, M. and Haymaker, J. (2013). Selection and Application of Choosing by Advantages on a Corporate Campus Project. *Proceedings IGLC-21, July 2013* (pp. 349-358). Fortaleza, Brazil

Ariely, D. (2009). Predictably Irrational: The Hidden Forces that Shape Our Decisions. Hammersmith, London: Harper Collins Publications.

Arroyo, P., Ballard, G. and Tommelein, I.D. (2014). Choosing By Advantages and Rhetoric in Building Design: Relationship and Potential Synergies. *Proceedings IGLC-22, June 2014* (pp. 391-408). Oslo, Norway.

Baron, J. (2008). Thinking and Deciding. (4, Ed.) New York: Cambridge University Press

Emuze, F.A and John Smallwood, J.J. (2012). Bridging public works project performance gaps in South Africa. *Proceedings of the ICE-Management, Procurement and Law, 165*, 111-118.

Emuze, F.A. (2012). Performance Improvement in South African Construction. Port Elizaberth: PhD Thesis: Nelson Mandela Metropolitan University

Lee, H.W., Tommelein, I.D. and Ballard, G. (2010). Lean Design Management in an Infrastructure Design-Build Project – A Case Study. *Proceedings IGLC-18, July 2010, Technion, Haifa, Israel* (pp. 113-112). California: University of California.

Legmpelo, N. (2013). On-Site Construction Versus Prefabrication. *Massachusetts Institute of Technology*, 1-117.Meng, X. (2012). The effect of relationship management on project performance in construction. *International Journal of Project Management*, 188–198.

Meng, X. (2012). The effect of relationship management on project performance in construction. International Journal of Project Management, 188–198.

Mollo, L.G., Emuze, F.A. and Geminiani, F (2016) Choosing by advantages in project team decisions: case studies of concrete works in South Africa. *In: Proceedings of the 2016 International Conference on Infrastructure Development in Africa,* 10-12 July, Johannesburg, South Africa, 337-346.

Parrish K. and Tommelein, I.D. (2009). Making Design Decisions Using Choosing by Advantages. *17th Annual Conference of the International Group for Lean Construction*, 501-510.

Schöttle, A., and Arroyo, P. (2016). "The Impact of the Decision-Making Method in the Tendering Procedure to Select the Project Team." In: *Proc. 24rdAnn. Conf. of the Int'l. Group for Lean Construction*, 20-22 July, Boston, MA, USA, sect.3 pp. 23-32,

Senior, B.A. (2012). "An Analysis of Decision-Making Theories Applied to Lean Construction" In: Proceedings of 20th annual Conference of the International Group on Lean Construction, San Diego, CA, USA.

Suhr, J. (1999). *The Choosing by Advantages Decision-making System.* California: Westport

Yin, K.R. (2011). *Qualitative Research from Start to Finish.* (9, Ed.) New York: The Guilford Press.

Yin, K.Y. (2014). *Case Study Research Design and Methods.* (5, Ed.) Thousand Oaks, California: SAGE Publications.

Young, B.K.., Hosseini, A., and Lædre, O. (2016). "Project Alliances and Lean Construction Principles" In: *Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction*, Boston, MA, USA, sect.3 pp. 33–42.

Zhang, L. (2013). Improving performance of construction projects: A project manager's emotional intelligence approach. *Engineering, Construction and Architectural Management, 20*, 195 – 207

A CONCEPTUAL FRAMEWORK FOR ETHICAL SOURCING OF CONSTRUCTION MATERIALS IN NIGERIA

Kabir Ibrahim[1], Winston .MW. Shakantu[2] and Ibrahim Saidu[3]
[1,2,3]*Construction Management Department, Nelson Mandela Metropolitan University, Port Elizabeth, 6031, South Africa*

The construction industry has been noted to have impacts on the ecosystem and human survival. On the positive side, it has provided humans with basic infrastructure not limited to buildings, dams and roads. However, there are negative impacts of human activities on the environment such as pollution, waste generation, resources depletion, global warming and climate change. In addition to these, is the high rate of energy consumption resulting in the loss of biodiversity. This has increased the interest over the way countries achieve their development targets with respect to sustainable development. On the review of peer group studies, there is a dearth of literature relating to ethical sourcing of materials in the construction industry particularly in developing countries. The question is therefore how can an ethical sourcing framework be used to source construction materials in a sustainable manner? As such, the research studied materials sourcing in the Nigerian construction industry with a view to improve sustainability practise. The paper discussed the conceptual framework for ethical sourcing of construction materials. The conceptual framework is expected to improve sustainability practices in the Nigerian construction industry.

Keywords: corporate social responsibility, ecological footprint, ethical sourcing, sustainability reporting

INTRODUCTION

The construction industry often lays the bedrock for any activity to be carried out ranging from shelter, roads, bridges, production and dams. The construction industry it is often adjudged a large employer of labour ranging from un-skilled, semi-skilled to skilled. Globally, activities in the construction industry have often been criticised for not been sustainable. The negative impacts of the activities in the construction industry has been documented by (Murray and Dainty, 2009; Loosemore and Phua, 2011; Dania *et.al,* 2013). The characteristics and challenges in developing

[1] s216719380@nmmu.ac.za
[2] winston.shakantu@nmmu.ac.za
[3] saidu.ibr@futminna.edu.ng

Ibrahim, K., Shakantu, W. M. W. and Saidu, I. (2017) A conceptual framework for ethical sourcing of construction materials in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 25-37.

countries are different from developed countries. According to Berardi (2013) developing countries demand for infrastructure and amenities, makes it imperative to implement sustainable construction practices. Dania *et al.,* (2014) observed that there is no framework that guides developing countries in Africa to achieve sustainability particularly for the construction industry. Luciana (2007) noted that the African countries including Nigeria have been touted as the next world economic hub, creating the need for sustainability practices in the continent. This will put more pressure on the natural resources base in the continent. Not only that, Ofori (1998) and du Plessis (2007) believed the characteristics and challenges in developing countries massive deficit in housing and infrastructure, frail institutional capacity of government, rapid growing population, social injustice and unsteady political environment. These factors might be the reason why successes in sustainability has been limited in developing countries. But du Plessis (2007) and Dania *et.al,* (2013) believed that developing countries need to see this as an opportunity to learn from the mistakes made by their developed counterparts to source, transport, produce and use materials ethically to achieve sustainable development. Ebohon and Rwelamila (2001) believed that the construction industry happens to be the foremost natural resources consumer, which significantly contributes to environmental disasters, global warming as well as harm to flora and fauna. Furthermore, Jacob *et.al,* (2014) submitted that the extraction of materials for the construction industry is weighing heavily on the environment and causing social problems. Moir and Carter (2012) avowed the need for a suitable framework to achieve sustainability in materials sourcing for the construction industry. The questions to be answered in this paper is can an ethical sourcing framework be used to source construction materials in a sustainable manner? The paper discusses the conceptual framework for studying ethics in materials sourcing particularly for Nigeria construction industry.

LITERATURE REVIEW

Sustainability in the construction industry

Sustainable construction activities in the built environment are believed to be a rejoinder to calls from different quarters to conduct activities sustainably. The most subscribed view of sustainable development comes from The World Conference Environment and Development's 1987, which puts it as “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Ding (2005) views sustainable construction as a rejoinder to sustainable development. The implementation of sustainability practices will revamp activities in the construction industry positively (Moir and Carter, 2012). Mosaku (2015) defined sustainable construction as " 'maintaining a delicate balance between the human needs to improve the lifestyles and a feeling of well-being on one hand and on the other hand preserving natural resources and ecosystem on which the present and the future generations depend". The varying negative impacts of the construction industry on the

environment as noted by Watuka and Aligula (2003) includes; natural resource depletion, energy utilisation, water, air pollution and also large generation of material waste.

Sustainable construction aims to ensure balance and harmony between various human activities and the ecosystem (Agenda 21, 2001). Pearce *et.al.,* (2005) believed that with respect to sustainability for construction materials, attention should focus on approaches that minimizes the consumption of energy, derivation of maximum satisfaction and reducing the occurrences of environmental damages.

du Plessis (2014) believed that the current global sustainability effort is only peripheral and will not have much impact on achieving a sustainable built environment. Hence the need to develop research questions in areas such as social-ecological structures, relevant systems model, adaptive strategies for climate change, resilience management, human behaviour and ethics.

The Nigeria Construction industry

The construction industry in Nigeria is pivotal for the country`s intended development, since it provides the basic facilities needed by humans for growth and survival. The idea of project development is often conceived without having consideration for a balance between economic, social and environmental factors in Nigeria (Mosaku, 2015). Akindoyemi (2012) submitted that stakeholders' demands for the sustainability practices in the Nigerian construction industry materialized after the organisation of a sustainability summit and the formation of a Green Building Council specifically to suit the Nigeria construction sector. Dania *et.al.,* (2013) concluded that the level of sustainability implementation in the Nigeria construction sector is below expectations. Alabi (2012) posits that the reasons for poor sustainability implementation in the Nigeria construction includes: the lack of appropriate regulation to promote sustainability practices, limited commitment to the economic benefits of sustainability, stakeholders' commitment is lacking, inadequate understanding of sustainable construction in the industry and the low desire to construct sustainably.

du Plessis (2007) submitted that the following condition must be met for the construction industry in developing countries to be sustainable:

I. There should be a synergy between the various stakeholders that exist in the construction industry.

II. The need for a balance between technology enablers, value system enablers and institutional system enablers.

III. The construction industry should be competent and proactive.

Table 2: Sustainable construction enablers in developing countries

Time	Technological	Institutional	Values
Immediate	Benchmarking & assessment	Clarified roles and responsibilities	Mapping the route to change
	Knowledge system & data-capturing	Education	Understanding the drivers
		Advocacy & awareness	Re-evaluating heritage
		Cooperation and partnership	
Medium	Technologies to mitigate impact	Linking research to implementation	Develop a new way of measuring value and reward
		Develop regulatory mechanisms	Develop code of conduct
Long term	Technologies of the future	Strengthening implementing mechanisms	Corporate social reportin
	Changing the construction process	Using institutions as drivers	
		Regional centres of excellence	

(Source: du Plessis, 2007)

Climate change

For over twenty years, the world has recognized the need to establish systems to regulate climate change, unfortunately, limited much success have been recorded. The Intergovernmental Panel on Climate Change (IPCC, 2013:2) report stated that the "Warming of the climate system is unequivocal, and since the 1950's, many of the observed changes are unprecedented over decades to millennia". The report attributed human activities including the construction industry as the major causes of climate change. The report further warned that the impact of climate change will continue if the current generation does not implement measures to reduce this trend. Evident changes in climate include persistent temperature rise, irregular rainfall pattern which increases the risk in drought in sub-Sahara Africa resulting in famine, while the melting of icebergs is linked to flooding (du Plessis, 2014).

Other indications of climate change also include the amount of high carbon dioxide (CO2) released into the environment. Currently, the CO2 equivalent concentrations in the atmosphere stands at 478ppm (MIT, 2013) however, du Plessis (2014) recommended that CO2 concentration should be kept back at 475ppm. This would lessen the effect of climate change on the environment by cutting the down the various greenhouse gases emitted from materials sourcing stage, transportation and production stage of building construction materials. Carpenter (1994) believed that the need for uprightness in the extraction process of natural from the earth crust is key to achieve sustainable development. The industrial and production of construction materials utilises large amounts of energy and emits a lot of CO2 into atmosphere as illustrated in Table 2 below.

Table 2: Industrial and Process activity sources of global CO_2 emissions annually

Fossil fuels process	Number of sources	Emissions (MtCo2yr-1)
Power	4,942	19,539
Cement production	1,175	932
Refineries	638	798
Iron and steel industry	269	646
Petrochemical industry	470	379
Oil and gas processing	-	50
Other sources	90	33
Total	7584	13375

Adapted from: Metz *et al.,* (2005)

RESEARCH METHODOLOGY

The desktop methodology approach was employed for the research, where a review of related literature from journals, conference papers, policies and guidelines and books was carried out. The process was carried out by systematically reviewing journals from International Journal for Social, Behavioural, Education, Economics, Business and Industrial Engineering, Journal of Organization and Environment among others.

The review approach adopted is identical to the works of Saidu and Shankantu (2016); Mensah *et al.* (2014) and Tang *et al.,* (2010) employed in their studies. The study espoused the procedures below to gather papers relevant to the study:

i. Examination of title and abstract of relevant published materials

ii. Finding keywords on many online search engines not limited to Science Direct, Business Sources Premier, Emerald Database and Taylor and Francis.

iii. Further abstract checks of relevant materials downloaded to determine important materials.

iv. Narrative review of the relevant materials to explain the current level of approaches in sourcing materials ethically in the construction to add to existing knowledge.

v. Selecting relevant themes that appear from the set of materials and making relevant conclusions.

CONCEPTUAL FRAMEWORK FOR ETHICAL SOURCING OF CONSTRUCTION MATERIALS

The literature reviewed gave a guide for constructs to be included in the conceptual framework. A concept is a mental picture for a course of an action and provides a basis for commencing a research work. The conceptual framework comprises of a minimum of two interconnected plans, in order to

elucidate an event systematically. It states the researchers view with respect to the research problems. Conceptual frameworks also illustrate the correlation that exist between key variables related to the research. Again, a conceptual framework is a pointer to research methodology process. Saidu and Shankantu (2016) believed a conceptual frame could emerge from the modification and adoption of similar models used in previous studies. Waheed et. al., (2009) puts forwards that a framework for sustainable development should consist of a conceptual model that brings forward and classifies parameters and indices that will be measured.

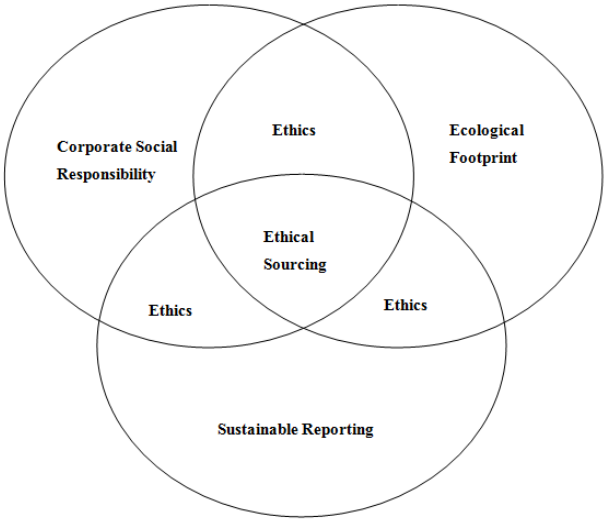


Figure 1. Conceptual framework for ethical sourcing of construction materials

CORPORATE SOCIAL RESPONSIBILITY

The pivot position occupied by the construction industry economically makes the industry important to any nation. Construction processes engages the services of skilled, semi- skilled and skilled personnel for project delivery not limited to the contractors, material producers and professional amongst others. Due to population growth and infrastructure expansion, the construction industry has been faced with sustainable development challenges relating to economic, environmental and social issues (Shen *et al.,* 2010). Teo and Loosemore (2003) noted that there has been more focus on the construction industry to operate sustainably in line with the sustainable development goals. Zhao *et al.,* (2012) noted that the public outcry by various stakeholders at the construction companies' mode of operation motivated companies to adopt a new strategy to redeem their image such as corporate social responsibility. Ritz and Ranganathan (2001) submitted that stakeholders' demand for more disclosures not relating to financial performance from organisations on social environmental stewardship is now the order of the day. Moneva *et al.,* (2007) believed that when an organisation imbibes into its culture the commitment to social and ethical moral and values will enable such organisation to draw and retain the good employees, enhanced overall productivity and evading litigations among other benefits. Zhao *et al.,* (2012) believed that companies can show their commitment to cooperate social responsibility by publishing results

and reports associated with reductions in pollution to air, water and land, release of toxic waste, carbon emissions and energy. According to Porter and Kramer (2006) organisations can demonstrate their commitment to cooperate social responsibility obligation when such organisations conduct business ethically and imbibe sustainability principles in their conducts. Jones *et al.,* (2006) stated that when organisations in the construction sector embrace ethical behaviour such as corporate social responsibility ideas might be an advantage over other organisations when bidding for construction projects.

ECOLOGICAL FOOTPRINT

The construction industry utilizes resources and energy both finished and semi-finished during construction process. Wackernagel and Rees (1996) defined the ecological footprint (EF) as "the total amount of ecologically productive land required to support the consumption of a given population in a sustainable way". Van *et al*., (2000) believed that ecological footprint should cover six (6) aspects namely: agricultural land, forest, fish, carbon and construction land area. World Business Council for Sustainable Development (2009) submitted that construction activities use up 50% of raw materials available on earth for various projects and these projects also requires 40% energy for daily operation. Again, Tam (2006) noted the unsuitable use of water, land and high pollution level in the construction industry. Resources consumption cuts across developing and developed countries leading to large amounts of materials waste. Activities in the construction industry in China adds to about 40% of total amount of waste generated in China, reaching an all-time high level of 300 million tonnes in 2010 (Wang *et al.,* 2010). Zhao et al., (2012) puts forward the resources consumption pattern in United Kingdom (UK) to be 420 million tonnes and generating 10% waste during the process. WBCSD (2009) linked the high energy consumption level to increase in population and economic growth and wasteful energy use pattern in developed nation. Ecological footprints involve stating both direct and indirect human materials demand for renewable resource production and use and evaluate these with the natural resources (Monfreda *et al*., 2004)

SUSTAINABILITY REPORTING

The Global reporting initiative (2006) puts forward that sustainability reporting intends to reveal to both the internal and external stakeholders an organisation`s commitment to sustainable development goals. Sustainability reports might be in various platforms such as online disclosure, disclosure in annual report or separate sustainability report of organisations (Zuo *et.al*, 2012). KPMG (2008) highlighted the drivers for sustainability reporting to includes;

- Organisations effort to meet stakeholders' need;
- Satisfying relevant laws, regulations and codes;

- Comparing an organisation current practices with other practices
- Performance measure and
- Practices to forestall stakeholders' wrath.

Adams and McNicholas in their study observed that the challenges to sustainability reporting are the lack of clear understanding on how to incorporate sustainability reporting efforts with the tactical planning for making important decisions and lack of knowledge to incorporate stakeholders in the reporting method.

Lankoski`s (2009) research on the benefits of sustainability reporting with the top executives of large companies submitted that reporting their companies' effort on environmental and social responsibility has improved their revenues and other profit lines.

Some challenges to sustainability reporting in the construction exist which has limited sustainability development goals. Maclaren (1996) believed lack of understandable and direct method for sustainability reporting is a barrier to sustainability. Studer *et al.,* (2005) noted the following as barriers to sustainability reporting:

- Deficient statutory legal requirement for sustainability reporting;
- Low motivation from the top ranked managers and
- Nonchalant attitude of stakeholders towards sustainability reporting;

ETHICAL SOURCING

Activities in the construction industry often come under scrutiny due the various impact on the environmental, supply chain, employee remunerations and benefit and inducement and fraud (Glass et al., 2014). This calls for a rethink from the current practice for sustainability in the construction industry mainly by considering ethics in the industry. Materials sourcing operation have varying degree of negative impact on the environment. The process of mineral resources extraction from the earth crust and production disturb the earth crust and result to loss of biodiversity (Gyang and Ashano, 2009). Gubbay (2003) noted that the impact of sand dredging for construction activities destroys the environment. Efforts to restore the environment back into its original state requires a lot of time, resources and remediation. Quarrying activities release harmful total suspended particles of size below 50 μm which affects the air quality (Bada et al. 2013). This causes respiratory and cardiovascular diseases where it destroys the lung tissues and may result to lung cancer over a long period of time for residents living around the quarry site (Abdul-Wahab et al., 2013). There is the urgent need for global commitment to improve on activities and processes that contributes to climate change. Anand et al., (2006) submitted that cement production utilises considerable amounts of energy from the process of raw materials sourcing, transportation of raw

materials to the production stage. The process contributes to approximately 20% of the global human CO2 emission (Anand et al., (2006)).

A study by Hansen and Treue (2008) revealed that about 90% of timber sourced in developing countries and particularly in West African countries including Nigeria is not sourced ethically. Efforts to ensure forest products are sourced ethically have been championed by countries that consume this product, by setting up relevant local and international programs to promote sustainability. However, the countries that supply the product have been left out of these efforts (Hansen and Treue, 2008). The lack of commitment from countries particularly in Tropics that supply timber may be the reason why significant achievement has not been recorded globally. Oborien (2005) noted that the unethical practices in stone quarry operations on the Iyuku community in Edo state Nigeria caused harmful impact to the social, environmental and economical livelihood of the inhabitant. As illustrated by Glass et al., (2012) the global uptake of ethical sourcing practices of construction materials is its infancy in the United Kingdom which is a developed country. OECD (1999) noted that material sourcing, transportation and production exert a lot of pressure on the environment resulting to devastation of environment, air, water and soil pollution and emission of dangerous substances not limited to NHX, SO2 and Co2. Raw materials and natural resources needs in Nigeria will increase due to the expanding middle class and the government ban on the importation of goods that can be manufactured locally. The implication of this is that more pressure will be on the environment to provide the needed natural resources to drive the manufacturing industries in Nigeria. Hence the critical need for ethical behavioural change on resources consumption pattern due to the earlier highlighted challenges to the continued survival of humans, plants and animal That might be the reason why Kabir et al., (2014) advocated for a framework for ethical sourcing of construction in Nigeria that integrates human wellbeing, health, safety and environmental considerations across the material supply chain. Ethical sourcing of construction will involve corporate social responsibility, sustainability reporting and ecological footprints.

CONCLUDING REMARKS

The study has shown the negative impact that the construction industry has on the environment. It further gives an insight into resources and energy consumption pattern. Again, it brings forward the current efforts made to improve sustainability practices regarding materials sourcing in the construction industry. Hence, the need of a framework for ethical sourcing of construction material is obvious. The framework is expected to improve sustainability practices, were construction materials will be sourced ethically.

REFERENCES

Abdul-Wahab, S. Fgaier, H. Elkamel, A and Chan, K (2015) Air quality assessment for the proposed Miller Braeside quarry expansion in Canada: TSP. Journal of Air Quality, Atmosphere and Health 8:573–589.

Alabi, A. A (2012) Comparative Study of Environmental Sustainability in Building Construction in Nigeria and Malaysia. Journal of Emerging Trends in Economics and Management Sciences 3(6): pp 951-961

Akindoyemi, A. (2012). Transformation Agenda and Building Production in Nigeria. 42nd National Conference and Annual General Meeting of the Nigerian Institute of Building. Enugu.

Anand, S. Vrat, P and Dahiya, R.P. (2006). "Application of a system dynamics approach for assessment and mitigation of CO_2 emissions from the cement industry." *Journal of Environmental Management* 79 (4):383-398.

Bada B.S, Olatunde K.A, Akande O.A (2013) Air quality assessment in the vicinity of quarry site. Environmental Natural Resources 3(2):111–115

Berardi, U. 2013. Clarifying the new interpretations of the concept of sustainable building. *Sustainable Cities and Society,* 8**,** 72-78.

Waheed, B. Khan, F and Veitch, B. (2009) "Linkage-Based Frameworks for Sustainability Assessment: Making a Case for Driving Force-Pressure-State-Exposure Effect-Action (DPSEEA) Frameworks ". Journal of sustainability 1, 441-463.

Carpenter, S. (1994). "Sustainable Communities." School of Public Policy, Georgia Institute of Technology, Atlanta.

CIB Publication 237 (2001) *Agenda 21 for Sustainable Construction in Developing Countries*, First Discussion Document, Version 2

Dania, A. A, Larsen G D and Ewart, I J (2014) Sustainable construction: Exploring the capabilities of Nigerian construction firms *In:* Raiden, A B and Aboagye-Nimo, E (Eds) *Procs 30Annual ARCOM Conference,* 1-3 September 2014, Portsmouth, UK, Association of Researchers in Construction Management, 3-12.

Dania, A. A, Larsen, G. D and Yao, R. 2013. "Sustainable Construction in Nigeria: Understanding firm level Perspectives." Sustainable Building Conference Coventry University.

Du Plessis, C. (2007) "A strategic framework for sustainable construction in developing countries" *Construction Management and Economics.* 25**,** 67-76.

Du Plessis, C. (2014) " Adapting the built environment to climate change in a post-sustainable world *In:* Laryea, S. and Ibem, E. (Eds) *Proceedings 8th Construction Industry Development Board (cidb) Postgraduate Conference,* 10-11 February 2014, University of the Witwatersrand, Johannesburg, South Africa, 51-54.

Ebohon, O. J, and Rwelamila, P.M. D. (2001). "Sustainable construction in Sub-Saharan Africa: relevance, rhetoric, and the reality." Agenda 21:16.

Friend, A.; Rapport, D. (1979). "*Towards a Comprehensive Framework for Environmental Statistics: A Stress-Response Approach"*. Statistics Canada,

Kabir, I. Mbamali, I and Ahmed, D. I. 2014. "Development of a framework for ethical sourcing supply chain in the Nigerian construction industry" In: Laryea, S. and Ibem, E. (Eds) Proceedings 8th Construction Industry Development Board (cidb) Postgraduate Conference, 10-11. University of the Witwatersrand, Johannesburg, South Africa, 247-256

Glass, J. Achour, N. Parry, T. and Nicholson, I. (2012) "Engaging small firms in sustainable supply chains: responsible sourcing practices in the UK construction industry" International Journal of Agile Systems and Management, Special Issue: Sustainable supply chain design and practice, 5**(**1), 29-58

Glass, J, Nebil A, Tony Parry, and I Nicholson. (2011). "The role of responsible sourcing in creating a sustainable construction supply chain." Management and Innovation for a Sustainable Built Environment MISBE, Amsterdam, The Netherlands, June 20-23, 2011

Global reporting initiative (2006). Sustainabilityreportingguidelinesversion3.0(G3) Netherlands

Gubbay, Susan (2003). Marine aggregate extraction and biodiversity. Information, issues and gaps in understanding. Report to the Joint Marine Programme of The Wildlife Trusts and WWF-UK.

Gyang, J. D and Ashano E. C (2009). "Effects of mining on water quality and the environment; a case study of parts of the Jos Plateau, North Central Nigeria." *Continental Journal of Environmental Sciences* 3 (33).

Hansen, C. P and Treue, T. (2008). "Assessing illegal logging in Ghana." *International Forestry Review* 10 (4):573-590.

Jacob H, Freeman R. E and Schaltegger S (2014) Applying Stakeholder theory in Sustainability Management: links, similarities, dissimilarities and a Conceptual Framework. Journal of Organization & Environment Vol. 27(4) 328–346

Jeon, C. M., S.M and Amekudzi, A. (2005) Addressing sustainability in transportation system: definitions, indicators, and metrics. *J. Infr. Syst. ASCE*, 11, 31-50.

Jones, P., Comfort, D. and Hillier, D. (2006)." Corporate Social Responsibility and the UK construction industry". *Journal of Corporate Real Estate*, 8, 134-150.

IPCC (Intergovernmental Panel on Climate Change) (2013) *Climate Change 2013. The Physical Science Basis. Summary for Policymakers. Working Group 1 contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Available online at www.climatechange2013.org Accessed 05/12/2013.

KPMG (2008) Sustainability reporting a guide, KPMG, Australia; May 2008.

Loosemore, M., and Phua, F. (2011) *Responsible corporate strategy in construction and engineering*, Spon Press, Abingdon, UK.

Lankoski, L. (2009) " Cost and revenue impacts of corporate responsibility: comparisons across sustainability dimensions and product chain stages". Scandinavian Journal of Management; 25:57–67.

Luciana, M. 2007. The Dutch sustainable building policy: A model for developing countries? *Building and Environment,* 42**,** 893-901.

Maclaren, V.W., (1996). "Urban sustainability reporting". Journal of the American Planning Association; 62:184–202

Mensah *et al.* (2014) framework for modeling sustainable construction practices towards low carbon construction *In:* Laryea, S. and Ibem, E. (Eds) *Proceedings 8th Construction Industry Development Board (cidb) Postgraduate Conference,* 10-11 February 2014, University of the Witwatesrand, Johannesburg, South Africa, 293-303.

Metz, B, O Davidson, HD Coninck, M Loos, and L Meyer. "IPCC special report on carbon dioxide capture and storage. 2005." *Working Group III. Intergovernmental Panel on Climate Change, Geneva (Switzerland).*

MIT (Massachusetts Institute of Technology) (2013). 400 ppm CO2? Add Other GHGs, and it's equivalent to 478 ppm. *Oceans at MIT,* 06 June 2013. Available online at http://oceans.mit.edu\featured-stories/5-questions-mits-ron-prinn-400-ppm-threshold. Accessed: 20/01/2014.

Mosaku, T.O (2015) Developmental issues in Africa: "A Sustainable Development Process or A Process of Robbing Peter to Pay Paul" (The Nigerian Construction Industry Scenario). International Conference on African Development Issues (CU-ICADI), Materials Technology Track.

Moneva, J.M., Archel, P. and Correa, C. 2006. "GRI and the Camouflaging of Corporate Unsustainability". *In Accounting forum* 30, 121-137.

Monfreda, C., Wackernagel, M., Deumling, D., (2004). Establishing national natural capital accounts based on detailed ecological footprint and biological capacity assessments. Land Use Policy 21, 231–246

Murray, M. and Dainty, A.R.J. (Eds.) (2009) *Corporate social responsibility in the construction industry*, Taylor and Francis, Abingdon, UK.

Moir S and Carter K (2012) Diagrammatic representations of sustainability A review and synthesis *In*: Smith, S.D (Ed) *Procs 28th Annual ARCOM Conference*, 3-5 September 2012, Edinburgh, UK, Association of Researchers in Construction Management, 1479-1489.

Ofori, G. (1998). "Sustainable construction: principles and a framework for attainment – comment", *Construction Management and Economics,* 16**,** 141-145.

Organization for Economic Cooperation and Development (OECD)1999. "Using the pressure-state-response model to develop indicators of sustainability." OECD *Conference*, Rome, Italy, December 15–17.

Pearce, A.R., Hastak, M. and Vanegas, J.A., (1995). A decision support system for construction materials selection using sustainability as a criterion. In *Proceedings of the NCSBCS Conference on Building Codes and Standards* 1-4.

Porter, M.E., Kramer, M.R., (2006). "Strategy and society: the link between competitive advantage and corporate responsibility". Harvard Business Review 84 (12), 78-92.

Ritz, D and Ranganathan, J. 1998. Global development on environmental performance indicators. *Corporate Environmental Strategy*, **5,** 47-52.

Saidu, I and Shakantu, W.M.W. (2016) "A Conceptual framework and a mathematical equation for managing construction- materials waste and cost overrun" International Journal for Social, Behavioural, Education, Economics, Business and Industrial Engineering. 10 (20) 587-593.

Shen, L.Y., Tam, V.W.Y., Tam, L., Ji, Y.B., 2010. Project feasibility study: the key to successful implementation of sustainable and socially responsible construction management practice. Journal of Cleaner Production 18 (3), 254-259.

Studer, S, Welford, R., Hills, P. (2005) "Drivers and barriers to engaging small and medium sized companies in voluntary environmental initiatives, working paper". The centre of Urban Planning and Environmental Management, The University of Hong Kong.

Tang, L. Shen, Q and Cheng, E. W. L. 2010. A review of studies on public-private partnership projects in the construction industry. *International Journal of Project Management*, 28, 683-694.

Keohane, R.O, and D.G Victor. 2010. "The Regime Complex for Climate Change." *The Regime Complex for Climate Change', Perspectives on Politics* 9 (1):7-23.

Van Vuuren, D. P., and Smeets, E. M. W. (2000). Ecological footprints of Benin, Bhutan, Costa Rica and the Netherlands. *Ecological Economics*, *34*(1), 115-130.

Wackernagel, M., Rees, W.E., 1996. Our Ecological Footprint: Reducing Human Impact on the Earth. New Society, Gabrioala Island, BC, Canada.

Wang, J.Y., Yuan, H.P., Kang, X.P., Lu, W.S., (2010)." Critical success factors for on-site sorting of construction waste: A China study". Resources, Conservation and Recycling 54 (11), 931-936.

Watuka, J., and Aligula, E. M., (2002), Sustainable Construction Practices in the Kenyan Construction Industry: The Need for a Facilitative Regulatory Environment, *Proceedings of the CIB W107 1*

World Business Council for Sustainable Development (WBCSD), August 2009. Transforming the Market: Energy Efficiency in Buildings.

WCED - United Nations World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press, Oxford, UK.

International Conference: Creating a Sustainable Construction Industry in Developing Countries, 11 – 13 November, Stellenbosch, South Africa.

Yin, R. K. (2003) *Case study research: Design and methods, 3rd edition,* London, SAGE Publications

Zhao, Z. Y., Zhao, X. J., Davidson, K., and Zuo, J. (2012). A corporate social responsibility indicator system for construction enterprises. *Journal of cleaner production*, *29*, 277-289.

Zuo, J., Zillante, G., Wilson, L., Davidson, K., and Pullen, S. (2012). "Sustainability policy of construction contractors: A review". *Renewable and Sustainable Energy Reviews*, *16*(6), 3910-3916.

A CONCEPTUAL FRAMEWORK FOR PROMOTING ECONOMIC GROWTH IN CRUDE OIL DEPENDENT ECONOMIES - A MODEL FOR NIGERIA

Nuruddeen Usman[1], Ahmadu S. Bustani[2], Nuru Gambo[3] and Gambo Ibrahim[4]

[1,2&4]*Department of Building Technology, Faculty of Environmental Technology, Abubakar Tafawa Balewa University Bauchi, Bauchi state, Nigeria*

[3]*Department of Quantity Surveying, Faculty of Environmental Technology, Abubakar Tafawa Balewa University Bauchi, Bauchi state, Nigeria*

Many countries are currently faced with adverse economic challenges. The situation is more pronounce on economies that solely depend on crude oil. However, among the countries, those that adopt flexible managerial policies cope better under these dwindling economic conditions. The study aims at developing a conceptual framework that can depict how economic challenges of crude oil dependent economies *(CODE)* can be improve through deliberate intervening and moderating measures. The method adopted was based on Baron and Kenny casual steps approach. It was observed that *CODE* countries employed different strategic policies in overcoming current economic challenges especially when prices of crude oil collapse in the global market. The proposed framework was developed based on Big Push theory and Causal theory, in conjunction with the concept of Baron and Kenny. The framework takes into account the different strategic policies used by these countries and considered how diversification and innovativeness (mediating measures) can promote better economic growth alongside effective and efficient managerial system (moderating measures) which ultimately can lead to more efficient resource management hence, a growing sustainable economy especially in a country like Nigeria where there are other abundant resources that can support the economy.

Keywords: Conceptual Framework, economy, intervening measures, moderating measures

[1] ibnothman13@gmail.com
[2] sabustani2@yahoo.co.uk
[3] gambonuru@yahoo.com
[4] gambo.na83@gmail.com

Usman, N, Bustani, A. S., Gambo, N. and Ibrahim, G. (2017) A conceptual framework for promoting economic growth in crude oil dependent economies - a model for Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 38-48.

INTRODUCTION

Oil dependent economies in the whole world are seriously affected by the continuous falling of oil prices. According to Meyer (2016) the countries that are mostly affected include Venezuela (oil account for 96% exports and more than 40% revenues of the government), Libya (energy sector accounting for 65% and 95% of government revenue), Russia (oil and gas account for 68%), Angola (oil industry account for 50% and more than 70% of government revenue), and Kuwait (relies on oil for more than 50% and 100% of government revenue), but these countries are politically unstable, and becoming more so with falling oil prices. Ekong and Ebong (2016) has also stated crude oil prices, stock market movement, and the economic growth have a long term and sustainable equilibrium relationship. Therefore, it means they are affected by the distributions in the prices of the crude oil. Also, Callen, Cherif, Hasanov, Hegazy, and Khandelwal (2014) stated that Gulf Cooperation Council (GCC) economies solely rely on oil where public and private sector were supported by it. However, with the present dwindling in the oil revenue, economic diversification is important, because it would reduce exposure to volatility and uncertainty in the global oil market. Furthermore, oil covers 70 percent of Saudi Arabia government revenue and it is the major employer for the Saudi workforce (Brew, 2016). But it appears Saudi Arabia is committed to make a major economic change as stated by crown prince Muhammad bin Salman, whereby the country would begin its transmission to an "oil-less" economy through an IPO of Saudi Aramco (Brew, 2016). It means Saudi Arabia have started diversifying their economy.

In addition, Ghana officially became an oil exporting nation in 2010, where it raises expectations and hopes for better Ghana, but to avoid bad management and corruption, sovereign wealth funds was proposed as a channel of managing the incoming revenues and economic stability account which will serve as a buffer in stormy times (Alagidede and Akpoza, 2015). The study did not suggest the way of improving the economy of Ghana through the introduction of certain factors as mediator or moderator, but only proposed ways of saving funds for future usage. Similarly, Hartwick and Olewiler (1986) consider the economics of natural resources as renewable and non-renewable resources, but did not consider the problems associated with the fall in price of crude oil that mostly affect oil producing and exporting countries (OPEC). Breton et. al. (2006) also proposed innovative approach to the management of coastal resources in the Caribbean states. The approach comprises the resources users, collaborating with government to manage the resources and mitigating common problems of resource overuse or misuse. The study did not consider diversification of the coastal resources for enhancing revenue generation and well-being of the community.

A policy framework for managing oil resources which involves market, state, and community was established by Obeng-Odoom (2016). Whereby, oil sector must run along market principles, state involvement must

systematically decline over time, and community must be engaged, but not put in charge. The study did not consider cost-effect relationship among the variables. Likewise, Obeng-Odoom (2014) presents various notions about how the relationship between the oil and gas wealth of African countries, and the record of their human development which are seen in terms of the "resource curse" doctrine. The study assesses the impact of the oil industry on the twin-city of Skondi-Takoradi in terms of land, livelihood, capital, and governance. Diversification and cost-effect of the oil industry were not considered in the study. However, Amoako-Tuffour (2016) suggested ways of saving revenues in case of uncertain future revenue generation, through establishing sovereign wealth funds (SWFs) with three components each with a clear savings objective: for future generations, for budget smoothening buffers, and for public infrastructure investment. But, the study did not consider mediator and moderator effect on the diversification of the resources.

Concept of Economic Growth

Economic growth has been viewed as the increase in the inflation-adjusted market value of the goods and services produced by an economy over time and conventionally measured as the percent rate of increase in real gross domestic product, or real GDP, usually in per capita terms. Since economic growth is measured as the annual percent change of gross domestic product (GDP), it has all the advantages and drawbacks of that measure. While labour efficiency has been a major issue of consideration in relation to economic growth, Krucher (2016) have analysed the contribution of labour efficiency as a dominant factor over technology on the issue. However, is very important for the ODEC to think on how to use the following economic theories.

The big push

The *Big Push* theory suggests that countries needed to jump from one stage of development to another through a virtuous cycle, in which large investments in infrastructure and education coupled with private investments would move the economy to a more productive stage, breaking free from economic paradigms appropriate to a lower productivity stage. This phenomenon was studied for growth in Sub-Saharan Africa by Abuzeid (2009).

Schumpeterian growth

Schumpeterian growth is an economic theory that explains growth as a consequence of innovation and a process of creative destruction that captures the dual nature of technological progress: in terms of creation, entrepreneurs introduce new products or processes in the hope that they will enjoy temporary monopoly-like profits as they capture markets. In doing so, they make old technologies or products obsolete. In another example, societies that emerged in colonies without solid native populations established better property rights and incentives for long-term investment than those where native populations were large. Aghion (2002) examined the relation of this theory and the dynamics of income inequality and the US and UK.

Statement of the problem

The major issue affecting the oil dependent economies is lack of a planned framework and strategic policies for diversification. The policies they adopted to diversify the economies are: a stable low-inflation economic environment, business climate has been strengthened, education has been expanded, trade and foreign direct investment (FDI) has been liberalized, national development plan, and new industries and services developed, however these diversifications are highly correlated with oil prices (Collen et al. ,2014).

Nevertheless, countries like Malaysia, Indonesia, Mexico, and Chile had established appropriate policies ahead of the decline in oil revenues, whereby they diversify away from oil and copper respectively, through creating a favourable economic and business environment, export diversification and encouraging workers in acquiring relevant skills and education to boost productivity. Then, there is need to balance between state and market policies in the pursuit of medium to long term goals (Malle, 2013). Therefore, these urged the need for a framework that can guide on diversification and measures to be taken after diversifying to ensure it success toward sustainable economic development.

METHODOLOGY

Big Push theory (Abuzeid, 2009) was used in the development of the conceptual framework for promoting economic growth in crude oil dependent economies based on causal principle (Snyder, 2012) which assumes that there are few genetically driven causes for behaviour of humans in general and none for individual traits : The persistence effects of the fall in the price of crude oil at the international oil market had led the oil depended economic countries (ODEC) such as Venezuela, Saudi Arabia, Nigeria etc. to search for alternative ways of revenue generation (Dev, 2016). The effects of ODEC had led to almost country's economic crashed (country's economic development, CED) in Venezuela and Nigeria with a high effect on Saudi Arabia, Kuwait, UAE etc (Baumeister & Kilian, 2016). The effects of the relationship between the ODEC and the CED in the recent years had shown a negative relationship with adverse effects on the economy of ODEC (Kilian, 2016). For example, in the last decade, Kuwait enjoyed the lowest oil production cost and boasts one of the oldest sovereign wealth funds but the effects of the collapse in the price of crude oil force the government of Kuwait to raise the company tax through corporate tax rate of 10% as a different form of revenue generation (Imam & Jacobs, 2014). The UAE government was the first Gulf country to target fuel subsidies through increasing of pump price, water and power services (Starr, 1991). In Saudi Arabia, the government slashed 14% on public expenditure, removed subsidies and cut downed foreign scholarship (Dev, 2016). Likewise, the government of Qatar cut oil subsidies through increasing pump prices to 35%, water and electricity bills were also reviewed (Davis, 2016). Similarly, in Bahrain, government reduced subsidies on foods such as beefs and chickens and proposed economic diversification as an

alternative measure (Dev, 2016). The government of Oman increased pump price from 12-15% as an alternative immediate measure (Dev, 2016).

Therefore, the countries now search for immediate alternative ways/tools of mitigating the gap created by the fall in the price of crude oil. The immediate measures could be achieved through the concept of mediation and moderation effects on economic diversification into non-oil sectors like solid minerals, agriculture, irrigation and small-scale enterprises. This could only be achieved through efficient and effective management of these sectors to achieve the set goal.

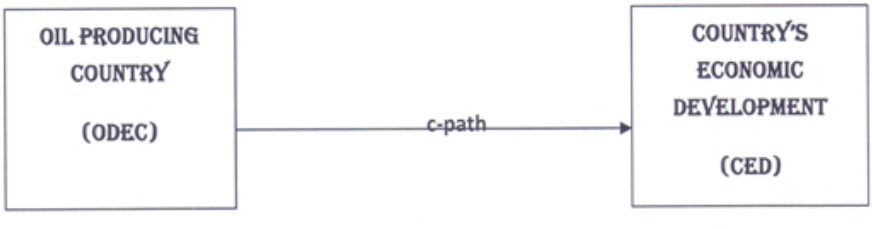


Figure 1: Framework for the Relationship between Oil Producing Countries and the Country's Economic Development

RESEARCH HYPOTHESIS

The direct effect of ODEC on CED is the direct relationship between the two constructs which is given by the relationship

$CED = Ci + ODECx_1 + e_1 \rightarrow c - path$ (from figure) ..... equation 1

FINDINGS: MEASURES OF REDUCING THE EFFECT

Mediation Measures

A mediating variable transmits the effects of an independent variable on a dependent variable (Mackinnon, 2008). Therefore, simple mediation model has three constructs, independent variable that is Oil depended economic country (ODEC), dependent variable that is Country's Economic Development (CED) and Country's Economic Diversification (CEDV) that mitigates the effects of the dependency of country's economic development on oil revenues due to the crash in the oil price. The model causal effect is the direct effects of ODEC on the CED i.e. c-path, the indirect effects are the effects through mediating variable CEDV i.e. a-path and b-path (figure 2). The total effect is the effect of ODEC on CED when CEDV is introduce into the model i.e the sum of the direct and indirect effects c = c'+ab (Hayes, 2009).

Assessing Effects of Mediation in the Model

An assessment of the mediation effects on a model. Three tests are used to assess the indirect effects of mediation model

i. Causal steps as presented by Baron and Kenny (1986)

ii. Percentile and bias-corrected bootstrap CIs presented by Hayes & Scharkow (2013).

iii. Sobel test (Sobel 1982)

Baron and Kenny (1986) suggested some important causal steps to test the mediation effects namely:

i. The direct effects between independent variable (ODEC) and dependent variable (CED) should be significant.

ii. The effect of independent variable (ODEC) on the mediator (CEDV) and mediator (CEDV) on dependent variable (CED) must be significant; and

iii. The magnitude of the direct effect between independent variable (ODEC) and dependent variable (CED) after including mediator should not be significant or reduced.

Hayes & Scharkow (2013) recommended bias-corrected bootstrap CIs as the most trustworthy test if power is of utmost concern. The percentile bootstrap CIs is a good compromise test. The test has the followings procedures:

i. Use the specific model in question including both the direct and indirect paths;

ii. Perform N number of bootstrap resampling

iii. Explicitly calculate the product of the indirect paths form the direct path under assessment (a*b);

iv. Estimates the significance using percentile bootstrap CIs (where z.95 is equal to the constant 1.96).

$$\left(\hat{a}\hat{b} \right) \pm S\hat{a}\hat{b}Z.95$$

Sobel test is used to calculate or determine the relationship between the independent variable and dependent variable. The effect of independent variable on dependent variable would significantly reduce after inclusion of the mediator variable. In other words, this test assesses whether a mediation effect is significant. The test examines the relationship between the independent variable and the dependent variable compared to the relationship between the independent variable and dependent variable including the mediation factor. Sobel test is more accurate than the Baron and Kenny approach. However, it does have low statistical power. As such, large sample sizes are required in order to have sufficient power to detect significant effects. This is because the key assumption of Sobel's test is the assumption of normality. Because Sobel's test evaluates a given sample on the normal distribution, small sample sizes and skewness of the sampling distribution can be problematic. Thus, the rule of thumb as suggested by MacKinnon, Lockwood and Williams (2002) is that a sample size of 100 is

required to detect a small effect, a sample size of 1000 is sufficient in detecting a medium effect, and a sample size of 5000 is required to detect a large effect.

However, Diversification is a risk management technique that mixes a wide variety of investments within a portfolio. The rationale behind this technique contends that a portfolio constructed of different kinds of investments will, on average, yield higher returns and pose a lower risk than any individual investment found within the portfolio.

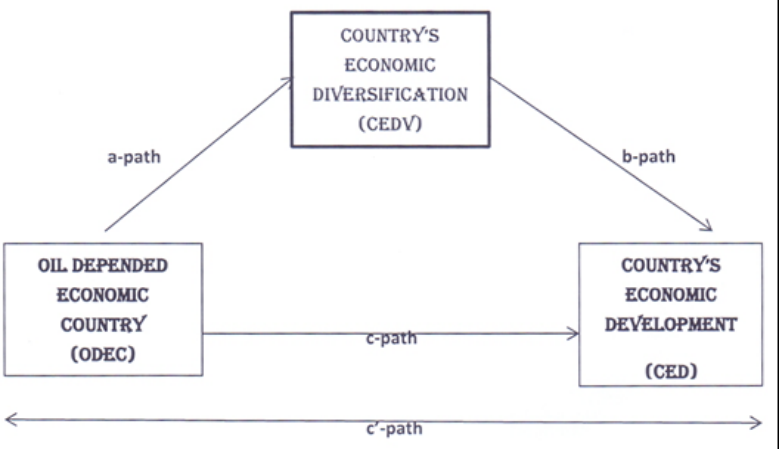


Figure 2: Frame work of the Mediation effect of CEDV on ODEC that affect CED

The relationship between the independent (ODEC) and the mediator (CEDV) variable and that of the mediator and dependent variable (CED) are presented in the equations below $CEDV = C_2 + ODECx_2 + e_2 \rightarrow a - path$ (from figure 2) …… equation 2

$CED = C_3 + CEDVx_3 + e_3 \rightarrow b - path$ (from figure 2) …… equation 3

The relationship between the independent (ODEC) and dependent (CED) variables after the introduction of the mediator variable (CEDV) is the total effect of the relationship which is presented in equation 4.

$CED = C_4 + ODECx_4 CEDVx_4 + e_4 \rightarrow c' - path$ (from figure 2) …… equation 4

Moderating Measures

The effect of sliding profile on crude oil price in the world market that affect economic development of oil exporting countries (ODEC) had it root from dependency on oil as the major foreign exchange/revenue earner. Nevertheless, only mediating measures (diversification) cannot solve the problem of ODEC, but effective and efficient management strategies (Moderator) for diversification of the ODEC nation's economy is paramount. Therefore, Country's economic diversification could be achieved only with effective and efficient management strategies.

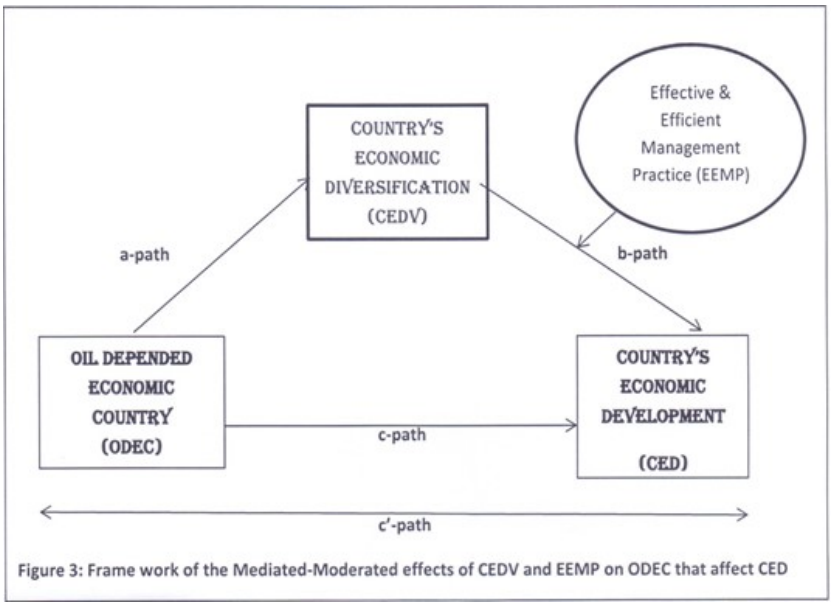


Figure 3: Frame work of the Mediated-Moderated effects of CEDV and EEMP on ODEC that affect CED

The relationship between the dependent variable CED and the mediator CEDV when EEMP is introduced as a moderator is presented in equation 5

$CED = C_5 + CEDVx_5 + EEMPx_5 + e_5$ (from figure 3) ..... equation 5

DISCUSSION

The findings of this conceptual paper revealed that, the mediation effect of country's economic diversification (CEDV) is the total effect of the relationship between oil depended economic countries (ODEC) and country's economic development (CED) after diversification, which can be achieved using the following equation: $CED = C_4 + ODECx_4CEDVx_4 + e_4 \rightarrow c' - path$.

Furthermore, only mediating effect cannot solve the problem of ODEC. Moderator EEMP need to be checking the effect of CEDV in order to accomplish CED through the following equation: $CED = C_5 + CEDVx_5 + EEMPx_5 + e_5$.

Therefore, this study has developed mediated-moderated effects for CED, based on the Big Push theory. However, Alagidede, and Akpoza (2015), and Amoako-Tuffour (2016) suggested sovereign wealth funds as ways of curbing effect of stormy times on oil depended economic countries. These studies considered only ways of saving and enhancing living standard, but diversification was not suggested as the way of saving the country's economy. Also, Obeng-Odoom (2016) established only a policy framework for managing oil resources based on market, state, and community. But diversification using mediators and moderators from oil depended economy to other resources were not considered in the framework. Likewise, Obeng-Odoom (2014) assess the relationship between oil and gas in twin-city of

Sekondi-Takoradi in terms of land, livelihood, capital and governance, but moderating effects was not included in the economic diversification.

However, this study has developed a framework as well as equations to test the conceived way of diversifying economy for the oil depended economy like Nigeria, in which previous studies did not consider.

CONCLUSION

This conceptual article presents a framework for mitigating the effect of falling price of crude oil in the ODEC. Oil producing countries are currently face with the problem of short fall in revenue generation that forces the countries to slash subsidies on social amenities like pump price, water, power services, etc. This had created hardship among the citizens of those countries. Hence, this article developed a framework which introduces immediate measures to the problem through introduction of mediator and moderator constructs into the country's economy. The mediator construct is the economic diversification into non-oil sectors such as irrigation, solid minerals development, small scale enterprises etc. These would provide quick foreign exchange to the ODEC, and in the long-run it can lead toward the provision of employment opportunities to teaming unemployed youth in the ODEC countries. Economic diversification could not be achieved unless it is moderated with effective and efficient management practice to ensure value for money (VFM). Hence effective and efficient management practice EEMP is used in the framework to ensure proper allocation and management of resources in the non-oil sector of the economy. Future research will determine the validity and reliability of the Constructs in the proposed framework. While ODEC should focus more on encouraging pursuing entrepreneurship and private sector employment, improve business environment, reorienting public spending, strengthening the role of private sector competition etc.

REFERENCES

Abuzeid, F. (2009). Foreign Aid and the Big Push Theory: Lessons from Sub-Saharan Africa. Stanford Journal Of International Relations, XI(1), 16-23.

Alagidede, P., & Akpoza, A. (2015). Sovereign wealth funds and oil discovery: lessons for Ghana, an emerging oil exporter. AfricaGrowth Agenda, 10(Oct/Dec 2015), 7-10.

Amoako-Tuffour, J. (2016). Should Countries Invest Resource Revenues Abroad When Demands for Public Infrastructure Are Pressing at Home? The Dilemma of Sovereign Wealth Funds in Sub-Saharan Africa. Journal of African Economies, 25(suppl_2), ii41-ii58.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology, 51(6), 1173.

Baumeister, C., & Kilian, L. (2016). Forty years of oil price fluctuations: Why the price of oil may still surprise us. The Journal of Economic Perspectives, 30(1), 139-160.

Breton,Y., Brown,D., Davy,B., Haughton,M. & Ovares,L. (2006). Coastal Resource Management in the Wider Caribbean Resilience, Adaptation, and Community Diversity. Jamaica : Ian Randle Publishers

Brew, G. (2016). Can Saudi Arabia Really Break its Dependence on Oil. OIL PRICE.COM.

Callen, T., Cherif, R., Hasanov, F., Hegazy, A., & Khandelwal, P. (2014). Economic Diversification in the GCC: Past, Present, and Future. Kuwait: IMF.

Davis, L. W. (2016). The Environmental Cost of Global Fuel Subsidies: National Bureau of Economic Research.

Dev, R. (2016). World's Oil Scenario–Falling Oil Prices Winners and Losers a Study on top Oil Producing and Consuming Countries. Imperial Journal of Interdisciplinary Research, 2(6).

Ekong, N. P., & Ebong, D. W. (2016). On the Crude Oil Price, Stock Market Movement and Economic Growth Nexus in Nigeria Evidence from Cointegration and VAR Analysis. Asian Journal of Economic Modelling, 4(3), 112 - 123.

Hartwick, J.M. & Olewiler, N.D. (1986) The Economics of Natural Resource Use. USA : Harper & Row Publishers, Inc.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. Communication Monographs, 76(4), 408-420

Hayes, A. F, and Scharkow, M. (2013). The Relative Trustworthiness of Inferential Tests of the Indirect Effect in Statistical Mediation Analysis Does Method Really Matter? Psychological science, 0956797613480187

Imam, P. A., & Jacobs, D. (2014). Effect of corruption on tax revenues in the Middle East. Review of Middle East Economics and Finance Rev. Middle East Econ. Fin., 10(1), 1-24.

Kilian, L. (2016). The impact of the shale oil revolution on US oil and gasoline prices.

Krucher, J. J. (2016). Revisiting the word technology frontier: a traditional distance function approach. Journal of Ecomonic Growth, 21(83), 1-29.

MacKinnon, D. P., Lockwood, C. M, & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. Multivariate behavioral research, 39(1), 99-128.

Malle, S. (2013). Economic modernisation and diversification in Russia. Constraints and challenges. Journal of Eurasian Studies, 4, 78-99.

Meyer, T. (2016). 5 Most Oil-Dependent Economies in the World

Obeng-Odoom, F. (2016). Oil, construction, and economic development. Real estate, construction and economic development in emerging market economies, 19-36.

Obeng-Odoom, F. (2014). Oiling the Urban Economy: land, labour, capital, and the state in Sekondi-Takoradi, Ghana (Vol. 1). Routledge.

Snyder, Faye (2012). The Manual: The Definitive Book on Parenting and the Causal Theory. Los Angeles: Clifton Legacy Publishing.

Sobel M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leindardt (Ed.) Sociology mehodology, 290-212.

Starr, J. R. (1991). Water wars. Foreign policy(82), 17-36.

A CONCEPTUAL MODEL FOR MEDIATING THE EFFECTS OF CONFLICT OF INTEREST IN CONSTRUCTION PROCUREMENT TENDERING PROCESSES IN NIGERIA

Abdullahi Nafiu Zadawa[1], Alhassan Dahiru[2], Abdullateef Abdulkarim Jimoh[3] and Mai Abdulkadir Muhammed[4]

[1,4]*Quantity Surveying Department, Faculty of Environmental Technology Abubakar Tafawa Balewa University, PMB 0248 Bauchi, Nigeria*

[2] *Department of Quantity Surveying Faculty of Earth and Environmental Sciences, Bayero University, Kano, Nigeria*

[3]*Department of Quantity Surveying, Waziri Umaru Federal Polytechnic Birnin Kebbi, Nigeria*

Conflict of interest among construction procurement stakeholders and project parties has been identified as one of the core factors affecting compliance with procurement guidelines in Nigeria. Tendering and bid evaluation stages of construction project development are the stages most vulnerable to conflict of interest, mainly due to non-compliance with procurement guidelines. This paper proposes a conceptual model intended for mediating the effects of conflict of interest factors affecting tendering and bidding processes of construction procurement practices in Nigeria. Existing literature has pointed at conflict of interest factors as some of the major causes of non-compliance with the procurement guidelines which subsequently provide room for conflict of interest occurrences. Yet, the mediating influence of procurement guidelines enforcement on conflict of interest affecting tendering process has not been well investigated. The model was developed in accordance with the concept of mediation analysis, it was framed based on an extensive review on conflict of interest factors, tendering and bidding processes, and enforcement of procurement guidelines as the major construct in the model. The model can be applied to mediate the effects of conflict of interest affecting tendering processes of construction procurement through Causal step approach and Sobel test mediation methods with an empirical data. The study serves as a foundation for future empirical research in order to test and validate the model. Also, it serves as an analytical instrument to procurement entities seeking for ways of controlling conflict of interest in tendering aspects of construction project development.

[1] nafiuzadawa@gmail.com

[2] alhassanlaisor@gmail.com

[3] ajabdoul16@yahoo.com

[4] abdulqadirmai@gmail.com

Zadawa, A. N., Dahiru, A., Jimoh, A. A. and Muhammed, M. A. (2017) A conceptual model for mediating the effects of conflict of interest in construction procurement tendering processes in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 49-61.

Keywords: conflict of interest factors, mediation model, tendering process, Nigeria

INTRODUCTION

In Nigeria, the input of the construction industry the country's economy has been challenged by various irregularities especially conflict of interest in the construction procurement process (Dahiru, 2014, Shehu, 2014). Although the policy regulating procurement practices known as PPA 2007 was enacted to duly overcome the rampant occurrence of irregularities, hitherto enforcement measures highlighted by the Act are yet to fully implemented (Abdullahi, Hussin & Atasya, 2015). This has been the reason for the perpetual incidences of conflict of interest in construction procurement especially at the tendering and bidding stages. Fayomi (2013), also stated that conflict of interest is one of the core barriers to compliance with the construction contract conditions and procurement guidelines. The practice of favouritism and all kinds of nepotism in tendering process portray the occurrence of conflict of interest in construction procurement practices (Heggstad et al., 2010). In construction procurement, conflict of interest is said to occur when there is disagreement on regulatory terms among between stakeholders or project parties (Rahim, 2001). These occur mostly at pre-contract stage especially tendering and bid evaluation phase. Previous studies were delimited only to the effects of conflict of interest factors affecting tendering process. The role of enforcing procurement guidelines to mitigate conflict of interest effects in tendering process was not thoroughly examine by the prior studies, thus the need for the current study. This paper proposed a conceptual model for mediating the effects of conflict of interest factors affecting tendering process of the construction procurement practices in Nigeria. The main objective of the current study is to propose an analytical instrument to procurement entities seeking for ways of controlling conflict of interest in tendering aspects of construction project development.

Research problem

Conflict of interest among construction procurement stakeholders and project parties has been identified as one of the core factors affecting compliance with procurement guidelines (Shehu, 2014, Fayomi, 2013). Tendering and bid evaluation stages of construction procurement were identified as the most vulnerable to conflict of interest (Abdullahi et al., 2015). Although Martini (2013), posited that conflict of interest can occur at any of the construction development stages in as much as self-fish interest of any procurement stakeholder or project party can override the lawful provision the procurement guidelines (Martini, 2013). Additionally, Martini (2013), also stated that conflict of interest mostly occur at project award stage during which decision on the choice of the main contractor is taken. In either case, non-compliance with the procurement guidelines is the major

cause, should enforcement measures be instinct against defaulters the frequency of conflict of interest occurrences would have been curtailed.

Non-compliance with procurement guidelines and procedural directives seems to be an issue of global concern. According to Gelderman et al. (2006), compliance with EU procurement and tendering directives among procurement stakeholders has been a subject of debate ever since 1970s. Among OECD member countries, application of procurement proceedings remained seldom in certain economic sectors (OECD, 2007). In Malaysia, an interview with contractors revealed cases of inappropriate application with procurement rules (Hui et al., 2011). In Ghana, challenges facing the implementation procurement policy known as Act 663 2003 was reported by Ameyaw et al. (2012). In Nigeria, indications of selective implementation and non-compliance with the procurement guidelines is evidenced in most economic sectors of the country (Ademola and Ajibola, 2014, Ojo and Gbadebo, 2014). An interview with both public authorities and procurement stakeholders conducted by Williams-Elegbe (2009), revealed less commitment from both parties for effective compliance with procurement guidelines in Nigeria.

Public procurement Act 2007 is the policy that provides regulations for the conduct of public procurement in Nigeria. The Act also provides public procurement guidelines with the aim of transforming the public procurement sector especially the rampant irregularities in construction project delivery (Shehu, 2014, Williams-Elegbe, 2011). Since the enactment of the Act and subsequent issuance of the procurement guidelines, non-compliance among major stakeholders and construction project parties has been an issue of concern in the construction industry (Abdullahi et al., 2015, Fayomi, 2013, Jibrin et al., 2014). Ademola and Ajibola (2014), also claims that compliance with the procurement guidelines in Nigeria has been extremely lacking. Although the procurement guidelines were inevitably meant to regulate public procurement practices, and prompted for best practices to align with international standard (Ademola and Ajibola, 2014), but ample challenges surrounded its implementation especially in the construction industry (Abdullahi et al., 2015, Jibrin et al., 2014, Hui et al., 2011). From the available literature, it is observed that most of the problems facing the Nigerian construction industry especially conflict of interest is attributed to the non-compliance with public procurement guidelines. The study is aim at developing a conceptual model to be use in mediating the effects of conflict of interest factors affecting construction procurement tendering process.

LITERATURE REVIEW

This section provides review of the related literature on the various constructs as the key elements that formed the proposed conceptual model.

Conflict of interest in construction procurement practices

Conflict of interest arises usually due to disagreements among parties that mighty be persons, groups or individuals in terms of sharing scarce

resources (Rahim, 2001). Conflict of interest occur where a secondary interest unduly influenced primary interest when making professional judgement. Conflict of interest is a well-recognised research measurement variable in the management field, procurement management included (Juma, 2009). This is because maintaining integrity is a core requirement for achieving effective and sound principles of management (Arrowsmith and Wallace, 2000).

In construction project procurements, it is the responsibility of the stakeholders and project parties to execute the construction process in accordance with the procurement guidelines and project specifications. Construction procurement process embraces different stages that are broadly categorised as pre-contract and post-contract stages (Adesanya, 2008). Conflict of interest can occur at any of these stages in as much as self-fish interest of any procurement stakeholder or project party can override the lawful provision the procurement guidelines (Martini, 2013). In particular, construction projects development by the public entity involves spending enormous funds from the public treasury which make the entire process susceptible to conflict of interest. Pre-contract stage especially tendering, bid evaluation and project award stages are often regarded as the most vulnerable to conflict of interest in public procurements (Abdullahi et al., 2015, Shehu, 2014). Additionally, Martini (2013), also stated that conflict of interest mostly occur at project award stage during which decision on the choice of the main contractor is taken.

In the Nigerian construction industry, specifically at the procurement entities of public organisations construction projects are awarded based on favouritism and all sorts of nepotism which ignites conflict of interest occurrence (Shehu, 2014). In some instance, the directors and procurement officers of the procurement entities mostly use their discretionary power to influence project award been the custodian of the tender confidential information just to protect their own interest or that of a favoured bidder (Martini, 2013). Instance where conflict of interest affects construction procurement process especially at the pre-contract stage, there is no assurances that the objectives of the projects will not be compromise. Such projects might not deliver good value for money, and in the long run the project will perform poorly in terms of cost and quality (Arrowsmith, 2010). Procurement guidelines provides strict measures against conflict of interest occurrences and the guidelines has clearly defined all forms of conflict of interest that prohibits project parties and stakeholders to engage themselves into. But refusal to enforce the regulatory measures of the procurement guidelines continues to give room for conflict of interest occurrences in construction project development in Nigeria (Shehu, 2014).

Enforcement of procurement guidelines (the mediator)

Enforcement are the needed actions and measures put in place by regulatory bodies to ensure compliance with specified regulations and or guidelines (Zubcic and Sims, 2011). From the available literature, quite a number of prior studies have identified enforcement as effective tool that improve compliance (Zubcic and Sims, 2011, Gunningham, 2005, Imperato,

2005). Enforcement mechanism in form of application, prosecutions and penalties were found to have great supremacy that improve compliance with the rules (Tukamuhabwa, 2012, Zubcic and Sims, 2011). Developing countries such as Nigeria, Bangladesh, India, Sri Lanka, Venezuela were observed to be affected more by irregularities in public procurement processes especially construction project development due to non-enforcement of the procurement guidelines (Raymond, 2008, Tukamuhabwa, 2012). Similarly, Okeahalam (2004), also stated that among developing countries especially in Africa, Nigeria and Ghana are characterised with weakness in terms of law enforcement.

In order to mitigate the effects of conflict of interest factors and other forms of irregularities in tendering aspect of construction project development, there is need to ensure full compliance with procurement guidelines. While achieving great level if not full compliance with procurement guidelines require a threat of legal sanctions which might be attain to by enforcement actions (Tukamuhabwa, 2012). This is because enforcement action has a strong consciousness signal to firms, individuals, and professional as well as entire stakeholders and construction projects parties concern that violators will be prosecuted. Enforcement as a threat actions naturally implants a culture of abidance, thus it has ever since been considered as fundamental element in any compliance regime (Gunningham, 2005, Sutinen and Kuperan, 1999). This is also posited by Gunningham (2005), who opined that the outcome of sustained enforcement action instilled a culture of compliance and had a direct impact on corporate compliance behaviour. Sutinen and Kuperan (1999) also mentioned that, enforcement measures remain an essential ingredient in any form of compliance.

Aside enforcement tool, another option is the complaint and review mechanism. Unlike enforcement, this gives bidders an opportunity to review and verify whether bidding and tendering processes and the entire procurement process conform to the procurement guidelines (Tukamuhabwa, 2012). In countries with established procurement policies, review mechanism has a tendency of motivating project parties and stakeholders, in-house professionals, bidders and other participants to abide by procedural guidelines (Hui et al., 2011). However, in situations where penalties for violators is set too low or countries where ineffective detection review mechanism is not encouraged, because some bidders especially those with low chances of winning the tender they might resolve to choose ineffective implementation since legal violation may be profitable because of under-enforcement (Tukamuhabwa, 2012).

Procurement offences and penalties as provided by the Nigerian procurement guidelines.

Public procurement Act 2007 (PPA, 2007) has highlighted various offences that can be prosecuted based on the appropriate penalties for those convicted. Section 58 (4) of itemised the followings:

- Entering or attempting to enter into a collusive agreement, whether enforceable or not, with a supplier, contractor or consultant where

the prices quoted in their respective tenders, proposals or quotations are or would be higher than would have been the case has there not been collusion between the persons concerned;

- Conducting or attempting to conduct procurement fraud by means of fraudulent and corrupt acts, unlawful influence, undue interest, favor, agreement, bribery or corruption;
- Directly, indirectly or attempting to influence in any manner the procurement process to obtain an unfair advantage in the award of a procurement contract;
- Splitting of tenders to enable the evasion of monetary thresholds set;
- Bid-rigging (which means agreement between persons whereby: offers submitted have been pre-arranged between them; or their conduct has had the effect of directly or indirectly restricting free and open competition);
- Altering any procurement document with intent to influence the outcome of a tender proceeding (which means; insertion of documents such as bid security or tax clearance certificate which were not submitted during bid opening; wrongful request for clarification);
- Offering or using fake documents or encouraging their use; and
- Willful refusal to allow the Bureau or its officers to have access to any procurement records.

Section 58 (2) and (3) provide that all offences under the Act are to be tried in a Federal High Court in the name of Federal Republic of Nigeria by Attorney General of the federation or his representative.

The proposed conceptual model

The proposed model is based on the concept of mediation and it has two major components i.e. (i) Direct effect model *(figure 1a)* which shows the direct relationship between conflict of interest factors *(independent variable)* and construction procurement tendering process *(dependent variable), "c-path"* denotes the coefficient for the effect of the relationship in the direct effect model. (ii) indirect effect model *(figure 1b)* which shows the effects of conflict of interest factors *(independent variable)* on tendering process of construction procurement *(dependent variable)* through the mediating variable *(enforcement of procurement guidelines)*. For the indirect effects model *"a-path" and "b-path"* denote indirect effects coefficients, *while c'-path* is the coefficient of the direct effects after adding the mediating variable. *Figure 1* below presents the whole model.

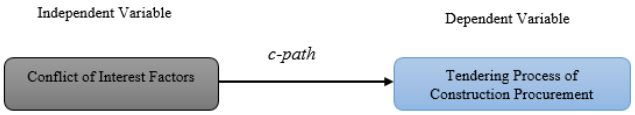


Figure 1a: Direct effects Model

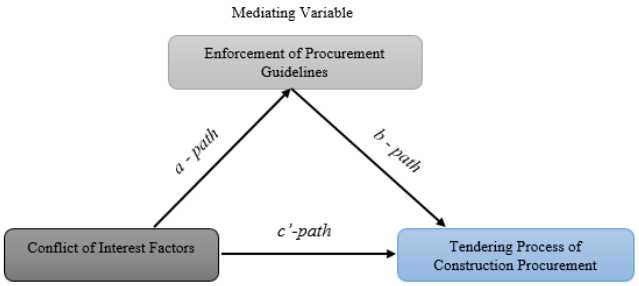


Figure 1b: Indirect effects model

Figure 1: Conceptual Mediation Model of the Study

The study hypothesis

Based on the proposed conceptualised model of the study, the following non-directional hypothesis were developed in order to test the mediation effects in the model.

H1: There is Causal relationship between conflict of interest factors and tendering process of construction procurement

H2: Enforcement of procurement guidelines mediates the effects of conflict of interest factors on tendering process of construction procurement in Nigeria.

RESEARCH DESIGN AND METHODS

This paper is conceptual in nature, it proposes a mediation-based conceptual model to be use in mediating the effects of conflict of interest factors affecting tendering process of construction procurement. According to Mora et al. (2008), conceptual research is a non-empirical research strategy with unique principles and basis seldom used by researchers. Xin et al. (2013), in certain research design, a conceptual paper may include empirical analysis of existing data to recall for new conceptual link. In addition, conceptual research method may be design based on previous concept built on empirical findings, but some of the strategies for collecting qualitative data such as ethnography, interviews and focus group are not applicable in conceptual research methods (Xin et al., 2013). There is no much literature available on conceptual research methodology, although quite a few exist in some research fields other than built environment research cluster (Xin et al., 2013). In construction procurement management field in particular, the importance of conceptual research methods for advancement and development of new research ideas is underestimated as compared to the famous empirical research methods. The current study proposes a model for mediating the effects of conflict of interest in construction procurement tendering processes based on conceptual research approach.

Assessing the mediating effects of enforcement with procurement guidelines in the model

Mediation is a modern statistic that allow researchers to explore and understand how and why relationships and or effects exist between study variables (Hayes, 2012, Wu and Zumbo, 2008). Mediation is said to occur in a given model, when the effects of the relationship between independent construct and outcome variable is mediated by an intermediary variable introduced as a mediator (Hayes et al., 2011). In this study, mediation effects of enforcement mechanism on conflict of interest factors that affect tendering process of construction procurement could be achieve using Process Macro mediation tool written by Hayes (2013). Based on the concept of process macro mediation application, the study proposes the following methods to assess the mediation effects in order to test and validate the developed model with an empirical data:

i. Causal steps mediation methods introduced by Baron and Kenny (1986)

ii. Sobel test mediation approach by (Sobel, 1986, Sobel, 1982).

Causal steps mediation method was established by Baron and Kenny (1986), the method is based on four distinct steps which are conditions for testing effects of a mediating variable in the study model as highlighted below:

i. The effects of the independent variable (Conflict of Interest factors) and the mediating variable (Enforcement of procurement guidelines) should be significant denoted as "*a-path"*

ii. The effects of the mediating variable (Enforcement of procurement guidelines) on the dependent variable (Construction procurement tendering process) should be significant, denoted as *b-path*

iii. The total effects of the independent variable (Conflict of Interest factors) on the dependent variable (Construction procurement tendering process) should be significant denoted as *c-path*

iv. The indirect effects of the independent variable (Conflict of Interest factors) on the dependent variable (Construction procurement tendering process) after introducing the mediating variable (Enforcement of procurement guidelines) should be insignificant or significantly less than the coefficient of the total effects denoted as *path-c'*

Sobel test is one of the prominent statistical approach for testing mediation effects, it is proposed in this study as a confirmatory mediation option to test and confirm the mediation effects obtained via causal steps. This is necessary because of some identified weaknesses associated with causal step method as advocated by Hayes (2009). Sobel test is a normality based approach that will examines the effects of the relationships between independent variable (Conflict of Interest factors) on the dependent variable (Construction procurement tendering process) compared with the effects of the relationships between the former and the later through the mediation variable (Enforcement of procurement guidelines). The conceptual model is

limited only to mediation analysis aspect of the Process Macro application, perhaps future research could focus on testing the moderation effects where applicable.

Discussion on the proposed Model

This study proposes a mediation-based conceptual model, to be use in mediating the effects of conflict of interest factors in tendering aspect of construction procurement practices. The model was developed in accordance with the concept of mediation analysis, it was framed based on an extensive review on conflict of interest factors, tendering and bidding processes, and enforcement of procurement guidelines as the major construct in the model. Thus, the model has three major constructs that jointly formed the direct and the indirect models as highlighted below;

Major constructs of the proposed model

In line with the concept of mediation analysis technique, the proposed model has three major construct which represent the study variables, these are

- Conflict of interest factors (Independent Variable of the Study)
- Tendering Processes of Construction Procurement (Dependent Variable of the Study)
- Enforcement of Procurement Guidelines' Regulations (Mediating Variable).

The total effects of the independent variable (Conflict of interest factors) on the dependent variable (Tendering Processes of Construction Procurement) formed the direct effects model. In accordance with Causal step approach mediation method, the coefficient of determination of the effects of the relationship in the direct effects model (i.e a-path) should be significant. This condition most be satisfied in order to proceed with the analysis on the indirect effects model. Mean, while the coefficient of determination for the indirect effects model should be significantly less the coefficient of determination for the direct effects model in order to confirm whether or not mediation has occurred in the model (Baron and Kenny, 1986). Also, as stated in the research design, Sobel test mediation analysis was recommended to be used in order to re-analyse the model to confirm and validate the mediation results obtain through causal step approach. This is necessary because of some identified weaknesses associated with causal step method as advocated by Hayes (2009). Sobel test is a normality based approach that will examines the effects of the relationships between independent variable on the dependent variable compared with the effects of the relationships between the former and the later through the mediation variables. These are the conditions to be followed in analysing the proposed model with an empirical data in order to validate the model and subsequently recommend the findings for possible implementations.

CONCLUSION AND RECOMMENDATIONS

This paper proposes a mediation-based conceptual model to be use in mediating interest factors affecting tendering process of constriction

procurement through enforcement mechanism as a mediating variable. The proposed model comprises three major constructs which are: the independent variable (conflict of interest factors in construction procurement process); the dependent construct (Tendering process of construction procurement); and the Mediating variable (Enforcement of procurement guidelines). Mediating the effects of conflict of interest factors could sanitise the rampant irregularities occurrence in tendering process of construction procurement especially conflict of interest and will enhance the delivery of construction projects generally. Enforcing the regulatory requirement of the procurement guidelines will ensure construction projects are been carried out in accordance with the regulatory requirements, specification and procedural guidelines and within cost limit and time schedule. This will obviously lessen the occurrence of conflict of interest. Therefore, this study hypothesised that construction industry could give more contribution towards economic development and wealth accumulation if procurement guidelines is duly enforced. The study therefore, recommends for the necessary measure to ensure enforcement measures are put in place for the appropriate compliance with the procurement guidelines in order to lessen the occurrences of conflict of interest in constriction procurement tendering process. When inducing the enforcement measures, the study recommends for strong penalties and constraining actions on any violating project party. It is over nine years now since the issuance of public procurement guidelines in Nigeria following the enactment of PPA 2007, but effective compliance is not yet achieved. It is expected that the proposed model will provide a lasting solution to the procurement guidelines non-compliance issues which usually lead to conflict of interest occurrences. Future research should focus on testing the empirical reliability of the study constructs and validation of the proposed model using raw data.

REFERENCES

Abdullahi, N. Z., Hussin, A. A. & Osmadi, A. 2015. Determinants of Compliance with Public Procurement Guidelines in The Nigerian Construction Industry *Jurnal Teknologi,* 75.

Ademola, E. O. & Ajibola, M. G. 2014. An Assessment of Non-Compliance with Procurement Proceedings in Procurement of Works in Nigeria. *International Journal of Economic and Business Management,* 2**,** 25-34.

Adesanya, O. 2008. Project Procurement Paths. *The Journal of the Federation of Construction Industry,* 23**,** 6-21.

Ameyaw, C., Mensah, S. & Osei-Tutu, E. 2012. Public procurement in Ghana: The implementation challenges to the public procurement law 2003 (Act 663). *International Journal of Construction Supply Chain Management,* 2**,** 55-65.

Arrowsmith, S. 2010. Public procurement: Basic concepts and the coverage of procurement rules. *Public procurement regulation: an introduction***,** 1-32.

Arrowsmith, S. & Wallace, D. 2000. *Regulation Public Procurement-National and International Perspectives*, Kluwer Law International.

Baron, R. M. & Kenny, D. A. 1986. The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology,* 51**,** 1173.

Dahiru, A. 2014. Conflict of Interests in Public Procurement Management in Nigeria. *NIQS National Seminar on Procurement of Construction Works and Services: Adapting to Contemporary Challenges.* Gombe, Nigeria.

Fayomi, I. O. 2013. Public procurement and due process policy in Nigeria: Thrust, prospects and challenges. *Peak Journal of Social Sciences and Humanities,* 1**,** 39-45.

Gelderman, C. J., Ghijsen, P. W. T. & Brugman, M. J. 2006. Public procurement and EU tendering directives-explaining non-compliance. *International Journal of Public Sector Management,* 19**,** 702-714.

Gunningham, N., And Kagan, R. A. 2005. Regulation and business behavior. *Law & Policy,* 27**,** 213-18.

Hayes, A. F. 2009. Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication monographs,* 76**,** 408-420.

Hayes, A. F. 2012. PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling [White paper]. 2012. *URL: http://imaging. mrc-cbu. cam. ac. uk/statswiki/FAQ/SobelTest*.

Hayes, A. F. 2013. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*, Guilford Press.

Hayes, A. F., Preacher, K. J. & Myers, T. A. 2011. Mediation and the estimation of indirect effects in political communication research. *Sourcebook for political communication research: Methods, measures, and analytical techniques,* 23**,** 434-465.

Heggstad, K., Frøystad, M. & Isaksen, J. 2010. The basics of integrity in procurement: A guidebook. *Version,* 3**,** 23.

Hui, S. W., Radiah, O., Normah, H. O., Rashidah, A. R. & Nurul, H. H. 2011. Procurement issues in Malaysia. *International journal of public sector Management,* 24**,** 567-593.

Ibrahim, A. & Musa-Haddary, Y. Concept of value for money in public infrastructure development. International Workshop on PPP Approach for Infrastructure Development in Nigeria, 2010.

Imperato, G. L. (2005). Corporate crime, responsibility, compliance and governance. *Journal of Health Care Compliance,* 7**,** 11-19.

Inuwa, I. I. 2015. *Project Planning in Construction Procurement: The Case of Nigerian Indigenous Contractors.* Jomo Kenyatta University of Agriculture and Technology.

Inuwa, I. I. & Diang'a, S. 2015. Effective Procurement Practices in A Developing Economy for Sustainable Construction. *ATBU Journal of Environmental Technology,* 8**,** 64-78.

Inuwa, I. I., Githae, W. & Diang'a, S. 2014. Construction Procurement Systems: Influencing Factors for Nigerian Indigenous Contractors' Project Planning *International Journal of Engineering Research & Technology* 3**,** 1043 - 1050.

Jibrin, M. S., Ejura, S. B. & Augustine, N. I. 2014. The Public Procurement Reforms in Nigeria: Implementation and Compliance Challenges. *Journal of Asian Business Strategy,* 4**,** 149-162.

Juma, M. 2009. Public Procurement and Disposal Manual (1st Ed.). Nairobi: Public Procurement Oversight Authority. Nairobi: Public Procurement Oversight Authority.

Kamar, K. & Hamid, Z. 2012. Sustainable Construction of Green Building: The case of Malaysia. *Sustainability Today,* 167**,** 15.

Martini, M. 2013. Conflict of Interest in Public Procurement

Mora, M., Gelman, O., Paradice, D. & Cervantes, F. The case for conceptual research in information systems. CONF-IRM 2008 Proceedings, 2008. 52.

Odediran, S. J., Adeyinka, B. F., Opatunji, O. A. & Morakinyo, K. O. 2012. Business Structure of Indigenous Firm in the Nigerian Construction Industry. *International Journal of Business Research and Management, vol3 (5)***,** 255-264.

OECD 2007. Bribery in Public Procurement Methods: Actors & Counter-Measures. Massachusetts USA.

Ojo, E. & Gbadebo, A. 2014. An assessment of non-compliance with procurement proceedings in procurement of works in Nigeria. *International Journal of Economic and Business Management,* 2**,** 25-34.

Okeahalam, C. C. 2004. Corporate governance and disclosure in Africa: Issues and challenges. *Journal of Financial Regulation and compliance,* 12**,** 359-370.

Rahim, M. A. 2001. *Managing conflict in Organisations* Westport, Connecticut, Quorum Books.

Raymond, J. 2008. Benchmarking in public procurement. *Benchmarking: An International Journal,* 15**,** 782-793.

Shehu, A. S. An Overview of Public Procuremnet Guidelines in Nigeria. Institute of Quantity Surveyors National Seminar 'Procurement of Construction Works and Services – Adapting to Contemporary Challenges', 11th -12th June 2014 Gombe International Hotel, Nigeria.

Sobel, M. E. 1982. Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological methodology,* 13**,** 290-312.

SOBEL, M. E. 1986. Some new results on indirect effects and their standard errors in covariance structure models. *Sociological methodology,* 16**,** 159-186.

SUTINEN, J. G. & KUPERAN, K. 1999. A socio-economic theory of regulatory compliance. *international Journal of Social Economics,* 26**,** 174-193.

THAI, K. V. 2001. Public procurement re-examined. *Journal of public procurement,* 1**,** 9.

TUKAMUHABWA, B. R. 2012. Antecedents and Consequences of Public Procurement Non-compliance Behavior. *Journal of Economics & Behavioral Studies,* 4.

WILLIAMS-ELEGBE, S. 2009. A Comparative Analysis of the Nigerian Public Procurement Act Against International Best Practice. *Journal of African Law***,** 1-14.

WILLIAMS-ELEGBE, S. 2011. The Reform and Regulation of Public Procurement in Nigeria. *Pub. Cont. LJ,* 41**,** 339.

WU, A. D. & ZUMBO, B. D. 2008. Understanding and using mediators and moderators. *Social Indicators Research,* 87**,** 367-392.

XIN, S., TRIBE, J. & CHAMBERS, D. 2013. Conceptual research in tourism. *Annals of Tourism Research,* 41**,** 66-88.

ZUBCIC, J. & SIMS, R. 2011. Examining the link between enforcement activity and corporate compliance by Australian companies and the implications for regulators. *International Journal of Law and Management,* 53**,** 299-308.

A CRITICAL EVALUATION OF THE BUILT ENVIRONMENT SUSTAINABILITY TOOL (BEST)

Jeremy Gibberd[1]
[1]*Built Environment Unit, CSIR, Pretoria, South Africa Nigeria.*

There is increasing consensus that the configuration and characteristics of neighbourhoods will be a key factor in achieving more sustainable cities. Environments and facilities within neighbourhood can be used to promote more sustainable living and working patterns. For instance, pleasant walking and cycling paths encourage increased walking and cycling. Similarly, well-located waste sorting and storage provision makes it easier to recycle. It is therefore important to understand this type of 'supportive' environment and facilities within neighbourhoods. As many neighbourhoods already exist, it also important to assess existing situations and envisage how these can be transformed to become more sustainable. This objective is addressed by the Built Environment Sustainability Tool, or BEST. The tool provides a framework for assessing existing neighbourhoods in terms of sustainability. It also can also be used to address assessments of existing situations by identifying, and testing, proposals which could be used to improve local sustainability performance. Once an optimum set of proposals have been identified through this process, local sustainability plans can be developed which sequence, and integrate, interventions to improve sustainability performance in a structured way, over time. This paper reviews the BEST and critically evaluates this as a means of assessing and improving the sustainability performance of neighbourhoods. It includes a critique of the criteria used to measure sustainability performance and the process by which the tool is applied. The paper concludes the tool can play a valuable role in supporting sustainability improvement as it enables a responsive, long term approach to be developed that is based on partnerships and community action, which is lacking in existing approaches. The paper also identifies number of areas within the tool that could be improved and makes a number of recommendations in this regard.

Keywords: Africa, assessment, BEST, Built Environment Sustainability Tool, neighbourhoods, sustainability

INTRODUCTION

There is increasing consensus that neighbourhoods will be a key factor in achieving improved urban sustainability (Choguill, 2008; Gibberd, 2013; Williams, 2007). Neighbourhoods which provide support for sustainable living and working patterns in the form of local access to education, health,

[1] jgibberd@csir.co.za; itshose@gmail.com

Gibberd, J. (2017) A critical evaluation of the Built Environment Sustainability Tool (BEST) *In: Laryea, S. and Ibem, E. (Eds) Procs West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 62-75.

work opportunities, recreation facilities and sustainable products and services provide an important means of achieving improved sustainability performance of urban areas (Williams, 2007).

The Built Environment Sustainability Tool, or BEST, aims to provide a way of measuring the extent to which this 'sustainability support' is in place in neighbourhoods. It also provides a way a means of exploring options for increasing this support in a structured way. This paper will present the tool and apply this to a neighbourhood in Pretoria, South Africa. Findings from the application of the tool will be reviewed and analysed. The tool and its application will be discussed in terms of its value as a methodology for improving the sustainability performance of neighbourhoods. The review indicates that the tool provides an innovative approach to sustainability assessment and contains useful guidance on how improvements can be achieved at a neighbourhood level. However, it also finds that aspects of the tool and its application can be improved and a number of proposals are made. These are presented as recommendations for further research. The research questions addressed by the study are therefore as follows:

- How is neighbourhood sustainability performance in the built environment measured in the BEST?
- What findings are generated through the application of the BEST to the neighbourhood case study area?
- Could the application of BEST to neighbourhoods be a useful means of improving the sustainability of neighbourhoods?

The paper therefore has the following structure. Firstly, a literature review is carried out to introduce neighbourhood sustainability assessment tools. This includes a description of the Built Environment Sustainability Tool and its theoretical basis within the sustainability and built environment fields. This addresses the first research question. Secondly, a case study is described. This details how the BEST tool is applied to assess sustainability in housing within Zambia. The results of this assessment are also presented. This addresses the second research question. Thirdly, the Built Environment Sustainability Tool and its application in the case study are discussed and critically evaluated. This addresses the third research question. Finally, conclusions and recommendations from the study are provided.

NEIGHBOURHOOD SUSTAINABILITY ASSESSMENT TOOLS

Neighborhood sustainability assessment tools, sometimes referred to as district sustainability assessment tools or sustainability community rating tools are tools which measure the performance neighborhoods against a set of sustainability criteria. They aim to ascertain the success of neighborhoods in relation to the achievement of sustainability goals (Sharifi and Murayama, 2013).

There has been an increasing interest in neighborhood assessment tools as a result of the acknowledgement that conventional green building rating tools such as BREEAM and LEED were insufficient to address the sustainability challenges being faced by cities (Sharifi and Murayama, 2015). In addition, neighborhoods are increasingly being seen as foundation for the development of sustainable communities, and therefore a wider focus was required (Sharifi and Murayama, 2013). A number of neighborhood sustainability tools that been developed are presented in table 1.

Table 1: Neighborhood sustainability assessment tools (adapted from Sharifi and Murayama, 2013)

Neighbourhood Sustainability Assessment Tools	Country
LEED-ND	US
ECC	US
BREEAM Communities	UK
CASBEE-UD	Japan
Qatar Sustainability Assessment System (QSAS) Neighborhoods	Qatar
Green Star Communities	Australia
Green Mark for Districts	Singapore
Green Neighborhood Index (GNI)	Malaysia
Neighborhood Sustainability Framework	NZ
HQE2R	EU
Ecocity	EU
SCR	Australia
EcoDistricts Performance and Assessment Toolkit	US
Sustainable Project Appraisal Routine (SPeAR)	UK
Cascadia Scorecard	US

Reviews of these tools indicate that they have a strong emphasis on resources and environment and tend not to address social or economic issues (Sharifi and Murayama, 2013). The process of selecting criteria in the tools and their weighting to produce results is often subjective (Sharifi and Murayama, 2013). Tools are generally developed by experts and it is argued that citizens are not adequately involved (Sharifi and Murayama, 2013). In addition, existing neighbourhood sustainability assessment tools are regarded as rigid and not responsive issues related to specific locations, culture and stakeholders (Sharifi and Murayama, 2015).

As can be seen from the table tools have been developed for developing countries, and in particular for the following areas: Australia, Europe, Japan and the United States (Sharifi and Murayama, 2013). Neighborhoods and societies in developing countries are fundamentally different to those in developing countries and therefore it is likely that existing neighborhood sustainability assessment tools developed in developed countries will not be

applicable. There is therefore a need to develop a tool that responds to a developing country neighborhood context. This goal is addressed by the Built Environment Sustainability Too.

Built Environment Sustainability Tool

The Built Environment Sustainability Tool (BEST) was developed by Jeremy Gibberd as a methodology and tool to support sustainability performance improvement in urban areas and human settlements (Gibberd, 2013). It provides a structured way of assessing sustainability in urban areas and developing strategies and plans for improving this (Gibberd, 2015).

The theoretical basis of the tool can be explained in the following way. To achieve sustainability will require specific technical aspects and systems within the built environments to be in place (ISO, 2011; Ravetz, 2000; Williams, 2007). It will also require that occupants use and manage these technical aspects and systems correctly (Kang et al, 2016; Ravetz, 2000; Williams, 2007). This can be illustrated through an example. Recycling provision in the form of spaces, containers and signage can be provided to support recycling. Concerned, motivated and informed occupants can sort and place waste for recycling in recycling provision to enable it to be recycled easily. Together, this can be used to achieve high levels of recycling. This illustrates the relationship between provision, behaviour, and sustainability performance. It shows that built environments must not only include technical aspects that support sustainability but must ensure these technical aspects enable, and encourage, particular user behaviours.

This approach results in a focus on proximity; technical aspects which support sustainability must be highly integrated into everyday living and working patterns in order to influence them. Everyday living and working patterns can be complex and require access to a wide range of facilities and services. This can be shown through reference to activities undertaken by a family over the period of a day. Firstly, parents need to go work, often in different locations. Secondly, children need to go to crèche, school or higher education. Thirdly, after school, they may need to do sports or other activities. Fourthly, parents need to buy food and other goods before returning home. Fifthly, Parents may also wish to undertake sport and other recreational activities. Sixthly, at home an evening meal needs to be prepared and eaten and homework, household chores and work preparation and further study carried out.

Improving sustainability performance requires that all of these activities are influenced and that more 'sustainable options' are chosen. One of the most effective ways of ensuring this occurs is to design sustainable options which are very easy and pleasant to undertake. A direct way of achieving this is to have sustainable options occur within walking or cycling distance of the home, where they are easy to access (Tight et al, 2011; Gibberd, 2015). This reduces the negative impacts of car travel and commuting and provides more time for activities that directly support sustainability such as recycling and food gardening. It also provides additional time for activities that

indirectly support sustainability such as study and exercise which improve awareness and health. This indicates the pivotal role of neighbourhoods and the facilities housed within them to sustainability performance (Williams, 2007).

SUSTAINABILITY

Within BEST, sustainability performance of neighbourhood populations is defined in terms of their Human Development Index and their Ecological Footprint. This is based on a definition of sustainability developed by the World Wildlife Fund that defines sustainability in human populations as the achievement of quality of life above 0.8 on the Human Development Index (HDI) and environmental impact of an Ecological Footprint (EF) less than 1.8 global hectares per person (World Wild Life Fund 2006).

The Human Development Index is based on:

- A long healthy life, measured by life expectancy at birth
- Knowledge, measured by the adult literacy rate and combined primary, secondary, and tertiary gross enrolment ratio
- A decent standard of living, as measure by the GDP per capital in purchasing power parity (PPP) in terms of US dollars (United Nations Development Programme 2007).

A Human Development Index of 0.8 has been defined by the WWF as a minimum universal quality of life standard that should be aimed at (World Wild Life Fund 2006).

Ecological footprints measure the amount of land and sea required to provide resource for a human population. This is based on measures of consumption and waste in the following areas:

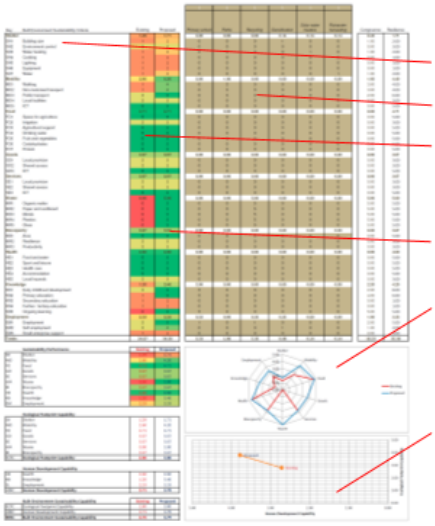
- Food, measured in type and amount of food consumed
- Shelter, measured in size, utilization and energy consumption
- Mobility, measured in type of transport used and distances travelled
- Goods, measured in type and quantity consumed
- Services, measured in type and quantity consumed
- Waste, measured in type and quantity produced

The area required for each of these is added together to provide a total personal foot print in global hectares (gha). This can be compared to the earth's carrying capacity which is estimated to be around 1.8 gha per person (Wackernagel and Yount, 2000).

This definition of sustainability is applied to neighbourhoods in the BEST through the concept of capability. Capability refers to the ability to do something, or the capacity to achieve a particular result. Built environment sustainability capability can therefore be understood as the capacity of the

built environment to support the achievement of Human Development Index and Ecological Footprint targets (Gibberd, 2015).

In the BEST, sustainability capability is measured through sustainability assessment criteria (see figure 1, A). These consist of Health, Knowledge and Employment capability indicators (which measure capability to achieve HDI targets) and Shelter, Mobility, Goods, Services, Waste and Biodiversity indicators (which measure capability to achieve EF targets).



A. Sustainability assessment criteria

B. Options being investigated

C. Existing sustainability performance colour coded for performance (red, poor, green, high)

D. Proposed sustainability performance including proposals(s)

E. Spider diagram of performance with red being existing performance and blue being proposed performance (including proposals). See figure 3 also.

F. Graph showing improved capability for sustainability from existing situation (red dot) to proposed situation (blue dot) after including options. See figure 3 also.

APPLYING THE TOOL

The tool can be used to assess the capability of an existing neighbourhood (existing, figure 1, C) and to propose and test proposals (figure 1, B) that can be used to improve this (proposed, figure 1, D). This is undertaken in the following steps. Firstly, the neighbourhood is demarcated, as shown in figure 2. Secondly, the assessment of the existing neighbourhood is carried out using the BEST and assessed performance entered into the tool. Assessed performance is reflected in report on a scale of 1 to 5, with 5 indicating full capability, as shown in table 1.

Table 1: BEST scales

BEST scale	Sustainable Built environment performance
5	Built environments provides full capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
4 - 5	Built environments provides excellent capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
3 - 4	Built environments provides strong capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
2 - 3	Built environments provides partial capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
1 - 2	Built environments provides limited capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
0	Built environments provides no capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.

Assessments follow protocols outlined in the BEST manual to ensure standardised and objective evaluation. Assessments are carried out by measuring performance within the neighbourhood against scales from 1 to 5 for EF and HDI criteria. For instance, the performance in terms of the HDI Health criteria would include measurement of the neighbourhood in terms of sub criteria such as access to healthy food, exercise facilities and so on. Assessments of sub criteria are then standardised to provide a score from 0 to 5. Thus, where measurements indicated that all of the sub criteria had been met within the neighbourhood, a score of 5 would be indicated. This reflects the fact that full capability for occupants to achieve this component of HDI were in place. Existing and proposed sustainability performance is shown both as a BEST score and in a spider diagram (see figure 1, E and figure 3).

This report provides an indication of areas of high and low capability and can be used to provide a basis to make proposals to improve sustainability capability. Proposals can then be tested by assessing levels of increased capability achieved within the neighbourhood as a result of their incorporation (figure 1, B). This is carried out by reassessing the capability of the neighbourhood with the proposal in place (figure 1, D). A number of proposals, or a mix of proposals, can be entered and evaluated in the tool. This enables proposals to be compared and developed to identify optimal proposals, or mixes of proposals, to achieve improved sustainability capability within the neighbourhood.

CASE STUDY

The neighbourhood selected for evaluation is Groenkloof in Pretoria, South Africa (latitude 25.77525, longitude 28.21744) and is shown in figure 2. The neighbourhood consists of middle to upper income housing (indicated in green) with some commercial office and retail development (indicated in orange). The neighbourhood has 2 parks, a supermarket, a hardware shop, some green grocers and a number of creches. It does not have schools or medical facilities although these are located close by (within 2-3 km of the edge of the neighbourhood).

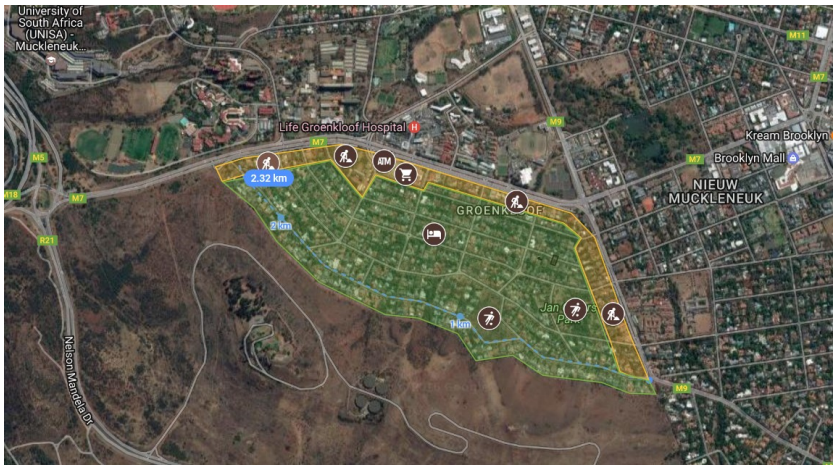


Figure 1: Map of neighbourhood

A BEST assessment report of the neighbourhood is shown in figure 3. This shows the results of an assessment of existing neighbourhood (Existing) and an assessment of the neighbourhood with a number of proposals (Proposed). The assessment indicates that existing neighbourhood has an overall capability of 2.80 and has partial capability to enable occupants to achieve HDI and EF targets and live in a sustainable way

Areas identified by the BEST as having poor or no capability include Shelter (1.29), Waste (0.00) and Knowledge (1.20). Areas with excellent capability include Health (4.71) and Food (4.71). This pattern of strengths and weaknesses can be used to determine, propose, and test, proposals that may improve sustainability performance.

INTERVENTIONS TO IMPROVE LOCAL SUSTAINABILITY CAPABILITY

In response to the initial assessment, the following proposals were developed; a primary school within the neighbourhood, improved pedestrian and cycle routes throughout the neighbourhood, a recycling scheme, support for increased development densities and the promotion of solar water heaters and rainwater harvesting systems. These proposals and their impacts in terms of increased local sustainability capability are described in more detail below.

- **Primary school:** Increased knowledge capability would be provided through a local primary school. This would be located to ensure that children could easily walk or cycle to this from within the neighbourhood. It would also include facilities that were available to the community out of school hours. This could include sports and recreational facilities such as a hall and sports fields. It could also include facilities such as classrooms and a computer centre that could be used for adult education and ongoing learning programmes. This provision would result in increased HDI capability by supporting improved access to facilities which promoted education and health. It would also increase EF capability by enabling key activities to be accessed by walking or cycling rather than by driving.
- **Paths:** Safe pedestrian and cycle paths within the neighbourhood would be developed. These would ensure that all key facilities in the neighbourhood could be easily and safely accessed by occupants of the neighbourhood. This would increase HDI capability as education, health and work activities could be accessed easily and affordably and walking or cycling would promote health. It would also increase EF capability as there would be a reduced requirement for vehicles and public transport.
- **Recycling scheme:** A recycling scheme with neighbourhood recycling depot for stockpiling recycling waste and provision at individual sites is proposed. This provision would be comprehensive and allow for up to 90% of all local waste to be recycled. This

intervention would increase HDI capability by providing employment linked to recycling activities. It would also increase EF capability by avoiding waste.

- **Densification:** Increased density would be promoted in both residential and commercial properties within the neighbourhood. This would include splitting larger residential units into a number of smaller units and increasing building bulk on sites. It would also require businesses to expand development on their sites for their own use or for rental to small enterprises. This intervention would improve HDI capability by increasing the number of local employment and small enterprise opportunities. Increased density could also support increased education and health provision as increased revenue from increased demand could be used to improve services and provision. Increased densities could also be used to increase efficiencies and achieve reductions in space use, energy, water and building materials consumption as well as reduced waste production per person enabling increased EF capability.
- **Solar water heater:** Solar water heaters could be promoted where hot water was required. This would increase EF capability as significant reduction in energy consumption could be achieved.
- **Rain water harvesting:** Rain water harvesting systems could be promoted in all buildings. Harvested water could be used for irrigation, cleaning and to flush toilets leading to significant reductions in water consumption. This intervention would therefore increase EF capability by promoting low impact planting and reductions in water consumption.

The impact of these proposals on measured HDI and EF capability can be identified through a review of the 'existing' scores for the neighbourhood and the 'proposed' scores for the neighbourhood. The proposed scores indicate that the proposals have improved local capability for sustainability from a 2.80 to a 3.80 (strong capability for sustainability). In particular, there is a very strong improvement in capability related to Waste and strong improvements in capability related to Knowledge, Mobility and Employment, as shown in figure 3.

	Sustainability Performance	Existing	Proposed
SH	Shelter	1.29	1.71
MO	Mobility	2.60	4.20
FO	Food	4.71	4.71
GO	Goods	3.67	3.67
SE	Services	3.67	3.67
WA	Waste	0.00	5.00
BI	Biocapacity	3.67	3.67
HE	Health	4.60	4.60
KN	Knowledge	1.20	3.40
EM	Employment	2.33	3.33

	Ecological Footprint Capability		
SH	Shelter	1.29	1.71
MO	Mobility	2.60	4.20
FO	Food	4.71	4.71
GO	Goods	3.67	3.67
SE	Services	3.67	3.67
WA	Waste	0.00	5.00
BI	Biocapacity	3.67	3.67
ECFC	**Ecological Footprint Capability**	**2.80**	**3.80**

	Human Development Capability		
HE	Health	4.60	4.60
KN	Knowledge	1.20	3.40
SL	Employment	2.33	3.33
HDIC	**Human Development Capability**	**2.71**	**3.78**

	Built Environment Sustainability Capability	Existing	Proposed
ECFC	Ecological Footprint Capability	2.80	3.80
HDIC	Human Development Capability	2.71	3.78
BESC	**Built Environment Sustainability Capability**	**2.76**	**3.79**

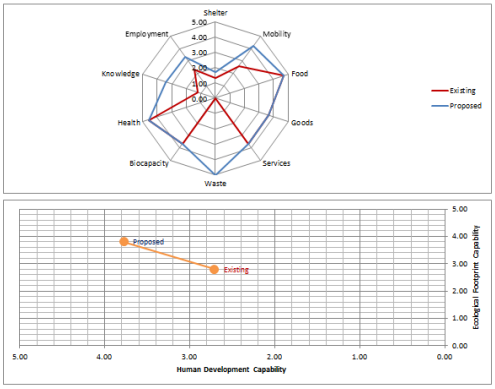


Figure 2: BEST report

DISCUSSION

The discussion is structured around the original research questions. Firstly, there is a discussion of the BEST in terms of its ability to measure sustainability performance. This is then followed by a discussion of findings generated from applying the tool.

- How is neighbourhood sustainability performance in the built environment measured in the BEST?
- What findings are generated through the application of the BEST to the neighbourhood case study area?
- Is the BEST and its application to neighbourhoods a useful means of improving the sustainability of neighbourhoods?

Measuring the potential for sustainability performance

The tool does not actually measure performance, but potential for performance. This is because it measures built environment capabilities **that may, or may not**, be used by occupant populations (Lützkendorf and Lorenz, 2006; Williams, 2007). The fact that the tool measures 'potential' for performance, instead of 'actual' performance could be made more explicit in the tool. This consideration may also be reflected in criteria which relate to measures that may be taken to ensure that this potential is taken up. For instance, education, awareness, incentives and penalties could also be used to encourage occupants to use available capability to achieve HD and EF targets. In addition, a number of other aspects affect whether capability is taken up. This includes aspects such as affordability, environmental access, attractiveness and management.

Affordability refers to whether access to the capability is affordable. For instance, capability to support improve education in the form of a local school may actually not have the desired impact if access to the school is only affordable to a small proportion of occupants. Therefore, local sustainability capability must be affordable.

Environmental access refers to whether the capability can be used by everyone easily. For instance, if a school is not physically accessible to people with disabilities and has learning material and equipment that cannot be used, the capability provided by the school will only have a limited impact. Capability must therefore be designed to be easily used by the full diversity of occupants. This could include ensuring full compliance with environmental access standards and having appropriate assistive technologies in place, as well as appropriately trained teachers and building managers.

Attractiveness refers to whether the capability is appealing to occupants. To use the school example; additional facilities such as a library and computer centre may not be used out of school hours, if this is not attractive to users. Therefore, capability must be designed and managed to appeal to occupants to ensure that this is well used. This may include signage, colours, daylighting, views and helpful staff within the facility.

Management refers to systems in place to ensure that the capability is available and in a condition that can be readily used. An example would include the opening hours and condition of school buildings. Therefore, if the school is only open for school hours and if facilities, such as a computer centre, are often closed for repairs, the potential learning impact of the facilities will not be reduced relative to a school that is managed to ensure facilities are open out of hours and are well maintained. Management is therefore an important aspect of ensuring sustainability capability is used. This may include effective access control systems as well as facilities management and maintenance programmes.

This indicates that in addition to the *type of physical capability* and the *proximity of this capability* to households within a neighbourhood, a range of other factors need to be taken into account. These management and operational factors are likely to have a major impact on sustainability performance as they fundamentally affect whether capability is used. These factors are however difficult to measure. For instance, how is affordability, attractiveness and management measured? Measuring these aspects is likely to require very different criteria and skills to those related to measuring physical aspects of the built environment. It therefore may be difficult to include these as criteria in the BEST.

The generation and testing of interventions

The tool appears to be able to rapidly identify areas where limited local capability may affect the achievement of HDI and EF targets. These areas included Shelter, Waste and Knowledge. It was also able to identify areas where there was strong capability that was able to promote the achievement of HDI and EF targets. These areas included capabilities in relation to Health and Food. This identification is useful as it provides capability gaps that need to be addressed (Gibberd, 2001; Häkkinen and Belloni, 2011; Kang et al, 2016)

Proposals developed to address gaps include a primary school, paths, a recycling scheme, densification, solar water heaters and rainwater harvesting systems. Of these introduced capabilities, the recycling scheme resulted in very significant improvements in capabilities. It was also interesting that this not only improved EF capability by reducing waste but also improved HDI capability through the provision of employment opportunities associated with recycling.

The densification intervention also results in multiple improvements in capability. Increased residential densities meant that there is greater scope (because this could be supported by larger numbers) for improved local facilities which supported health and education, such as health food shops, clinics and sports facilities. Increased commercial densities meant that there was increased scope to develop small businesses and for large existing businesses to expand and employ more people (Howley et al, 2009). However, while this argument may hold for increases in density at this level, it would not hold for increases in density at high densities when this

would impinge on quality of life, or the liveability of an area (Howley et al, 2009; Neuman, 2005).

While the dynamics of urban neighbourhoods are complex, it is useful to be able to understand neighbourhoods in terms of fundamental capabilities that enable, or support, the achievement of sustainability targets by occupant populations (Ravetz, 2000; Sharifi and Murayama, 2015).

The sustainability of neighbourhoods

The review of the BEST indicates that it is an effective way of identifying important sustainability gaps in neighbourhoods. It also provides a rapid and useful way of testing interventions to improve capability that be used to develop practical, responsive local sustainability plans (Sharifi and Murayama, 2015, Säynäjoki et al, 2012, Choguill, 2008, Pinter et al., 2012).

CONCLUSION

The review of the tool and its application to neighbourhood reveals that the BEST appears to be an effective way of identifying important gaps in neighbourhood physical provision for more sustainable living and working patterns. It also provides a methodology that encourages the exploration of proposals that can be used to address these gaps. The approach therefore provides a holistic assessment of physical support, or capability, for sustainability in a way that promotes integrated approaches and multi-impact solutions.

The BEST approach does not measure sustainability performance of a neighbourhood but rather the potential for sustainability performance. It does this through measurement of the existence of physical aspects and provision within the neighbourhood required to lead sustainable lifestyles. Physical aspects and provision within the neighbourhood are defined through reference to Human Development Index (HDI) and Ecological Footprint (EF) targets that are taken to represent sustainability. However, these physical aspects and provision can only support the achievement of sustainability if they are *used*. Therefore, while the BEST may be an effective tool for assessing and planning neighbourhoods, it is important that aspects related to affordability, environmental access, attractiveness and management of physical aspects and provision are also addressed in order to achieve EF and HDI sustainability targets.

ACKNOWLEDGEMENTS

This work is based on the research supported in part by the National Research Foundation of South Africa (Grant Numbers 103996).

REFERENCES

Choguill, C.L. (2008). Developing sustainable neighbourhoods. *Habitat International*, *32*(1): 41-48.

Gibberd J. (2001). *Building Sustainability: How Buildings can support Sustainability in Developing Countries*. Continental Shift 2001 - IFI International Conference, 11 – 14 September 2001, Johannesburg.

Gibberd, J. (2013). Neighbourhood Facilities for Sustainability, *WIT Transactions on Ecology and The Environment, Vol 179,* WIT Press, ISSN 1743-3541

Gibberd, J. (2015). Measuring capability for sustainability: the built environment sustainability tool (BEST). *Building Research & Information*, *43*(1): 49-61.

Haapio, A. (2012). Towards sustainable urban communities. *Environmental Impact Assessment Review*, *32*(1), 165-169.

Häkkinen, T., Belloni, K. (2011). Barriers and drivers for sustainable building. *Build. Res. Inf.*39 (3): 239–255.

Howley, P., Scott, M. and Redmond, D. (2009). Sustainability versus liveability: an investigation of neighbourhood satisfaction. *Journal of environmental planning and management*, *52*(6): 847-864.

ISO, (2011). ISO 21929-1 Sustainability in building construction – Sustainability indicators – Part 1: Framework for the Development of Indicators and a Core Set of Indicators for Buildings. first ed: 11–-15.

Kang, H., Lee, Y. and Kim, S. (2016). Sustainable building assessment tool for project decision makers and its development process. *Environmental Impact Assessment Review*, *58*: 34-47.

Lützkendorf, T. and Lorenz, D.P. (2006). Using an integrated performance approach in building assessment tools. *Building Research & Information*, *34*(4): 334-356.

Mulliner, E., Smallbone, K. and Maliene, V. (2013). An assessment of sustainable housing affordability using a multiple criteria decision making method. *Omega*, *41*(2): 270-279.

Pinter, L., Hardi, P., Martinuzzi, A., & Hall, J. (2012). Bellagio STAMP: Principles for sustainability assessment and measurement. *Ecological Indicators,* 17: 20–28.

Neuman, M. (2005). The compact city fallacy. *Journal of planning education and research*, 25: 11–26.

Ravetz, J. (2000). Integrated assessment for sustainability appraisal in cities and regions. *Environmental impact assessment review*, *20*(1): 31-64.

Säynäjoki, E., Kyrö, R., Heinonen, J. and Junnila, S. (2012). An assessment of the applicability of three international neighbourhood sustainability rating systems to diverse local conditions, with a focus on Nordic case areas. *International Journal of Sustainable Building Technology and Urban Development*, *3*(2): 96-104.

Sharifi, A., & Murayama, A. (2013). A critical review of seven selected neighborhood sustainability assessment tools. *Environmental Impact Assessment Review*, *38*: 73-87.

Sharifi, A., & Murayama, A. (2015). Viability of using global standards for neighbourhood sustainability assessment: insights from a comparative case study. *Journal of Environmental Planning and Management*, *58*(1): 1-23.

Sharifi, A. and Murayama, A. (2015). Viability of using global standards for neighbourhood sustainability assessment: insights from a comparative case study. *Journal of Environmental Planning and Management*, *58*(1): 1-23.

Tanguay, G.A., Rajaonson, J., Lefebvre, J., Lanoie, P., Canada, B., Chabot, R., Thornton,G. (2009). *Measuring the Sustainability of Cities: A Survey-Based Analysis of the Use of Local Indicators*.

Tight, M., Timms, P., Banister, D., Bowmaker, J., Copas, J., Day, A., Drinkwater, D., Givoni, M., Gühnemann, A., Lawler, M. and Macmillen, J. (2011). Visions for a walking and cycling focussed urban transport system. *Journal of Transport Geography*, *19*(6): 1580-1589.

Ugwu, O.O. and Haupt, T.C. (2007). Key performance indicators and assessment methods for infrastructure sustainability—a South African construction industry perspective. *Building and Environment*, *42*(2): 665-680.

USGBC, (2013). LEED Reference Guide for Home Design and Construction, Retrieved from http://www.usgbc.org/sites/all/assets/section/files/v4-guide-excerpts/Excerpt_v4_HOMES.pdf

United Nations Development Programme, (2007). Human Development Report 2007/2008. United Nations Development Programme, New York.

Wackernagel, M. and Yount, D. (2000). Footprints for Sustainability: the Next Steps. Environment, Development and Sustainability 2, Kluwer Academic Publishers: 21-42.

Williams, A. (2007). Framework of Sustainable Behaviours that can be Enabled through the Design of Neighbourhood-Scale Developments, *Sustainable Development, Sust. Dev.* 15: 160–173.

World Wildlife Fund. (2006). *Living Planet Report 2006*. Retrieved from assets.panda.org/downloads/living_planet_report.pdf

A CRITICAL EVALUATION OF THE SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT)

Jeremy Gibberd[1]
[1]*Built Environment Unit, CSIR, Pretoria, South Africa*

Very rapid urban growth rates have meant that now 40 % of the Africa's population live in cities. A large proportion of this growth has been in informal settlements which accommodate over 60% of the urban population Sub Saharan African cities. Continued growth and climate change has meant that it is becoming increasingly important to address these informal settlements and develop improved housing. The Sustainable Building Assessment Tool (SBAT) for housing has been developed for this context. The tool has a focus on developing countries and provides a way of assessing sustainability performance. The paper reviews the SBAT to understand the theoretical basis for the approach. An application of the tool in a housing case study is also evaluated to determine the value of the tool as a means of measuring the sustainability performance of buildings. The review finds that the SBAT provides useful sustainability guidance for built environment projects is more responsive to developing country issues than conventional green building rating tools such as BREEAM and LEED. It also finds that it may possible to strengthen the tool and makes a number of recommendations in this respect.

Keywords: Africa, assessment, SBAT, Sustainable Building Assessment Tool, sustainability housing

INTRODUCTION

In 1960 Africa was the least urbanised continent, with an urban population of less than 20% (United Nations Environment Programme, 1999). Urban growth rates of 4.87% led to rapid change and by 2010 over 40 % of the population lived in cities (United Nations Centre for Human Settlement, 2002). Much of this growth has been in the form of informal settlements and in 2012 the UN estimated that 62% of people living in Sub Saharan African cities were living in slums (UN-Habitat, 2014). There is an urgent need to address backlogs resulting from this growth by improving housing and developing more sustainable urban environments.

This context is addressed by the Sustainable Building Assessment Tool (SBAT) which has a focus on developing countries. The SBAT aims to

[1] jgibberd@csir.co.za; itshose@gmail.com

Gibberd, J. (2017) A critical evaluation of the sustainable building assessment tool (SBAT) *In: Laryea, S. and Ibem, E. (Eds) Procs West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 76-89.

measure sustainability performance and not just environmental impacts of buildings. It therefore includes social and economic sustainability indicators as well as environmental sustainability indicators. The tool has a markedly different approach to conventional green building tools and rating systems such as BREEAM and LEED (USGBC, 2013; Gibberd, 2003).

This paper includes a review of the theoretical underpinning of the SBAT to understand the rationale for the approach. In addition, the value of the tool is evaluated through a case study where the SBAT is applied. The review finds that the tool provides useful sustainability guidance for built environment projects. It, however, identifies a number of weaknesses and makes recommendations for further development of the tool. The paper is structured around the following research questions:

- How is sustainability interpreted in the Sustainable Building Assessment Tool (SBAT)?
- How is sustainability performance in the built environment measured in the SBAT?
- What findings are generated through the application of the SBAT?
- Are SBAT findings useful for assessing the sustainability performance of built environments and supporting improved performance?
- Are there shortcomings in the SBAT and its application? How can these be addressed?

The paper therefore is structured as follows. Firstly, a literature review is carried out to introduce sustainability and the theoretical basis of the Sustainable Building Assessment Tool (SBAT). This addresses the first and second research questions. Secondly, the application of the SBAT to case study is described. This addresses the third research question. Thirdly, a critical review of the SBAT, in terms of its objectives, theoretical basis, practical application and results, is carried out and the findings discussed. This addresses the fourth and fifth research questions. Finally, conclusions and recommendations from the study are drawn.

SUSTAINABILITY

Sustainability is contested issue and there are many different definitions (Ravetz, 2000). These are often vague and are difficult to translate into practical actions that can be implemented in built environments (Curwell & Cooper, 1998). In order to be applicable to built environments, definitions must capture the essential characteristics of human and environmental systems (Curwell & Cooper, 1998). Definitions must also understand, and reflect, the complexity of the 'human system' being evaluated by reflecting the performance of both the technical systems, such as an electrical system in a building, as well as behavioural aspects, such as the way occupants use the electrical system (Williams, 2007).

The complexity of the relationship between environmental and human systems is captured in a definition of sustainability developed by the World Wildlife Fund which relates human activity and technological systems to both quality of life and to environmental limitations (World Wildlife Fund, 2006). Sustainability is defined as the ability of human populations to achieve a Human Development Index (HDI) of 0.8 while simultaneously realising an ecological footprint (EF) of less than 1.8 global hectares (gha) per person (World Wildlife Fund, 2006). To understand this definition better, it is useful to review the Human Development Index and Ecological Footprints.

Human Development Index

The Human Development Index (HDI) of a population is is based on the following indicators:

- A long healthy life, measured by life expectancy at birth
- Knowledge, measured by the adult literacy rate and combined primary, secondary, and tertiary gross enrolment ratio
- A decent standard of living, as measured by the GDP per capita in purchasing power parity (PPP) in terms of US dollars

Each of these indicators has minimum and maximum values (goalposts) as indicated below:

Dimensional indicator	Maximum value	Minimum value
Life expectancy at birth	85	25
Adult literacy rate (%)	100	0
Combined gross enrollment ratio (%)	100	0
GDP per capita (PPP US$)	40,000	100

The Human Development Index is the average of three-dimensional indexes, as captured in the equation below (United Nations Development Programme, 2007):

HDI = 1/3 (life expectancy index) + 1/3 (education index) + 1/3 (GDP index)

A Human Development Index of 0.8 has been defined as a target for human development. This is regarded as a minimum universal quality of life standard that must be achieved (World Wildlife Fund, 2006).

The implications for built environments of the HDI target are that built environments must have the characteristics, and be configured, to enable occupant populations to achieve this target. Another way of stating this would be to say that built environments must have the capability to enable occupant populations to achieve the HDI targets.

Ecological Footprint

An Ecological Footprint is compiled by calculating the biologically productive land and sea required to provide the resources a human population consumes and absorb the corresponding waste. The following consumption and wastes and emission production rates are used:

- Food, measured in type and amount of food consumed
- Shelter, measured in size, utilisation and energy consumption
- Mobility, measured in type of transport used and distances travelled
- Goods, measured in type and quantity consumed
- Services, measured in type and quantity consumed

The area of biologically productive land and sea required for consumption and waste patterns are calculated in global hectares (gha) (Wackernagel & Yount, 2000) This measure is then compared to the earth's carrying capacity which is estimated to be about 1.8 global hectares (gha) per person (World Wildlife Fund, 2006). This provides a sustainability target of 1.8gha per person.

The implications for built environments are that they must have characteristics, and be configured, to enable this to be achieved. Again, this can be described as a requirement for built environments to have the capability to enable occupants to follow living and working patterns that achieve the EF target.

The WWF sustainability definition has specific implications for strategies designed to achieve sustainability. For instance, developing countries may have an ecological footprint that is within target (under 1.8gha) while their Human Development Index is not, as it is below 0.8. In this case, sustainability strategies should focus on achieving the HDI target while maintaining EF performance. In the case of developed countries, countries may have an ecological footprint that is over the target (over 1.8gha), while they may have achieved the HDI targets (over 0.8). Their focus, therefore, should be on reducing their EF to achieve the target, while maintaining HDI performance. This confirms that priorities in developing and developed countries are dissimilar and that different strategies will be required (Holden and Linnerud, 2007). It also suggests that sustainability can be understood in terms of the capability of communities and their environments to improve local quality of life while remaining within environmental carrying capacities (Gibberd, 2015).

THE SUSTAINABLE BUILDING ASSESSMENT TOOL

Environmental, economic and social built environment objectives and criteria within the SBAT have been derived to support the achievement of the HDI and EF targets defined in the WWF sustainability definition. Criteria measure the extent to which characteristics and configurations required to achieve HDI and EF targets are in place in built environments. The extent to which these characteristics and configuration are in place is also referred to as built environment capability for sustainability.

Thus, for instance, space and equipment for recycling in built environments (capability for recycling) are required to enable and encourage occupant populations to recycle their waste and therefore ensure that the waste aspects of the ecological footprint are in line with the required target. The

recycling capability is required in order to achieve the EF target. The structure and criteria of the SBAT can therefore be understood in terms of environmental, economic and social performance. Performance in each of these is captured in terms of a particular area, objective and sets of indicators. This relationship between sustainability areas, built environment objectives and indicators can be charted as a table and is shown in table 1.

Table 1: Sustainable Building Assessment Tool Areas, Objectives and Indicators

Category	Area	Objective	Indicator
Environmental	Energy	Built environment is energy efficient and uses renewable energy	EN1 Orientation, EN2 Building Depth, EN3 Roof Construction, EN4 Wall Construction, EN5 Floor Construction, EN6 Window to Wall Ratio, EN7 Ventilation openings, EN8 Daylight, EN9 Internal Lighting, EN10 External Lighting, EN11 Installed Equipment Power Density, EN12 Food Cooking, EN13 Water Heating, EN14 Renewable Energy Generation
	Water	Built environment minimises the consumption of mains potable water	WA1 Toilets, WA2 Wash Hand Basins, WA4 Showers, WA5 Hot Water, WA6 Landscape, WA7 Rainwater harvesting
	Waste	The building minimises emissions and waste directed to landfill.	WE1 Recycling Area, WE2 Recycling Collection, WE3 Organic Waste, WE4 Sewage, WE5 Construction Waste
	Materials	Construction impacts of building materials are minimised.	MA1 Building Reuse, MA2 Timber Doors and Windows, MA3 Timber Structure, MA4 Refrigerants, MA5 Volatile Organic Compounds, MA6 Formaldehyde, MA7 Locally Sourced Materials
	Biodiversity	Built environment supports biodiversity	BI1 Brownfield Site, B14 Municipal Boundary, BI3 Vegetation B14 Ecosystems
Economic	Transport	The building supports energy efficient transportation.	TR1 Pedestrian Routes, TR3 Cycling, TR3 Public Transport
	Resources	The building makes efficient use of resources.	RE1 Site Density, RE2 Area per occupant RE3 Renewable Energy Generation, RE4 Food Production
	Management	The building is managed to support sustainability.	MN1 Manual, MN2 Energy Metering, MN3 Water Metering, MN4 Recording, MN5 Residents Association
	Local Economy	The building supports the local economy.	LE1 Locally Sourced Materials and Products, LE2 Small Enterprise, LE3 Construction Workers Support
	Services and Products	The building supports use sustainable products and services	SP1 Fruit and Vegetables, SP2 Bakery Products, SP3 Beans and pulses, SP4 Milk and Eggs, SP5 Clothing, SP6 Furniture, SP7 Equipment Hire, SP8 Notice Board
	Access	The building supports access to facilities.	AC1 Internet Access, AC2 Banking, AC3 Groceries, AC4 Post Office, AC5 Creche, AC6 Primary Schools
Social	Health	Built environment supports a healthy and productive environment	HE1 Exercise, HE2 Health facility, HE3 Fruit and Vegetables, HE4 Bean and Pulses, HE5 Milk and Eggs, HE6 Water, HE7 External Views, HE8 Daylight, HE9 Openings, HE10 Roof Construction, HE11 Wall Construction, HE12 Volatile Organic Compounds, HE13 Formaldehyde, HE15 Construction Worker Health
	Education	The building supports education.	ED1 Primary Schools, ED2 Secondary Schools, ED3 Ongoing education, ED4 Internet, ED5 Noticeboards, ED6 Space for Learning, ED7 Building User Manual, ED8 Construction Worker Education
	Inclusion	The building is inclusive of diversity in the population.	IN1 Public Transport, IN2 Groceries, IN3 External Routes, IN4 Entrances and Exits, IN5 Lobby, IN6 Window, door and lighting controls, IN7 Doors, IN Bathroom, IN9 Kitchen, IN10 Inclusive Employment, IN11 Affordability
	Social Cohesion	The building supports social cohesion.	SC1 Occupants, SC2 Community space, SC3 External Facilities, SC4 Residents Association

Actual performance is measured by assessing existing or proposed housing using the indicators listed. Performance in terms of the indicators is calculated in the tool to provide a value from 0 to 5, with 5 indicating that all aspects are in place within housing for occupants to achieve HDI and EF targets and that therefore full performance has been achieved. The scales used in the SBAT rating are shown in table 2.

Table 2: Sustainable Building Assessment Tool Scales

SBAT Scale	Sustainable Built environment performance
5	Built environments provide full capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
4 - 5	Built environments provide excellent capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
3 - 4	Built environments provide strong capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
2 - 3	Built environments provide partial capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
1 - 2	Built environments provide limited capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.
0	Built environments provide no capability to enable occupants to achieve HDI and EF targets and live in a sustainable way.

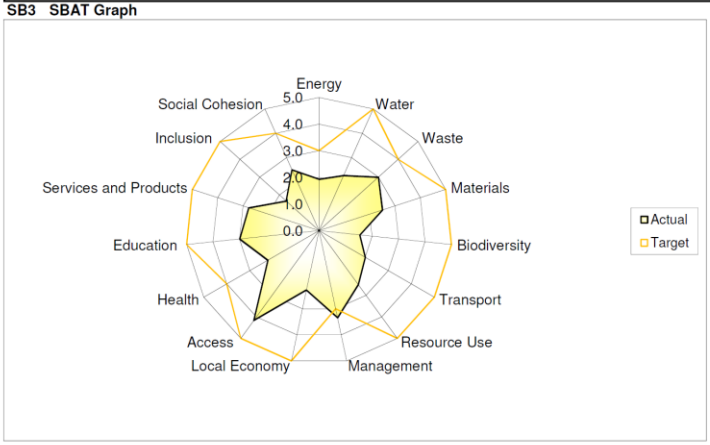
The SBAT consists of a manual which describes the tool, the criteria, and how to apply to the tool to develop ratings (the manual). It also consists of a locked preformatted Excel spreadsheet (the tool). The tool generates reports, graphs and a rating based on data entered into the tool. Training and the manual ensure that assessments are objective and standardised. The tool generates reports provide an overall picture of the performance of the building in the form a spider diagram shown in figure 1. A sustainability performance rating is also provided at the top of the report, under 'achieved'. Performance in the different areas (environmental, economic and social) is provided and can also be seen in figure 1. Performance against targets is also provided and indicated in terms of percentage of target achieved. Finally, details of the Assessor and an External Validator, who validates the Assessor's measurements is also provided.

The SBAT was conceptualized by Jeremy Gibberd and versions for a range of different building types have been developed and applied in different contexts (Gibberd, 2001; Gibberd 2003). The version described in this paper is the SBAT Residential 1.04 tool and has been specifically developed for housing and associated neighborhoods.

SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL
1.04

SB SBAT REPORT	Achieved 2.5
SB1 Project	
	0
SB2 Address	
	0

SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	2.2
Economic	2.9
Social	2.4
SBAT Rating	2.5

SB5 EF and HDI Factors	Score
EF Factor	2.3
HDI Factor	2.3

SB6 Targets	Percentage
Environmental	57
Economic	65
Social	57

SB7 Self Assessment: Information supplied and and confirmed by

Name	Date
Signature	

SB8 Validation: Documentation validated by

Name	Date
Signature	

SB9 Validation Report Version	
	IVR

Figure 3: SBAT report (generated by the SBAT)

APPLICATION OF THE SBAT

The SBAT was applied to evaluate a low-cost pilot housing near Lusaka, Zambia. Housing has been designed by a developer to investigate options before replicating this within a large-scale project. The developer wished to ensure that housing was as sustainable as possible within tight financial constraints. Ideally, the SBAT would have been used to set sustainability targets and inform design and specification decisions during the initial phases of the project. However, in this case, the SBAT was only used to evaluate the house once it had been completed (but not occupied).

SBAT methodology

The housing assessment was carried out using the SBAT Residential tool. Assessments were carried out in January to February 2016 through an analysis of construction drawings, interviews with the Architect, Quantity Surveyor and Developer and a visit to the building and the surrounding

area. Data from these sources were used to complete the SBAT and generate SBAT reports and scores. Assessments followed guidance and protocols for the SBAT ensure that the processes were standardised and as objective as possible.

SBAT assessment

Findings using the SBAT indicate that the house has a sustainability capability of 2.1. This means the house provides partial capability for sustainability. The assessment can be summarised in terms of the three performances areas: environmental, economic and social sustainability.

Environmental performance

The house performed poorly in terms of environmental criteria. While the basic building form and envelope openings met energy criteria, other aspects such as building envelope colour, thermal conductivity and energy consuming equipment such as electrical cookers and water heating equipment performed poorly and there was no use of renewable energy systems.

It also performed poorly in terms of water and fittings were inefficient and the building had no capability to recycle water, such as a grey-water system, or to capture this on site, such as rainwater harvesting systems. Capability for reducing waste and supporting recycling also did not exist and no provision was made for recycling within the house or within the local area.

Performance in terms of materials used in the house was mixed. A locally-made interlocking concrete block was used for the walls. This reduced embodied energy and increased local content. Other materials however generally consisted of imported prefabricated materials and components, some of which contained hazardous materials such as formaldehyde. The building does not support biodiversity as it is located outside an urban area and in a green field site. It, however, benefits from the inclusion of food gardens that surround the house.

Economic performance

An assessment of the location and routes to the house indicates those while that while many facilities such as schools and shops are close by, access to these is difficult and require walking or cycling along busy roads and uneven, narrow paths. Similarly, public transport is available but is in the form of infrequent buses which stop at road location over 800m from the house.

Both the area per occupant of the house and the density of the development within which it is situated do not meet the SBAT criteria. However, some of the space on the site is put to productive use in the form of food gardens. Capability to manage the building and area to support sustainability is low. There are no meters in the building or guidance, such as manuals, on the building's systems. There is, however, a Residents' Association and the electricity system has a prepaid meter, which provides some control over consumption.

Other than the building envelope materials, local content of materials and equipment is low and products have generally been imported from China or South Africa. This means that construction of the building provides limited opportunities for local businesses and do not create many jobs within the country. Few measures to support local enterprises and employment have been included in the development however informal capability has been generated by occupants who operate vegetable gardens as well as small poultry, hair dressing and retail enterprises with the area.

Housing is located near a market which provides a wide range of locally produced food, furniture and other products. Many of the products available, such as locally grown fruit and vegetables, pulses, milk, bread and eggs, support low ecological footprint diets and therefore meet SBAT criteria in this area.

Social performance

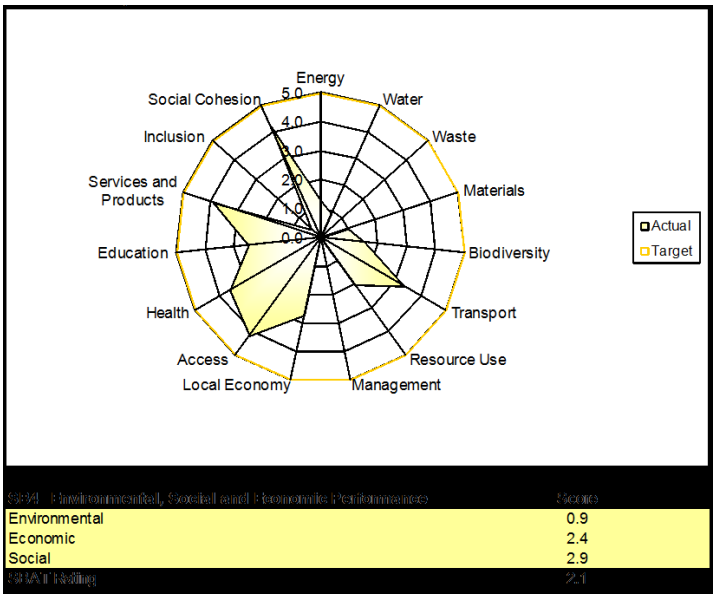
While routes (see Economic Performance) such as roads and paths are of poor quality, the house is well located in terms of access to facilities used on an everyday basis, such as schools, sports grounds, food retail, banking, post office and clinics. Local capability to support health also exists in the form of easy access to fresh healthy affordable food, clean water, clinics and exercise opportunities. The building form and envelope also provide for views, good daylight and ventilation.

Local capability to support education is available in the form of both a primary and a secondary school which are within walking distance (less than 2km) of the house. There is, however, no support for adult or post-school education. Internet access, while available, is expensive. The spatial layout of the house includes provision for studying and homework to be easily carried out.

The building performs poorly in terms of inclusion. It is not located near inclusive public transport and can only be accessed along narrow uneven paths. There are steps into the building and the layout of rooms results in restricted circulation space. Built-in furniture and fittings are difficult to use. Capital and operational costs of the house are also relatively high compared to average incomes making the houses unaffordable for most of the population. No provision has been made to provide more affordable accommodation within the housing area.

There is strong capability for social cohesion with the development. Community halls and sports fields are available a no cost for community activities. A residents' association exists and are involved in managing the area and initiating local events and activities.

This narrative description of the performance is underpinned by a detailed quantitative analysis using the tool which is used to generate the SBAT report, shown in figure 2. This shows that capability was lowest within the environmental area and was better in the economic and social areas.



SBAT : Environmental, Social and Economic Performance	Score
Environmental	0.9
Economic	2.4
Social	2.9
SBAT Rating	2.1

Figure 4: SBAT report on housing performance (generated by the tool)

DISCUSSION

The description of the SBAT and the application of the tool and findings from its use provide a useful basis to evaluate and discuss the tool. This focusses initially on the design of the tool and then moves to its applicability and value as a means of supporting sustainability in the built environment in developing countries.

Theoretical basis

The link HDI and EF sustainability goals and the SBAT appear to be effective and have provided a useful means of defining the purpose and scope of the tool. In comparison, it is sometimes difficult to ascertain the basis used for the inclusion of criteria in other tools (Oswald and McNeil, 2010; Lützkendorf and Lorenz, 2006). LEED Residential, for instance, includes criteria related to Integrative Process, Location and Transport, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation and Regional Priority (USGBC, 2013). The justification for the inclusion of these criteria is not provided but appears to be implicitly aimed at reducing environmental impacts and improving internal conditions.

Criteria

Criteria and findings generated by the SBAT appear suitable to a developing country context and address many issues that relate to everyday local living and working patterns, such as food, schools, clinics, public transport and transport (Gibberd, 2001). In this respect, the tool appears to reflect, and respond to, developing country contexts better than green building rating tools such as LEED (Gibberd, 2003; Gibberd, 2015). LEED Residential criteria, for instance, include 'HVAC startup', 'air filtration', 'space heating and cooling' and 'garage pollution protection' which would not be relevant to most housing in developing countries. It also appears that an

assumption in the tools such as LEED is that access to education and health facilities, availability of affordable local healthy food and local employment opportunities, required for sustainability are in place, are in place and therefore do not need to be measured. This is not the case many developing countries where these issues must be addressed in new developments (Ugwu and Haupt, 2007; Zuo & Zhao, 2014).

Scales

A review of the SBAT indicates that, within sets of criteria (such as Water), individual criteria are weighted differently, reflecting their relative importance. This, however, changes when, at the next scale up, scores for sets of criteria are not weighted but standardised to reflect a value from 0 to 5. This makes it easy to generate graphs and enables the relative strengths and weaknesses of a building to be readily identified. However, this aspect of the tool masks the differing levels of impact that different areas may have. For instance, energy may have a much more significant impact on an Ecological Footprint relative to Waste. In this respect, the differential weighting of categories of criteria, found in tools such as LEED may provide a more accurate reflection of performance (USGBC, 2013).

However, there are also counter arguments. Expressing performance very clearly in a spider diagram enables all project stakeholders to develop a holistic picture of the performance of the project. This enables stakeholder to 'balance' competing demands and identify and prioritise aspects that they consider important **(**Gasparatos, 2010**;** Ugwu and Haupt, 2007; Sharifi and Murayama, 2015; Ravetz, 2000).

Findings and recommendations from applying the tool

Findings from applying the tool are useful because clear guidance on how performance can be improved is provided. For instance, the environmental performance of the building could be improved by including more energy efficient equipment, a renewable energy system, more water-efficient fittings, a grey water and rainwater harvesting system and recycling provision. In future, care should be taken to specify non-hazardous, high local content building materials and components in new housing (Wallbaum et al., 2012).

Economic performance of housing could be enhanced through design changes. This could include a greater emphasis on designing improved cycle and pedestrian routes as well as links to public transport. In addition, site layouts and housing designs should increase development densities, productive use of space and the range of enterprises supported by the development. The inclusion of metering and sub-metering systems for services accompanied by support for improved building management capacity could also be used to enhance the efficient operation of systems.

Social performance of housing could be improved through a redesign of the housing which ensures that this was accessible to people with disabilities. In addition, sustainability and inclusion could be supported by ensuring that affordable housing is included in the development (Mulliner et al, 2013).

The findings and recommendations generated by the assessment are practical and readily implementable. An interesting aspect of the approach is the inclusion in the assessment surrounding area and not a sole focus on the building. This larger scope is useful because it also places an emphasis on improving the overall sustainability performance of the area, which in turn improves the sustainability performance of housing. For instance, making provision for greater productive use of spaces and creating small enterprises not only reduces environmental impacts as transport requirements are reduced as services and products (such as groceries) become available within walking distance of housing, it also supports social and economic sustainability of housing by creating addition employment opportunities and increases the diversity of incomes (Mulliner et al, 2013).

Value articulating institutions

Sustainability assessment tools can be described as 'value articulating institutions'. The tool and criteria indicate the values that must be subscribed to and the assessor, through their reports and recommendations, enforce these values **(**Gasparatos, 2010**).** A review of the SBAT indicates that there is there is an attempt to provide an objective basis for the selection and development of criteria and to link this to global sustainability targets (Gibberd, 2003). The target setting facility in the tool is also an attempt to ensure building users and stakeholders are involved in the setting of targets and that this is not left at the sole discretion of an assessor or design team (Gibberd, 2003; Pinter et al., 2012). In this way, the tool attempts to ensure that the values reflected in the tool relate to global sustainability targets while providing an way that stakeholders can be involved through defining which issues to should be addressed as a priority (Tanguay et al, 2009; Sharifi and Murayama, 2015).

CONCLUSION

A review of the SBAT indicates that it provides a robust way of measuring sustainability performance of built environments in developing countries. Assessment criteria appear to achieve strong relevance to the achievement of wider global sustainability targets while being appropriate to developing country contexts. Findings and associated recommendations generated through application of the tool also provided useful insight into how sustainability performance can be improved in practical and effective ways.

However, while graphical reports generated by the tool are useful for identifying sustainability strengths and weaknesses in the building they do not differentiate between performance in relation to global sustainability targets and local priorities. This aspect of the tool could therefore be investigated further. One way of addressing this would be to develop a weighting system linked to global sustainability targets and local priorities to generate 'global' and 'local' performance, in addition to the standard SBAT rating.

ACKNOWLEDGEMENTS

This work is based on the research supported in part by the National Research Foundation of South Africa (Grant Numbers 103996).

REFERENCES

Curwell, S. and Cooper, I. (1998). The implications of urban sustainability. *Building Research & Information*, *26*(1): 17-28.

Gasparatos, A. (2010). Embedded value systems in sustainability assessment tools and their implications. *Journal of environmental management*, *91*(8): 1613-1622.

Gibberd J. (2001). *Building Sustainability: How Buildings can support Sustainability in Developing Countries*. Continental Shift 2001 - IFI International Conference, 11 – 14 September 2001, Johannesburg.

Gibberd, J. (2003). Building systems to support sustainable development in developing countries. *Facilities Planning and Management, CSIR Building and Construction Technology, Pretoria.*

Holden E, and Linnerud K. (2007). The sustainable development area: satisfying basic needs and safeguarding ecological sustainability. *Sustainable Development* 15: 174–187.

Mulliner, E., Smallbone, K. and Maliene, V. (2013). An assessment of sustainable housing affordability using a multiple criteria decision-making method. *Omega*, *41*(2): 270-279.

Oswald, M.R. and McNeil, S. (2010). Rating sustainability: Transportation investments in urban corridors as a case study. *J. Urban Plan. D.*, 136: 177–185.

Ravetz, J. (2000). Integrated assessment for sustainability appraisal in cities and regions. *Environmental impact assessment review*, *20*(1): 31-64.

Pinter, L., Hardi, P., Martinuzzi, A., & Hall, J. (2012). Bellagio STAMP: Principles for sustainability assessment and measurement. *Ecological Indicators*, 17: 20–28.

Sharifi, A. and Murayama, A. (2015). Viability of using global standards for neighbourhood sustainability assessment: insights from a comparative case study. *Journal of Environmental Planning and Management*, *58*(1): 1-23.

Tanguay, G.A., Rajaonson, J., Lefebvre, J., Lanoie, P., Canada, B., Chabot, R., Thornton,G. (2009). *Measuring the Sustainability of Cities: A Survey-Based Analysis of the Use of Local Indicators*.

Ugwu, O.O. and Haupt, T.C. (2007). Key performance indicators and assessment methods for infrastructure sustainability—a South African construction industry perspective. *Building and Environment*, *42*(2): 665-680.

UN-Habitat, (2014). The State of African Cities 2014, United Nations Human Settlements Programme

United Nations Centre for Human Settlements, (2002). *Urbanisation: Facts and Figures,* UNCHS, Nairobi, Kenya.

United Nations Environment Programme, (1999). *Geo 2000: Global Environmental Outlook 2000*, Earthscan Publications, New York, NY.

USGBC, (2013). LEED Reference Guide for Home Design and Construction. Retrieved from http://www.usgbc.org/sites/all/assets/section/files/v4-guide-excerpts/Excerpt_v4_HOMES.pdf

Wackernagel, M. and Yount, D. (2000). Footprints for Sustainability: The Next Steps. Environment, Development and Sustainability 2, Kluwer Academic Publishers: 21-42.

Wallbaum, H., Ostermeyer, Y., Salzer, C. and Escamilla, E.Z. (2012). Indicator based sustainability assessment tool for affordable housing construction technologies. *Ecological Indicators*, *18*; 353-364.

Williams, A. (2007). Framework of Sustainable Behaviours that can be enabled through the Design of Neighbourhood-Scale Developments, Sustainable Development, *Sust. Dev*. 15: 160–173.

World Wildlife Fund, (2006). *Living Planet Report 2006*. Retrieved from www.panda.org

Zuo, J., & Zhao, Z.-Y. (2014). Green building research–current status and future agenda: A review. Renewable and Sustainable Energy Reviews, 30: 271–281.

A REVIEW OF PUBLIC PROCUREMENT ACT AND ITS IMPLEMENTATION IN ONDO STATE, NIGERIA

Abimbola Omotola[1], Timothy 'Seyi Odeyale[2] and Kayode Fagbemi[3]
[1]*Ondo State Oil Producing Area Development Commission, Akure, Ondo State, Nigeria*
[2]*Department of Architecture, University of Ibadan, Ibadan, Oyo State, Nigeria*
[3]*Department of Architecture, Federal University of Technology, Akure, Ondo State, Nigeria*

In most developing countries across Africa, the adoption of good governance practices has taken considerable long time to take root, even though good governance mechanism promises enhanced rapidity of economic growth and sustainable development. This seems to be the experience of Nigeria and her federating states in the case of the public procurement reform agenda. While the Federal government of Nigeria has tried to adopt a public procurement regime to achieve the goal of good governance, most of the 36 federating states seem uninterested. The study is an expository analysis on the problems of adopting public procurement processes by federating states in Nigeria using Ondo State as case study. This study also traces the evolution of Nigeria's public procurement systems from the pre-existent traditional till the Public Procurement act 2007 and charting the way forward for domestication by the federating units (States). The study used a methodology based on case study analysis, it focuses on the problems of adopting public procurement processes by federating states in Nigeria. It employed both primary and secondary sources of data. The primary data were sourced through informal random opinion survey targeted mostly at the stakeholders, using the opportunity of the Tenders Days in selected Government MDAs. The secondary data were primarily government publications, Treasury Circulars, Daily Newspapers, Public Procurement Act and Manual. Finding from the study revealed that some federating states have out-rightly refused to adopt public procurement regime as a good governance mechanism due to lack of political will, negligence and corruption which are bane towards the full adoption of best practice and sustainable development. It concludes by encouraging a competitive environment for public procurement and ensuring maximal autonomy of the procurement process regulators.

Keywords: built environment, good governance,, public procurement, sustainable development goals, tendering, transparency,

[1] abimbolajoshua.omotola@gmail.com
[2] toodeyale@futa.edu.ng
[3] ayoikudayisi@gmail.com

Omotola, A., Oyedale, T. and Fagbemi, K. (2017) A review of public procurement act and its implementation in Ondo State, Nigeria In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 90-105.

INTRODUCTION

The imperative of prudence, transparency and accountability in government spending, particularly in the procurement of goods and services for development projects cannot be over-emphasized. Obadan and Ayodele (1999) further noted that the country's optimism for rapid and superlative socioeconomic growth and development is predicated on its substantial natural resources endowment, such as major oil and gas deposit, a variety of solid minerals, a developing industrial base, an extensive banking system, a large labour force, a vibrant private sector, favourable growth indices, and a competent civil service. In spite of all these potentials, the poor performance of the Nigerian economy in many sectors is very evident. The real sectors of manufacturing and agriculture are performing rather poorly. The country imports a large proportion of what it consumes. The capacity utilization of industries is around 50% of installed capacity. The country's per Capita Gross National Product which was as high as $1,218.4 in 1980, declined continuously to its lowest level of $240.0 in 1992; standing at around $250 in 1995 and at $270 in 1997. As shown in figure 1, Nigeria's per capital Gross National Product kept growing from 1997 to $3,284 in 2014 and dropped to $2,260.3 in 2016. The GDP is predicted to have a slight growth rate of 0.4% as the country emerge out of recession in 2018 and 2019 (World Bank, 2017)

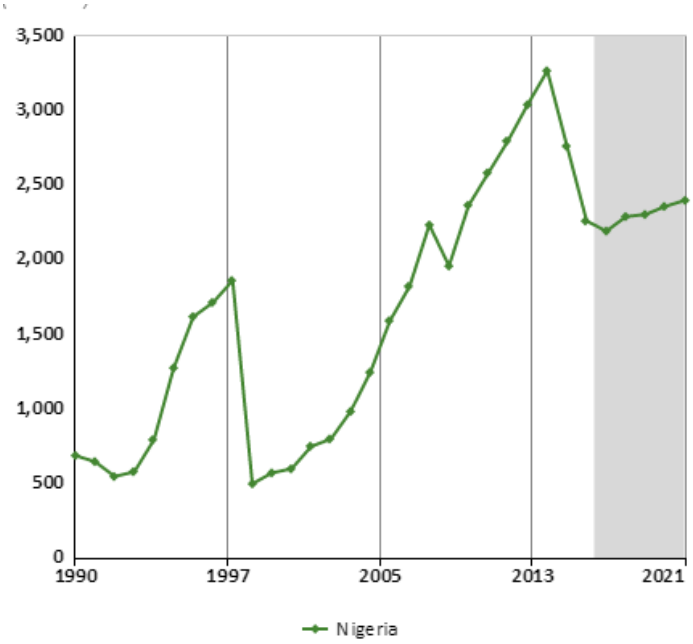


Figure 1: Nigeria's per capital Gross National Product (Source: https://knoema.com/pjeqzh/gdp-per-capita-by-country-statistics-from-imf-1980-2021?country=Nigeria)

In most Developing countries across Africa for instance, the adoption of good governance practices has been slow taking root even when it is obvious that good governance mechanism promises enhanced rapidity of economic growth and sustainable development. This seems to be the experience of Nigeria and her federating states when it comes to the adoption of public

procurement reform agenda. In view of this, this paper traces the evolution of Nigeria's public procurement systems from the pre-existent traditional till the Public Procurement act 2007 and charting the way forward for domestication by the federating units or States. As Ezekwesili (2004) noted, the public procurement law regime is predicated on a veritable good governance mechanism which seeks to streamline, legalise and institutionalize public procurement practices in order to achieve the objectives of transparency, accountability, probity and anti-corruption. While the Federal Government of Nigeria has tried to adopt a public procurement regime to achieve the goal of good governance, most of the 36 federating states seem uninterested (Adewole, 2015). Some federating states have out-rightly refused to adopt public procurement regime as a good governance mechanism. Others who tried to adopt the agenda did it halfheartedly by whittling down the force of the law. A key reason for this is that the status quo benefits the political class. According to Seember (2012), this situation has aggravated the ongoing under development crisis, it has stunted growth and engendered poverty in concerned African nations.

LITERATURE REVIEW

Since independence, Nigeria has experienced a high degree of mismanagement of resources particularly in the area of public procurement. There have been existing open abuses of rules and standards in the award and execution of public contracts in Nigeria. These are evident in over-invoicing, inflation of contract costs, and proliferation of white-elephant projects and diversion of public funds through manipulation of the traditional contract system. The regulatory bodies set up to ensure compliance with laid down rules and regulations on procurement and award of contracts in the public sector appear ineffective, such as the Budget Monitoring and Price Intelligence Unit (BMPIU) popularly called Due Process Unit at the State level and Bureau of Public Procurement (BPP) at the Federal level. This has resulted in a high level of corruption and enormous wastage of public resources, lack of transparency, accountability, fairness and openness in the award and execution of public contracts. The situation makes foreign and even local investors to lose confidence in the Nigerian economy. It must be noted that the prevailing high level of corruption is closely linked to the public sector procurement systems, considering that about ten percent of the entire gross domestic product (GDP) must pass through these procurement systems. Figure 1 and 2 shows the existing procurement process followed in the award of contract and consultancy services in Nigeria. It thus becomes imperative that the public procurement systems must be reformed if Nigeria must achieve sustainable economic growth and physical infrastructural development.

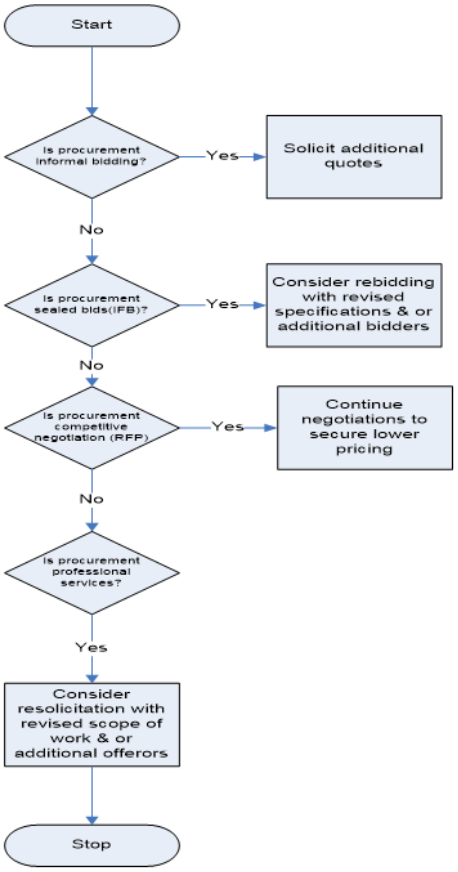


Figure 2: Operational flowchart for the Federal Public Procurement Process for Contractors
Source: Bureau of Public Procurement. 2010

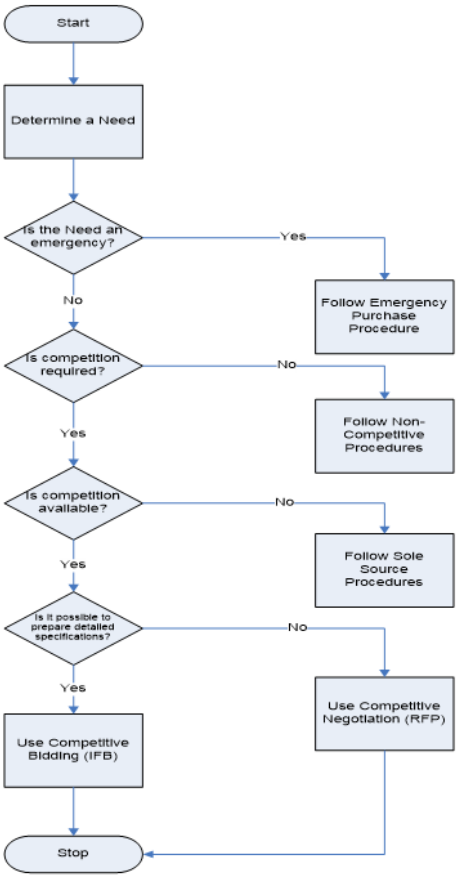


Figure 2: Operational flowchart for the Federal Public Procurement Process for Contractors
Source: Bureau of Public Procurement. 2010

Also, the fuller integration of developing countries, notably poorer ones, into the world economy is one of the top priorities of the OECD countries, in the pursuit of globalization. This is seen as a situation where economies worldwide, irrespective of location, seamlessly mesh in the production, procurement and logistics of goods and services, which of course, presupposes that there must be synchronization of protocols and regulatory processes required for the effective brokering of these goods and services. This is intended to facilitate constructive and positive support for the trade and development of partner countries. According to Woolcock (2001), transparency in government procurement is one of the four "Singapore issues" that Trade Ministers agreed to put on the negotiating agenda at the 4th Session of the WTO Ministerial Conference held at Doha in November 2001. The importance of this subject from a development perspective is self-evident, as the purchase of goods and services by the public sector typically accounts for 10 percent to 15 per cent or more of GDP in developing countries. The Doha Ministerial Declaration recognizes the case for a multilateral agreement on transparency in government procurement, while emphasizing the need for enhanced technical assistance and capacity building in this area. There are critical concerns among experts in the role of governance reform as antidotes to national growth and development, (Kaufmann, 2003; Sebastian, 2006). Along this line, various studies have

been conducted on the types of governance reforms that are available as ways of enhancing sustainable growth and development of Nations and states. Among such studies are, Sabbath (2014) focuses on the challenges facing the retrieval and analysis of Public Procurement Information and government control in some Southern African Countries that include, South Africa, Uganda, Zimbabwe and Tanzania. Adewole (2014) and Awosemusin (2014) on their part looked at the state of procurement activities in the three tiers of government in Nigeria and reported the need for reform starting from the grassroot level. Enyioko and Onwusoro (2014) explored corporate governance reforms in Nigeria and the attendant weak regulatory frameworks. However, there still exists wide knowledge-gap in public procurement processes and governance issues as to why some countries and states in countries may deliberately choose not to adopt good governance practices, despite the inherent benefits to the growth and development of their countries. In Developing countries in Africa for instance, the adoption of good governance practices has taken too long a time to take root. Even within Nigeria where it has been federally adopted, most of the federating units are still foot dragging on this issue. Considering that almost 10 years after it was signed into federal law, and when it is obvious that good governance mechanisms promote speedy growth, sustainable growth and development. This seems to be the experience of Nigeria and her federating states in the case of public procurement reform agenda. The public procurement law regime has proven to be a veritable good governance mechanism which seeks to streamline, legalise and institutionalize public procurement practices in order to achieve the objectives of transparency, accountability, probity and anti-corruption.

While the Federal government of Nigeria has tried to adopt public procurement law regime to achieve the goal of good governance most of the 36 federating states seems not interested. Some federating states have out-rightly refused to adopt public procurement regime as a good governance mechanism. Others who tried to adopt the agenda did it halfheartedly by whittling down the force of the law. A key reason for this is that the status quo benefits the political class. According to Seember (2012), this situation has aggravated the preexistent underdevelopment crisis, stunted growth and engendered poverty in the concerned states. It was in the light of the above that President Olusegun Obasanjo on assumption of office, in 1999, sought for and obtained the World Bank assistance to undertake a study of the existing procurement and financial systems in Nigeria. The outcome of that study was the proposal submitted by the World Bank to Mr. President in 1999 that was tagged the "Country Procurement Assessment Report" (CPAR). That report indicated the need for reform of the procurement law based on the United Nations Commission on International Trade Law (UNCITRAL) which has proven effective in a number of countries in the developing (Lithuania, Estonia and Tanzania) and developed world, (United states, Japan, United Kingdom, France). The findings of the Study (CPAR), which covered institutional as well as organizational structures relating to the existing procurement regime, are:

i. Proliferation and ineffectiveness of Tender Boards.

ii. Lack of professionalism in the execution of the procurement functions iii. Weaknesses in bank financed projects

iii. Excessive deposit for opening of letters of credit.

iv. Lack of communication strategy.

v. Weaknesses in the export, import and tariff procedures.

vi. Lack of streamlined quality control practices.

vii. Lack of knowledge in electronic procurement in the public sector (World Bank, 1999; 2017),

Some of the identified weaknesses also included: the lack of comprehensive public procurement policy, and central body with technical expertise, the absence of clearly defined roles and responsibilities for procurement entities, absence of comprehensive legal regime to safeguard public procurement, the lack of rules and regulations to guide, direct, train and monitor public procurement. The report also identified that there was no independent appeals process to address complaints from tenderers.

The Obasanjo's administration further reformed the public procurement system in Nigeria by the introduction of a new procurement system called "Due Process" Policy in 2001. This reform was a major landmark in contemporary Nigeria, marking a deliberate departure from the previous administrations in the country. The "Due Process Policy" was introduced into the nation's procurement system via Treasury Circular by the Federal Ministry of Finance No, TRY/F15775 of 27th June 2001 (Federal Republic of Nigeria, 2002). It metamorphosed into an Act of parliament called "Public Procurement Act" 2007, and thus including Nigeria in the league of countries with legislation on expenditure and disbursement of public funds. Prior to 2007, Nigeria was among the few African countries without such legislation.

THE PUBLIC PROCUREMENT LAW 2007

The "Due Process Policy" was passed into law, via an act of the National Assembly and assented to by the then President Umaru Musa Yar'Adua. The Act sought to establish the National Council on Public Procurement and Bureau of Public Procurement as the regulatory authorities responsible for the monitoring and oversight of public procurement, harmonizing the existing government policies and practices by regulating, setting standards and developing the legal framework and professional capacity for public procurement in Nigeria; and for related matters. The provisions of the Act shall apply to all procurement of goods, works, and services carried out by:

(a) The Federal Government of Nigeria and all her procurement entities;

(b) all entities outside the foregoing description which derive at least 35% of the funds appropriated or proposed to be appropriated for any type of

procurement described in this Act from the Federation share of Consolidated Revenue Fund.

(c) The provisions of this act shall not apply to the procurement of special goods, works and services involving national defense or national security unless the President's express approval has been first sought and obtained (Public Procurement Act 2007). The act also provided for establishment of Ministerial Tenders Boards for Ministries, and Parastatals Tenders Boards for extra-ministerial agencies and Departments which clearly states that the Permanent Secretary in the case of the Ministry and the Director-General for parastatals, as the Accounting officer of the body, is the Chairperson of the Tenders board, as applicable. The MTBs and PTBs are to be the clearing house for all procurement activities in their respective MDAs.

As expected, the Nigerian Public Procurement Law 2007 took the bull by the horns. The law is radical in its approach to some of the major procurement issues that have inhibited Nigerian growth and development. It is divided into twelve parts. Part 1 of Public Procurement Law (2007) establishes the National Procurement Council (NPC) to provide uniform national regulatory platform for procurement broad policy formulations. Part II of the law establishes the Bureau of Public Procurement (BPP). The Bureau of Public Procurement (BPP) according to the law is to act as supervisory organ and provide operational guidelines to regulate public it procurement practices. Part III of the Public Procurement Law (2007) exemplifies the scope of its application. By this, it is clear that the law is applicable only to Federal Government of Nigeria due to the federal nature of Nigerian nation. Part IV establishes legal format with regard to procurement thresholds. It also makes it a legal imperative for government procurement entities to engage in procurement plans and open competitive bidding.

It also provides clear definition for the status of contractors/suppliers/service provides among other critical issues with the aim of strengthening public procurement practices. While Part V of public procurement law (2007) gives legal basis for the establishment of procurement planning units and sets criteria for pre-qualification of bidders, Part VI deals with procurement methods that are permitted under the law. Part V11 focuses on conditions for special or restricted methods of procurement and Part V111 of the law gives conditions and steps for engaging consultants. Part IX deals with procedures for procurement surveillance and reviews by the Bureau of Public Procurement (BPP), while Part X focuses on methods of disposing public property. Part XI of public procurement law specifies code of conducts to regulate activities of stakeholders (Bureau officials, Tender Board, Contractors, CSO's, Procurement officers etc.) and Part XII deals with offences for various categories of infractions under the law.

A general review of the objective principles and framework by relevant legal researchers and development practitioners indicates that the Public

Procurement Law (2007) provides adequate leverage for countering recurring problems of the lack of regulatory framework. It attempts to solve problems of absence of thresholds and other obvious lapses that have precipitated gargantuan corrupt practices in Nigerian public procurement system (COPE-AFRICA 2010). The law also has been described as a breakthrough in the Nigerian governance reform package. In fact, the law is acclaimed as a desirable governance mechanism to institutionalize transparency, professionalism, due-process, value for money, accountability, cost effectiveness and zero corruption in Nigerian public procurement processes (Obasanjo, 2003; Ogheidi, 2012).

As Igwe et al (2012) noted, there have also been some agitations for the laws to be amended in view of some obvious lacuna and the exigencies of unfolding challenges (Ogege, 2010; Ossai 2014). These agitations are not in any way misplaced. Laws often undergo periodic amendments based on emerging realities which may not be foreseen. Nevertheless, the public procurement law regime in Nigeria has become a watershed in governance reform programs. With the Public Procurement Law 2007, public procurement practices have become institutionalized. Sanity is gradually being restored to procurement practices, while past errors in which public procurements are shrouded in secrecy are beginning to be a thing of the past at the federal level. The procurement practices of most Nigerian federal ministries, departments and agencies (MDAs) have been brought under complete watch of public procurement law regime.

RESEARCH METHODOLOGY

The study employed primary and secondary sources for data collection. The secondary data were primarily sources from government publications, Treasury Circulars, Daily Newspapers, Public Procurement Act and Manual. The primary data were sourced through informal random opinion survey targeted mostly at the stakeholders, using the opportunity of the Tenders Days in selected Government MDAs. The study is an expository analysis on the problems of adopting public procurement processes by federating states in Nigeria as part of desirable good governance reform agenda to fast track national sustainable growth and development with Ondo State (one of the federating Units of the Federal Republic of Nigeria) as a case study. As earlier stated, this study also traces the evolution of Nigeria's public procurement systems from the pre-existent traditional till the Public Procurement act 2007 and charting the way forward for domestication by the federating units or States.

THE ONDO STATE EXPERIENCE

In the case of Nigeria's federating units however, the public procurement act 2007 is substantially yet to take effect. This is because there is critical hurdle of how to deepen public procurement law regime across entire 36 federating states and all the 774 local governments in Nigeria. The Public Procurement Law (2007) is applicable only to federal government. As a

fallout of the federating nature of Nigerian political configurations. Other tiers of government (states and local government) are expected to adopt the law out of their own volition. It is a fact that until all the three tiers of government (federal, states and local) subscribes to public procurement law regime, the obvious gains of public procurement sub-sector as a major governance reform agenda may not make any meaningful impact and help achieve desired development goals. Igwe et al. (2012) has confirmed that the federal share of public expenditure from federal collectable allocation stands at 48%, while the combined expenditure by other tiers (states and local) governments is 52%. The implication of this is that substantial part of public procurement expenditure profile is yet to be institutionalized or captured by public procurement reform agenda. It will be pretty difficult to feel real impacts of public procurement reform in national development context unless every segment of government adopts and practices Public Procurement Law regimes, the original expectation was that all the tiers of government will subscribe to public procurement law regime given the potency of public procurement laws as veritable reform mechanism to fast track sustainable national development.

Oyinlola (2011) notes that while substantial number of states have refused to pass the law, those that passed it have remarkably tinkered with the law in order to achieve objectives other than good governance reform. There is also no single local government in Nigeria that deemed it fit, to key into public procurement law regime in order to enhance proper procurement practices. Various reasons have been advanced for this appalling situation. These include the problems of Nigerian federating system of government which encourage laxity and free choice among the tiers of government to pass law. There are also the issues of lack of political will towards radical national development change; absence of strong or compelling institutions, high-level corrupt tendencies among political class, absence of philosophical and ideological vision and orientation to developing a dream in society, lack of commitments to corruption war in Nigeria and the pervading corrupt practices that has almost become accepted as a norm in the Nigerian socio-cultural values system.

Ondo State came into being in February 1976, via decree by the then Federal Military Government, as an offspring of the then western state. Being virtually bereft of government presence, except for a few schools haphazardly scattered across her communities, a large quantum of development inputs became necessary. During this period, especially till the return to democracy in 1979, the military was at the helm of affairs in the state; and thus, development decisions were made by military fiat. In this period, roads, housing estates and some school projects were awarded, but usually to cronies of the ruling military class. The Ajasin Administration, from 1979 marked the first attempt by Ondo State to set up a State Tenders Board, which oversaw most of the major procurement activities, even though the operations of government were still opaque, shrouded in secrecy by the official secrets act. Subsequent Military administrations maintained this, but a Project Monitoring Unit was set up in the Governor's office.

In 1999, with the return to democracy and a strong clamor for openness, transparency and accountability in carrying out the business of government, the Ondo State Government attempted to strengthen the State Tenders Board system via executive orders and circulars, towards ensuring that due process was followed in both the award and execution of government contracts. It was not until 2003 that a due process office was finally established called "Projects and Price Monitoring Unit" PPMU as an adjunct of the Governor's office with a mandate for ensuring value for money on all government projects (see figure 3). The 2003 Executive Order is what is being followed till date for all government procurement processes. According to Projects and Price Monitoring Unit (PPMU, 2016), the Ondo State Government sought to domesticate the Federal Public Procurement Act 2007 at the State Level by sending a bill to the State House of Assembly for an act of law for the establishment under appropriate legal frameworks the State Board for Public Procurement and a State Bureau of Public Procurement, said bill being essentially a mirror image of the Public Procurement Act 2007 but with some adjustments to align with the peculiarities of the local characteristics. Also, it must be noted that this arrangement is skewed in favor of procurement of works and goods, with very little attention given to procurement of knowledge-based issues such as professional consultancy services, outsourced services, process management and others. For example, project consultants are hired at the whim of the Governors Special Adviser on Infrastructure, who conducts all prequalification exercises for all consultants and issues letter of approval to the MDAs for commissioning of the consultants. This leaves room for over concentration of power in one individual with the propensity for encouraging corruption.

From the Table 1 it is clear that control of the existing procurement process is firmly under the control of the political class who thus manipulate and tweak the system ultimately to their own benefit. This is especially clear in the area of procurement of goods and works where final investment decisions are totally at the behest of the State Tenders Board (Nominees of the Governor) and the State Executive Council (also nominees and Staff of the Governor) as against having in place a validly constituted State Board for Public Procurement. For the procurement of knowledge-based functions such as technical/professional consultancy, all control and final decision-making is vested in the office of the Special Adviser to the Governor on Infrastructure, who ultimately approves hiring of consultants and oversees their work.

Table 1: Existing Ondo State Procurement Process (emphasis on goods and works)

s/no	Description/Activity	Key Operators	Approving Authority
1.	Needs Assessment	Communities, MDAs, SHASS	MDAs
2.	Budgeting & Appropriation	MDAs, SHASS& Gov. Office	SHASS& Gov. Office
3.	Engage Consultants (either through prequalification by OSAI of using in-house professionals for design and billing)	MDAs, OSAI, Gov. Office	OSAI
4.	Send Bill to PPMU to benchmark	MDAs, PPMU, STB	STB
5.	Advertise Projects for Tendering (Except where Governor's Approval has been sought and obtained for selective tendering)	MDAs, STB	STB
6.	Prospective Bidders obtain tender/Prequalification documents as applicable	MDAs	STB
7.	Submission of Tender documents	MDA or STB (depending on threshold)	STB
8.	Tender Opening and Recording	MDAs, STB, Bidders	STB
9.	Tender Analysis, Brief Documentation and Reporting	MDAs, Project Consultant	STB
10.	Brief Consideration and Recommendation for award	STB (MDAs invited to Observe)	STB
11.	Final approval and Award of Contract	State EXCO (MDAs invited to Observe)	EXCO
12.	Vendor Issued Letter of Award and Submits Letter of Acceptance	MDAs	STB
13.	Vendor submits APG in order to receive mobilization funds	MDAs/Min. of Finance	MDAs
14.	Project Monitoring, Evaluation, Reporting and Certification	MDAs, PPMU	MDAs-Interim, PPMU final.

Source, PPMU (2015)



Figure 4: Construction of Model School Building, Igbokoda, Ilaje LGA
Source: Ondo State Government, 2013

The major procurement activities of government include road construction, building, defense, aviation, agriculture, water installation, education, technological equipment, information technology hardware and software (see figure 4). Other activities are health procurements, energy generation, transmission, and distribution procurements in the energy sector. It also includes oil and gas sector procurements and the generalized recurrent expenditure items like stationery and other office consumables.

CONCLUSION

The Due Process Mechanism as a model application of "Best Practice" in procurement system has become a key reform agenda in the management of public finance. It ensures that requisite standards are maintained, while transparency, accountability and the elimination of waste are guaranteed in contrast to the old procurement system that was not integrity-driven. By its introduction, appropriate level of respect for rules, regulations and procedures relating to the management of public funds is being institutionalized within the set legal frameworks. It is noteworthy that numerous benefits and dividends of the policy, which have accrued to Nigeria over the years since its inception in 2001. The feedback from the implementation process has generated diverse mixed reactions among Nigerians. Even in government circles, it has not really turned out as professed by its vision and mission in practice. The system is still fraught with a gaping hole of public distrust. Nevertheless, this should not raise unnecessary alarms as per the beauty of the policy, considering a great deal of dividends it has achieved for Nigeria in developmental and governance processes. It is hoped that the perceived lapses and abuses in the policy and its accompanying systems shall be conquered with time and possible adoption of the recommendations set out hereunder. Also, in the case of Ondo State with partial application of the due process regime via executive orders, a lot more needs to be done in institutionalizing the national public procurement processes, adapted to the peculiarities of the state and with sufficient legal frameworks underpinning it to ensure sustainability and effectiveness of the public procurement process reforms, while significantly reducing the intrigues, power-play and opacity associated with government business, particularly by enactment of laws for domestication of the same by the State house of Assembly. The status quo must not continue as from our analysis, the government, contractors/vendors, the system operators and indeed all development stakeholders the state, especially the people who are the ultimate beneficiaries of the "product" pf the public procurement process, are all short-changed as long as we continue business as usual.

Recommendations

The following are recommendations stemming from this study, which we believe if implemented, would in no small measure catalyse reform of the public procurement processes in Ondo State for optimal efficiency and effectiveness, ensure transparency and openness, free up valuable executive time for the more important work of state-wide policy formulation and

implementation management while ensuring government gets enhanced value for money on every Naira spent on the products of the procurement process:

i. Adoption of public procurement legislation at all levels of governance

The type of federalism practiced in the country limits the application of the Public Procurement Act 2007 to the federal level. However, there are indications that corruption in procurement has extended to the state and local government levels following the findings of National Integrity Systems (2004) that corruption is endemic and pervasive in every stratum of the Nigerian society. This may not be peculiar to Nigeria. Gould and Amaro-Reyes (1983) argued that corruption is pervasive throughout all levels of public bureaucracies and government. Similarly, Bardhan (1997) maintained that corruption pervades different ministries, agencies, and levels of local government. Empirical evidence from Treisman (2002) with data from 166 countries which include Nigeria, concludes that countries with more tiers of government tend to have higher perceived corruption and to provide public. This is in consonance with empirical evidence across countries by Fisman and Gatti (2002) which suggests that fiscal decentralization in government expenditure is strongly and significantly associated with corruption at lower tiers of government, especially when decentralization originates from a country's legal system. There is need to broaden the public procurement legislation to include the states and local governments which control about 48 percent of the country's financial resources. A holistic approach to anti-corruption in public procurement is more likely to yield a significant result. Thus, outright domestication of the Federal Public Procurement act 2007 by timeous establishment via appropriate legal/regulatory frameworks of the State Boards on Procurement and State Bureau of Public Procurement becomes extremely desirable.

ii. Insulation of Procurement Processes and Personnel from Political Influence.

The most important way to improve compliance with the Public Procurement Act, 2007 is *to insulate routine procurement decisions from political interference or at least, reducing it to the barest minimum*. This requires that political leaders muster the necessary political will (currently lacking) to implement the Act in full.

iii. Public Participation and Inclusiveness

Effective reforms to control corruption in public procurement systems must be sustainably participative and inclusive of all essential stakeholders in the society i.e, must be sufficiently open and transparent as to afford ease of public participation, reducing to the minimum, by aforesaid legal/regulatory frameworks, the propensity for political interference in the public procurement process, thus ensuring sustainability of the process and enhancing full completion and delivery of development projects.

iv. Entrenching a competitive environment for all government procurement.

There is some evidence that lack of competition in the public procurement system promotes costly inefficiencies in public performance, and that measures to support competition policy enhance the efficiency of public procurement (Falvey et al., 2007). Competitive sourcing in public procurement is expected to encourage innovation as well as improve efficiency and performance (U.S. Government Accountability Office, 2005). An effective public sector procurement contract system hinges on a desired degree of transparency, integrity, competence, competition, and value for money. Therefore, market conditions have a great influence over the public procurement system's effort to maximize competition, and the market determines whether or not socio-economic objectives of procurement are accomplished. However, due to different levels of economic growth among countries in the world, market conditions impact differently on public procurement in industrialized countries and in developing countries (Thai, 2001).

REFERENCES

Adewole, A. (2015) "Governance Reform and Public Procurement Law Regime in Nigerian Federating States: A Case Study of Oyo State". International Journal of Development and Economic Sustainability Vol.3, No.1, pp.18-29.

Adewole, A. (2014) "Governance Reform and the Challenge of Implementing Public Procurement Law Regime across Nigerian State and Local Governments". International Journal of Public Administration and Management Research (IJPAMR), Vol. 2, No 4, ISSN: 2350-2231 (Online) ISSN: 2346-7215 (Print).

Awosenusi, B. (2014) Summary of action plan for CSOs to assist in partnership into World Bank on deepening public procurement practices, COPE-AFRICA strategic plan 2013- 2018.

Bardhan, P. (1997). "Corruption and Development: A Review of Issues." Journal of Economic Literature, 35 (3): 1320-1346.

Enyioko, N. C and Onwusoro, C. O. (2014) Corporate Governance Reforms in Nigeria: A Study of Shareholders' Right of Entry. Available at SSRN: https://ssrn.com/abstract=2397377

Ezekwesili O (2004). Welcome Speech at the Public Procurement workshop, held at Abuja, Nigeria.

Federal Ministry of Finance (2008). Ref. No. Try/A4&B4/2008, OAGF/CAD/026/Vol.11/439, "Guidelines for Due Process Certification of Contracts and Application for Release of Funds from Central Capital Account to the Capital Accounts of Ministries, Extraministerial Offices and Agencies at the Central Bank of Nigeria, Abuja. Federal Republic of Nigeria (2002). Official Gazette on "Pubic Procurement Act" 2007, Abuja.

Falvey, R., Chimia, A.L., Morrissey, O., & Zgovu, E. (2007). "Competition Policy and Public Procurement in Developing Countries." (Centre for Research in Economic Development and International Trade Research Paper No. 08/07). [Online]. Available at www.nottingham.ac.uk/economics/credit

Fisman, R., & Gatti, R. (2002). "Decentralization and Corruption: Evidence across Countries." Journal of Public Economics, 83 (3): 325-345.

Federal Republic of Nigeria, (2002). Federal Ministry of Finance Treasury Circular No. TRY/F15775 of 27th June 2001. Official Gazette on "Due Process and BMPIU", Abuja

Gould, D. J., & Amaro-Reyes, J. A. (1983). "The Effects of Corruption on Administrative Performance: Illustrations from Developing Countries." (World Bank Staff Working Papers, No. 580). Management and Development Series, No. 7). Washington, DC: World Bank.

Igwe. R, Mboto, W.A. & Ebong. E.E. (2012) Project Abandonment, Corruption and recovery of unspent budgeted public funds in Nigeria, www.revecom.ro/articles/2012-1/2012-1-2pdf

Kaufmann. D. (2003) Growth without governance. Economic: The Journal of Latin America and Cambean Economic Association Vol 3, No 1, 169 -215.

National Integrity Systems (2004). "Integrity Systems: Transparency International Country Study report." [Online]. Available at http://www.transparency.org/policy_research/nis/nis_reports_by_country.

Nwabuzor, A. (2005), "Corruption and development: new initiatives in economic openness and strengthened rule of law", Journal of Business Ethics, Vol. 59 No. 1, pp. 121-38.

Obadan MI (2003). Transparency and Accountability in Fiscal Management and Public procurement. A paper presented to the Forum for Directors of Administration, 23-25 September, NCEMA, Ibadan.

Obadan MI, Ayodele FO (1999). Savings, Investment and Growth Connections in Nigeria: Empirical Evidence and Policy Implications: NCEMA Policy Analysis Series, Vol. No. 2.

Obasanjo, O. (2003) Nigeria. From Pond of Corruption to Island of Integrity, Lecture at the 10th Anniversary of Transparency International (TI), Berlin Germany.

Ogheidi, M. M (2012) Political Leadership and Corruption in Nigeria Since 1960: A Social Economic Analysis, Journal of Nigeria studies. Vol 1, No 2 Fall 1-25.

Ossai. O. (2014) A Review of Nigerian Procurement Process, www.saharereporters.com/2014/03/21/call-review-nigeria.procurement-tonyossai.accessed 10/12/2016.

Oyinlola. O.A. (2011) Corruption Eradication in Nigeria: An Appraisal, Library Philosophy andPracticeISSN 1522-0222. http//www.unlib.uni.edu. /11p assessed 18th December 2014.

PPA 2007, Public Procurement Act 2007, Federal Government of Nigeria.

PPMU 2015, Project and Price Monitoring Unit, Governor's Office, Ondo State of Nigeria

Sebastian D.A. (2006) Good governance, institutions and economic development: beyond the conventional wisdom. Forum Paper, Department of Political Science, University of Bacalonia, 3rd of May.

Seember. N (2012) Manual on Public Procurement law 2007, Abuja Public and Private Development Centre. www.ppdc.com

Thai, K. V. (2001). "Public Procurement Re-examined." Journal of Public Procurement, 1 (1): 9-50.

Treisman, D. (2002). "Decentralization and the Quality of Government." Mimeo, UCLA [Online]. Available at www.sscnet.ucla.edu/polisci/faculty/treisman/DecandGovt.pdf

U.S. Government Accountability Office (2005). "Competitive Sourcing: Greater Emphasis Needed on Increasing Efficiency and Improving Performance." Journal of Public Procurement, 5 (3): 401-441.

Woolcock, S. (2001) 'Investment in the World Trade Organisation' in Klaus Deutsch (ed) The European Union in the Millenium Round, Cambridge University Press.

World Bank (1996). Nigeria, Poverty in the Midst of Plenty: The Challenge of Growth with Inclusion. Population and Human Resources Division, Western Africa Department, Africa Region.World Bank (2017). World Development Indicators. http://databank.worldbank.org/data/reports.aspx?source=2&series=NY.GDP.PCAP.KD&country=NGA (Accessed 28 July 2017)

A ROAD TRAFFIC SAFETY MANAGEMENT ROADMAP FOR THE MANAGEMENT OF THE ZION CHRISTIAN CHURCH EASTER WEEKEND PILGRIMAGE

A.M. Mathebula[1] and J.J. Smallwood[2]

[1,2]*Faculty of Engineering, the Built Environment and IT, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

The Zion Christian Church (ZCC) hosts one of the biggest mass gatherings (MG) on the African continent and pilgrims travel from all the corners of the country as well as neighbouring countries mainly by cars, buses and mini buses to Zion City Moria for spiritual fulfilment. The rationale for the study is to highlight that South Africa policy makers need to review their vehicle centric approach to transport planning with the view to promoting a sustainable transport system during the ZCC Easter Weekend pilgrimage. A single-question questionnaire consisting of 21 sub-questions with one open ended question was administered to (35) ZCC members who are studying at the following South African universities in the Gauteng Province: The University of South Africa (UNISA); University of Pretoria; Tshwane University of Technology; University of Johannesburg, and the University of the Witwatersrand. The members have travelled to Limpopo on the N1 freeway from Johannesburg, and the R101 feeder road from Pretoria to Zion City Moria. The researcher went to the libraries of these universities and identified the ZCC members by star pointed insignia. The aim as well as the objectives of the study were discussed with all the respondents. Twenty-five (25) responses were received from the respondents. The questionnaire consisted of two sections. The first section aimed to establish if respondents have personally experienced travelling towards the Limpopo Province during the Easter period and what their experiences had been. The study showed that traffic congestion is the major issue during the ZCC Easter pilgrimage and that alternative ways should be explored to deal with the high volume of traffic during the pilgrimage. For example, 88% of respondents strongly agreed that a train as a supplementary mode of transport with the view to reducing road accidents and traffic congestion during the pilgrimage. The study recommended that there should be a paradigm shift in transport planning from a vehicle centric approach to an integrated or intermodal approach. The state of safety during the Easter Weekend is mainly measured by road fatalities and other factors are not considered. It is highly recommended that injuries should also be measured as well as the travel time index, percentage lane kilometres under traffic monitoring, and the buffer index. The general conclusion of the study was that the ZCC Easter pilgrimage is a very big

[1] Mabilamabila7@gmail.com

[2] John.smallwood@nmmu.ac.za

Mathebula, A. M. and Smallwood, J. (2017) A road traffic safety management roadmap for the management of the Zion Christian Church Easter weekend pilgrimage *In: Laryea, S. and Ibem, E. (Eds) Procs West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 106-120.

event and vehicular traffic is not enough to manage the pilgrimage; other modes of transport should be introduced to bring about the synergy.

Keywords: mass gathering, public health, transport planning

INTRODUCTION

South Africa is home to the Zion Christian Church (ZCC) which was founded in 1910 during the Anglo-Boer war by Bishop Engenas Lekganyane, God bless him and give him peace (TRC, 2005). The Church is one of the fastest growing African Independent Churches (AIC) on the African continent with an estimated 15 million members; some of these members are based in South Africa's neighbouring states such as Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Zambia, and Zimbabwe. The ZCC hosts two pilgrimages per year; the first one during the Easter Weekend and the second one during September each year. The Easter pilgrimage attracts many pilgrims who travel from every province in South Africa, as well as pilgrims from neighbouring states. It is notable that most of these pilgrims utilise vehicles to reach Zion City Moria where the ZCC is headquartered.

Easter is both a commemorative and a celebratory period in the Christian calendar in many parts of the globe; it is also that time of the year in South Africa when the N1 freeway from Johannesburg and the R101 feeder road from Pretoria are highly congested with vehicular traffic, due to the ZCC members, holiday makers and migrant labours head towards one direction. Vilakazi (2008) observes that South Africa is overwhelmingly rural, and people should not be fooled by the cities and towns in which people live and work. The migrant labours have a singleness of purpose – to work in the cities as sojourners and when they are off duty; they return to their homes in the rural areas. Simply put, migrant workers travel between rural and urban areas.



Figure 1: Aerial photo of Zion City Moria (Photo courtesy of Ivan Muller)

It is notable that the literature relative to ecclesiology in South Africa focuses largely on doctrine and church administration, and there is no evidence that the question of pilgrim road safety is addressed in either ecclesiological or missiological literature. A plethora of research studies have focused solely on linking a pilgrimage to tourism and thus relegating the safety of pilgrims whilst en route to the pilgrimage, to the background. Hitherto, there is a literature lacuna with regards to the number of tragic deaths and injuries on the road amongst pilgrims in South Africa. Newspaper articles are replete with stories of pilgrims who die whilst on their spiritual journey, but to date, no study in South Africa has linked road traffic safety to the pilgrimage.

PROBLEM STATEMENT

The ZCC mass gathering event is one of the largest events on the African continent and a major religious gathering in the world, but there is still a big penumbra in literature as to what characterises a mass gathering. Researchers oscillate between 1 000 and 25 000 attendees (Mitchell and Barbera, 1997). The ZCC attracts more than 13 million pilgrims during the Easter Weekend who mainly travel to Zion City Moria by means of vehicular transportation (Lekganyane, 2017). Researchers have always focused on the Hajj and the Kumbhamela as two major religious gatherings in the world and relegating ZCC pilgrimage to the background regardless of the number of pilgrims who visit Zion City Moria during the Easter Weekend pilgrimage. Alahmadi (2014) opines that the diversification of people who attend mass gathering events could lead to high rates of morbidity and mortality from infectious disease, road accidents causalities and terrorist attacks in his PhD thesis.

The number of pilgrims who visit the holy City of Moria during Easter exponentially increases from year to year. For example, in 2016, an estimated 12 million pilgrims visited the holy city and in 2017, the figure was 13 million (Lekganyane, 2016 and Lekganyane, 2017). The ZCC does not have a quota system in place as opposed to Mecca where the number of Hajj pilgrims is known in advance. According to the WHO (2008), the organisers of mass gatherings are required to furnish information about how many people will attend a MG and who they are likely to be. The exact number of pilgrims who attend the ZCC pilgrimage would only be known once the counting process has taken place during the pilgrimage. The organisers ensure that traffic in the holy city of Moria is well managed to avoid accidents and stampedes. The ZCC has a clean record in that since its establishment in 1910; there has never been a stampede, but the incremental number of pilgrims on a yearly basis may expose the pilgrims to risks, and as a law abiding organisation, it should comply with international protocols on MGs. The WHO encourages organisers of MG to follow the following steps when doing a risk assessment: communicate and consult with stakeholders; establish the context of the risk; identify risks; analyse risks; evaluate risks; treat risk, and monitor the effectiveness of the risk management process (WHO, 2008).

The majority of ZCC pilgrims use vehicular transport to reach their pilgrimage during the Easter Weekend and there is currently no strategy in South Africa that deals with the transit safety of pilgrims. The festive season and the Easter Weekend are notoriously two periods when South Africa records a high number of fatalities. It is notable that South Africa is not the only country where pilgrims perish on the road; faith based organisations around the world have lost their members on the road through road accidents. For example, six British pilgrims were killed as they were driving towards Medina when their minibus crashed. The group had completed the Umrah pilgrimage to Mecca, a lesser version of Hajj (Telegraph, 2017). Pilgrims who travel on the road are prone to accidents, this happens before or after the pilgrimage. Nine pilgrims who were returning from a Kumbh Mela. A fair is a Hindu pilgrimage that is held every 12 years. There was another devastating tragedy when pilgrims were killed on the Agra-Mumbai highway when their vehicle collided with a truck (Hindustan Times, 2016). Two Sabarimahalai pilgrims were killed in 2016 and four injured when their car collided with a truck. The victims were on their way back home after visiting the Sabarimahalai Temple when the accident happened. According to Times of India (2016), six pilgrims were killed when their van collided with a government bus; they were returning home after visiting the Velankanni Church in Nagapattinan district.

South African highways are overcrowded with vehicular traffic during the ZCC pilgrimage. Recent literature relative to transport places an emphasis on the dire effects of overcrowding on the psychological wellbeing of passengers. The possible underlying cause of how road traffic overcrowding affects pilgrims psychologically has become a critical issue given the fact that pilgrims routinely endure levels of overcrowding in vehicular transportation during the pilgrimage (House of Commons Transport Committee, 2003). A study conducted by Cox, Griffiths and Houdmont (2003), found overcrowding to be associated with higher levels of illness; increases in negative reaction, social withdrawal and antagonistic behaviour.

Research has shown that there has been limited success with the implementation of Travel Demand Management (TDM) strategies in South Africa (Behrens and Del Mistro, 2006, Behrens, Des Mistro, Lombard and Venter, 2007). TDM emerged as a reaction to predict and supply vehicle orientation transport practices, to reduce private vehicle trips (Bickford, 2013). South Africa has not yet leveraged the benefits of non-motorised transport (NMT) (Litman, Zolla, De Waal, 2009).

The adoption of traditional transport planning practices in the developing world means that NMT trips are often neglected, and the majority of people are not considered in the planning and development of transport projects. Briefly put, the research question which this study attempts to answer is: What other alternative modes of transport are available in South Africa to decrease the high volume of traffic and road accidents during the ZCC pilgrimage?

PURPOSE AND OBJECTIVES OF THE PAPER

The purpose of this paper is to highlight that South African policy makers need to review their vehicle centric approach to transport planning with a view to achieving a sustainable transport system in South Africa. The road infrastructure was not designed to accommodate the mobility of millions of pilgrims and other motorists during the Easter Weekend. Finally, the paper attempts to achieve the following objectives: reduce congestion; enhance safety; expand economic opportunities; improve air quality, and preserve the value of transportation assets.

LITERATURE SURVEY

Road traffic accidents

Road accidents in South Africa stand out as a public health issue that warrants the attention of all the citizens. The first road accident in South Africa was recorded in October 1903 in Maitland. Since then, many people have lost their lives on the road and some have sustained major and minor injuries (DOT, 2011). According to the 2013 International Transport Forum on Road Safety Annual Report, South Africa performed badly in terms of road safety. The report indicated that there were 28 fatalities per 100 000 population, which was among the highest rates worldwide in 2011 (OECD, 2013). It was previously mooted that the speed limit should be reduced to 110km/h. However, this might not be the solution, as the Automobile Association (AA) attributes road accidents in South Africa to poor road maintenance as well as the lack of enforcement. Figure 1 below graphically shows fatal crashes per province during the Easter Weekend of 2016.

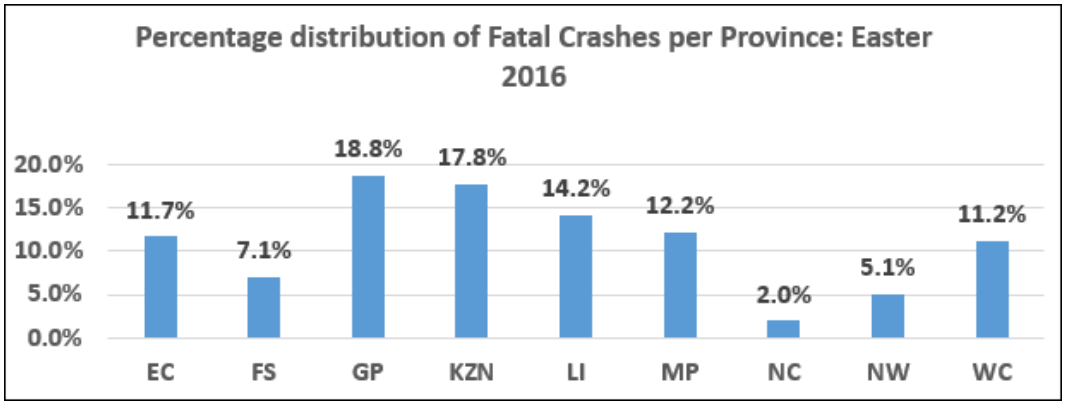


Figure 2: Percentage distribution of fatal crashes per province: Easter 2016 (RTMC, 2016)

The economic cost of South Africa's road vehicle accidents is estimated to be R307 billion each year (OECD, 2013). South Africa has an Occupational Health and Safety Act and Regulations No. 85 of 1993, which is paved with good intentions, but the Act is not specific with regards to the cost of preventing a fatality, given the high number of road deaths in South Africa. The Act presents a huge gap when it comes to the 'willingness to pay' (WTP). South Africa is a signatory to the UN Decade of Action for Road Safety 2011 to 2020. The aim of the campaign is to reduce the horrific rates of road deaths, and South Africa is among countries where accident rates and loss

severity rates have not improved. This first global conference on Road Safety took place in Russia in 2009, which is where the Decade of Action for Road Safety was mooted and adopted by the Ministers of Transport of member states. Based on the 2006 Millennium Developmental Goals, one of the goals of the Road Traffic Safety Management Plan was to reduce by half the rate of accident fatalities arising from road and other transport by 2015. The Millennium Development Goals have come and gone and nothing has been achieved as far as the reduction of the accidents is concerned. The Sustainable Development Goal target 3.6 and 11.2 aim at achieving affordable and safety transport systems by 2030 (ICSU and ISSC,2013).

It is notable that car ownership in South Africa is at the compound annual growth rate (CAGR) of no less than 12%. According to the 2013 International Transport Forum Road Safety Annual Report; motorised vehicle fleet in South Africa had doubled in the last 20 years and that between 1990 and 2011 the number of road fatalities increased by 25 percent (OECD, 2013). Pilgrims and other road users suffer hours of congested-related delays during the pilgrimage. Admittedly, the South African transportation system is creaking under the strain during the ZCC pilgrimage. Being able to travel quickly, conveniently, and safely with little environmental impact is of critical importance. The reform of mobility systems during the pilgrimage is one of the biggest challenges confronting policy makers, stakeholders, and road users today and to do it justice the study requires a commensurately ambitious approach.

RESEARCH METHODOLOGY

Sample frame and procedure

Table 1: Travelling data

Question	Percentage
Have you ever travelled to Limpopo during the Easter Weekend?	0,9
What mode of transport did you use?	
Private car	0,9
Minibus	0,0
Bus	0,8
Train	0,0
Flight	0,0
What time of the day did you travel?	
Night	0,2
Morning	0,5
Day	0,3

A single-question questionnaire consisting of 21 sub-questions with one open ended question was administered to (35) ZCC members who are studying at the following South African universities in the Gauteng Province: The University of South Africa (UNISA); University of Pretoria; Tshwane University of Technology; University of Johannesburg, and the University of the Witwatersrand. The members have travelled to Limpopo on the N1 freeway from Johannesburg and the R101 feeder road from Pretoria to Zion City Moria. The researcher went to the libraries of these

universities and identified the ZCC members by star pointed insignia. The aim and the objectives of the study were discussed with the respondents. The questionnaire consisted of two sections. The first section aimed to establish if respondents have personally experienced travelling towards the Limpopo Province during the Easter period and what their experiences had been. Twenty five (25) responses were received from the respondents. Table 1 below indicates the travelling experience of respondents.

The second section investigated perceptions relating to the movement, mode of transport and other related matters. Given that respondents were required to respond in terms of the extent to which they agree / disagree, it was necessary to compute a measure of central tendency in the form of a mean score (MS) with a minimum value of 1.00 and a maximum value of 5.00, to determine the degree of concurrence. There was one open-ended question to allow respondents to air their views.

The MS is calculated using the formula:

$$MS = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{(n_1 + n_2 + n_3 + n_4 + n_5)}$$

Where n_1 = Strongly disagree

n_2 = Disagree

n_3 = Neutral

n_4 = Agree

n_5 = Strongly agree

Table 2 indicates the extent to which respondents concurred relative to 21 statements. The statements with the ten highest MSs are related to road safety, namely 'Petrol stations on the N1 and R101 are crowded during the Moria pilgrimage', 'The high volume of traffic poses a risk to ZCC pilgrims and other road users', 'The waiting time at the toll gates during the Moria pilgrimage is too long', 'Driver fatigue contributes to road accidents during the Easter Weekend', 'Schools and universities should open after the Easter Weekend to reduce the traffic on the road', 'I know that vehicular traffic contributes to carbon emission during the Easter Weekend', 'A train will be a safe mode of travel for the Moria pilgrimage', 'The N1 highway is congested from Johannesburg due to the ZCC pilgrimage', 'ZCC pilgrims from other Southern African countries contribute towards the high volume of traffic during the Moria pilgrimage', 'R 101 public road is congested from Pretoria due to the ZCC pilgrimage', predominate in terms of the level of concurrence. Given that the MSs are $> 4.20 \leq 5.00$ the concurrence can be deemed to be between agree to strongly agree / strongly agree. The findings demonstrate that the over crowdedness of the roads during the ZCC pilgrimage is a fundamental problem to pilgrims and other road users who travel to Limpopo during the Easter Weekend.

The following statements achieved MSs $> 3.40 \leq 4.20$ (neutral to agree / agree): 'I commemorate Easter every year',' Having trains as an alternative

of transport will solve the traffic problem for the Moria pilgrimage', 'The law enforcement officers contribute towards the smooth running of traffic during the Moria pilgrimage', 'I am always frustrated by the high volume of traffic when I drive towards Limpopo during the ZCC pilgrimage', 'A number of minibus taxis carrying none pilgrim passengers breakdown during the Moria pilgrims', 'A number of buses carrying pilgrims break down on the road during the ZCC pilgrimage'. The findings demonstrated that many South Africans commemorate the Easter Weekend, and the high volume of traffic during the pilgrimage is an inconvenience to road users. The following statements achieved MSs > 2.60 ≤ 3.40 (disagree to neutral / neutral): 'I know of pilgrims who died on the road during the Easter Weekend', 'Drivers adhere to safety rules during the Moria pilgrimage', 'Drivers adhere to safety rules during the Moria pilgrimage', 'I know that buses travelling to Moria during the pilgrimage are safely designed', 'Having air craft as an alternative mode of transport will solve the traffic problem for the Moria pilgrimage', 'Petrol attendants have enough time to check oil, water and the tyre pressure during the Moria pilgrimage.' This indicates that respondents had serious concerns with safety issues during the ZCC pilgrimage.

Table 2: Degree of concurrence relative to various statements

Statement	Response (%)					MS
	Strongly disagree…….Strongly agree					
Petrol stations on the N1 freeway and R101 feeder road are crowded during the Moria pilgrimage.	0.0	0.0	0.0	0.1	0.8	4.68
The high volume of traffic poses a risk to ZCC pilgrims and other road users.	0.0	0.0	0.0	0.3	0.7	4.64
The waiting time at the toll gates during the Moria pilgrimage is too long.	0.0	0.0	0.0	0.2	0.8	4.60
Driver fatigue contributes to road accidents during the Easter Weekend.	0.0	0.0	0.1	0.2	0.7	4.60
Schools and universities should oper after the Easter Weekend to reduce the traffic on the road.	0.0	0.0	0.0	0.2	0.8	4.56
I know that vehicular traffic contributes to carbon emission during the Easter Weekend.	0.0	0.0	0.1	0.2	0.7	4.52
A train will be a safe mode of travel for the Moria pilgrimage.	0.0	0.0	0.1	0.2	0.7	4.48

Table 2 cont'd: Degree of concurrence relative to various statements

The N1 freeway is congested from Johannesburg due to the ZCC pilgrimage.	0.0	0.0	0.2	0.3	0.5	4.28
ZCC pilgrims from other Southern African countries contribute towards the high volume of traffic during the Moria pilgrimage.	0.0	0.1	0.1	0.2	0.6	4.20
R 101 feeder road is congested from Pretoria due to the ZCC pilgrimage.	0.0	0.0	0.2	0.3	0.4	4.12
I commemorate Easter every year.	0.1	0.1	0.2	0.1	0.5	3.84
Having trains as an alternative mode of transport will solve the traffic problem for the Moria pilgrimage.	0.2	0.0	0.2	0.0	0.6	3.68
The law enforcement officers are instrumental towards the smooth running of traffic during the Moria pilgrimage.	0.1	0.1	0.2	0.2	0.4	3.64
I am always frustrated by the high volume of traffic when I drive towards Limpopo during the ZCC pilgrimage.	0.2	0.1	0.0	0.2	0.4	3.56
A number of minibus taxis carrying passengers who are not members of the ZCC breakdown during the Moria pilgrims.	0.2	0.2	0.1	0.3	0.3	3.28
A number of buses carrying pilgrims break down on the road during the ZCC pilgrimage.	0.2	0.1	0.2	0.2	0.32	3.16
I know of pilgrims who died on the road during the Easter Weekend.	0.4	0.0	0.1	0.1	0.4	2.92
Drivers adhere to safety rules during the Moria pilgrimage.	0.0	0.4	0.4	0.1	0.1	2.80
I know that buses travelling to Moria during the pilgrimage are safely designed.	0.3	0.4	0.1	0.1	0.2	2.48
Having air craft as an alternative mode of transport will solve the traffic problem for the Moria pilgrimage.	0.4	0.2	0.2	0.0	0.1	2.12
Petrol attendants have enough time to check oil, water, and tyre pressure during the Moria pilgrimage.	0.48	0.20	0.20	0.12	0.00	1.96

DISCUSSION

The study has shown that people who travel to Limpopo during the Easter weekend are fully aware of the high volume of traffic, and as a result, some of them proactively leave either before or after the Easter weekend to avoid the congestion on the road. The respondents also confirmed that the traffic to the holy city of Moria poses a risk not only to the pilgrims, but to other road users. For example, 88% of respondents recommended a train as an alternative mode of transport with the view to reducing traffic as well as road accidents. The study also answered the following research question: Are enforcement officials a pain in the neck for motorists? 60% of respondents strongly felt that the law enforcement officials are vital for the smooth running of traffic during the ZCC pilgrimage. It is notable that 92%

of respondents said that petrol stations were crowded during the pilgrimage, and 68% said that overcrowding prevented them from checking water, oil, and tyre pressure.

Criticisms or perhaps to be more accurate; damaging criticism have been launched with respect to the South African Transport planners for being vehicle centric. This planning approach relegates public and non-motorised transport (NMT) modes to the background (Bickford, 2013). It is notable that the White Paper on National Transport Policy in 1996 emphasised the enhancement of public transport and non-motorised users (DOT, 1996). Walters (2012) argues that policy for each mode of public transport has been developed in a staggered manner which presents a major challenge for the integration of systems spatially and operationally. Research has shown that there has been limited success with the implementation of Travel Demand Management (TDM) strategies in South Africa (Behrens and Del Mistro, 2006, Behrens, Des Mistro, Lombard and Venter, 2007). TDM emerged as a reaction to predict and supply based vehicle orientation transport practices, to reduce private vehicle trips (Bickford, 2013). Some authors have documented the benefits of using non-motorised transport (NMT) (Litman, Zolla, and De Waal, 2009). The adoption of traditional transport planning practices in developing world countries means that NMT trips are often neglected and most people are not considered in the planning and development of transport projects. There should be a paradigm shift in terms of transport planning to reduce road accidents and congestion during the ZCC pilgrimage. The National Green paper on Rail Policy encourages South African to use rail as a preferred mode of transport (DOL, 2015). The implementation of the policy will also promote intermodalism as well as the safety of passengers. It is notable that 90% of the respondents recommended a train as an alternative to cars, buses and taxis during the pilgrimage. In addition, respondents suggested various ways of reducing the volume of traffic during the pilgrimage, for example investment in rolling stock, enhanced law enforcement, dedicated bus lanes and increasing the cost of toll gates in order to discourage vehicular traffic.

Hajj uses different modes of transportation during the life cycle of the pilgrimage. It is notable that 60% of respondents disagreed that air travel could be used as an alternative to vehicular traffic because airline are associated with the rich and the middle class. It is ironical that the South Africa Airways (SAA) has been running at a loss for many years and the government is compelled to bail out the SAA out of taxpayers' money. Briefly put, the government uses poor people's many to fly the rich and the middle class. Many ZCC pilgrim are not exposed to air travel and cannot afford the air fares, but this does not mean that airlines cannot be used as a complementary mode of transport during the ZCC pilgrimage. For example, if the SAA is given a bail out by the government; what would stop the government to transport the poor who have been using their taxes to subsidies ailing airline?

CONCLUSIONS

It would be very difficult to understand the dynamics of the ZCC pilgrimage without comparing and contrasting it with the Hajj. Coincidentally, the ZCC shares a lot in common with the Islamic faith; both faiths are ritualistic and rule-based. For example, the following rules apply to both faiths during the pilgrimage: no smoking, no alcohol intake, no physical union between men and women, no quarrelling, no violence, seek compromise and don't insist on differences; avoid excess, especially in words and laughter and proscribe jokes. The Hajj, as opposed to the ZCC pilgrimage is quintessentially intermodal, pilgrims fly from all over the world to Saudi Arabia to perform this important Fifth Pillar of Islam. Each country is required to adhere strictly to the quota system with the view to assisting the Saudi Arabian government to their planning process. For example, the number of pilgrims attending Hajj 1435 was more than 2 million, of which approximately 1400 000 had arrived from outside the Kingdom. The aircraft is the original mode of transport used by pilgrims outside Saudi Arabia to reach the pilgrimage. Hajj is performed at different sacred locations in Saudi Arabia, as a result, pilgrims are transported from one sacred place to another by means of vehicular transport and trains. The integration of these transport modes makes the performance of Hajj seamless. It is notable that if there was no railway line to transport 72 000 passengers per hour to various locations, the transportation of pilgrims during Hajj would be an onerous exercise. Briefly put, the line was not designed to compete with buses and cars but to complement them. The ZCC pilgrimage is not a rotational pilgrimage - Zion City Moria is the final destination for pilgrims. The transportation of multitude of pilgrims on the road during the ZCC pilgrimage has a potential to expose them to road fatalities and injuries.

The ZCC hosts one of the biggest pilgrimages in Africa and there are risks associated with hosting a pilgrimage of this nature. The high volume of traffic to Zion City Moria cannot be telescoped without the introduction of other alternative modes of transportation. Travelling to the ZCC pilgrimage during the Easter weekend poses a lot of risks to both pilgrims and other road users and other transport modes such as a train service and airlines could play an important role in the reduction of traffic vehicular traffic. What is needed in South Africa during the ZCC pilgrimage is synergy. Briefly put, all modes of transport should complement one another.

RECOMMENDATIONS

The reform of mobility systems during the ZCC pilgrimage is one of the biggest challenges confronting policy makers in South Africa today. The responses from respondents also showed that the South African approach to transport planning over accentuates vehicular transport at the cost of other transport modes; it is recommended that policy makers should look at transport planning from an intermodal perspective and not from a vehicular perspective. Pilgrims and other road users suffer hours of congested-related delays during the pilgrimage. The South African transportation system is

creaking under the strain during the pilgrimage. Being able to travel quickly, conveniently, and safely with little environmental impact is of critical importance, and should be a priority of transport planners. The challenge for transport policy makers in South Africa is to encourage synergy in the transportation arena. The word synergy is constituted by two ancient Greek words*: syn*, which means together, and *ergein*, which means to work (Dennis, 1997). Put another way, synergy means working together, complementing each other, and not competing against each other.

The Road Traffic Management Corporation (RTMC) focuses on recording road fatality rates during the Ester weekend, yet other factors are not measured. It is also recommended that injuries are also measured because an injury alters one's life after an accident. To gain the full view of all traffic activities during the pilgrimage; the following measures should also be considered by the RTMC when reporting the state of road safety during the Easter Weekend:

- Travel time index (Travel time index is a measure that provides an idea of the magnitude of congestion. It is a measure of the ratio of the peak hour travel time to the free-flow or off-peak travel time, and indicates how much longer travel takes due to congestion alone);
- Buffer index (The buffer index is an indicator of travel time reliability that provides an idea of the variation of observed travel times for a section of a road over a period of time);
- Percentage lane kilometres under traffic monitoring / surveillance (Traffic management centres provide surveillance of the road system, which greatly enhances response times to incidents, thereby improving congestion and safety);
- Air quality index (The air quality index is a measure structured to take into account the mobile source emissions that affect human health), and
- Daily CO_2 emission (Carbon Dioxide (CO_2) is a gas emitted from burning fossil fuels, which is associated with global warming. Vehicular emissions are a significant anthropogenic source of CO_2 and these must be considered while assessing the sustainable of transport systems).

Employers should grant employees who happen to be members of the ZCC at least two days leave prior to the start of the Easter weekend and two days after Easter Monday. The Government should also give incentives to such employers and recognise them. There should be collaboration between government, employer's associations, and transport service providers to ensure that heavy trucks are prohibited during the Easter weekend.

It is notable that the ZCC has other activities at Zion City Moria throughout the year where pilgrims visit the holy city. For example, the ZCC has established a chamber of business and members meet quarterly to discuss business matters and every weekend some pilgrims travel to Zion City Moria for prayers. A dedicated pilgrim train from Johannesburg to

Polokwane is highly recommended. The ZCC should consider the example of Saudi Arabia of introducing a pilgrim train. According to the Saudi Railway Commission (2014), the Al Mashaer Al Mugaddassah Metro is a metro system designed to transport the high volume of pilgrims safely and efficiently between Arafat, Muzdalifah, Mina and Jamarat. The line is approximately 18 km (including 14.5 of elevated section) and 9 stations.

REFERENCES

Alahmadi, R.W. (2014) Modelling the relationship between pilgrims' pedestrian casualties and land type: a case study of Al Madinah and Al Monowaran (PhD). Edinburgh Naper University. Scotland

Behrens, R., and Del Mistro, R. (2006) Methodological problems in the analysis of changing habitual travel behaviour over time. 25th Southern African Transport Conference, Pretoria 10-13 July 2006. Document Transformation Technologies cc, 195 -205

Bickford, G.2013. South African cities network: literature review on public transport mobility in municipalities. Available from http:www.sacites.net/wp-content/uploads/2014/10/literature review on public transport and mobility-pdf

Cox, T., Griffiths, A., & Houdmont, J. (2003). Rail safety in Britain: An occupational health psychology perspective. Work Stress, 17(2): 103–108

Cox, T., Lotinga, J., Houdmont, J., & Griffiths, A. (2002). Rail passenger stress and health: Report for Rail Passengers Council. University of Nottingham, UK: Institute of Work, Health and Organisations

Del Mistro, R., and Behrens, R. (2008) How variable is the variability in traffic? How can TDM succeed? 26th Southern African Transport Conference, Pretoria 7-11 July 2008. Document Transformation Technologies cc, 221-234

Del Mistro, R., Behrens, R., Lombard. M., and Venter, C. (2007) The triggers of behaviour change and implications for TDM targeting: findings of a retrospective commuter travel survey in Cape Town. 26th Southern African Transport Conference, Pretoria 9-12 July 2007. Document Transformation Technologies cc, 475-486

Dennis, P. 1997. Quality, Safety and Environment: Synergy in the 21st Century: ASQC Quality Press. Wisconsin. Unites States of America

Department of Transport (1996) White paper on national transport policy. Pretoria: Department of Transport. Available from http://www.comair.co.za/media/...white-paper-on-Nat-Transport-Policy-1996.pdf [Accessed 3 July 2017]

Department of Transport (2011) Decade of action and arrive alive: national road safety strategy 2011-2020 [online]. Pretoria: DOT. Available from http://www.arrivealive.co.za/...Road%20%Safety%Strategy% for 20% South% Africa% 202011. Pdf [Accessed 3 July 2017]

Department of Transport (2015) Green paper on national rail policy. Pretoria: Department of Transport. Available from http://www.transport.gov/LinkCLick.aspxPfileticket=OMT1GeNPZ85%3D &tabid [Accessed 3 July 2017]

Department of Transport. (2016) Easter Weekend Report 2016 [online] DOT. Available from: http://www.gov.za/...road-traffic management –corporation-Easter weekend-road-accidents [Date accessed 12 May 2017]

Hindustan Times (2016) 9 pilgrims killed in road accident while returning from Kumbh Mela. Hindustan Times [online] 21 May Available from: http://www.hindustandtimes.com/india/9-pilgrims-killed-road-accident-while-returning-from-kumbh-mela/story-zvV6pvJ3V5rsHyzn7wawl1.htm [Date accessed 30 June 2017]

House of Commons Transport Committee. (2003). Overcrowding on public transport: Seventh Report of Session 2002–03, Volume 1, Report, together with formal minutes (HC 201-I). London: The Stationery Office Ltd. Retrieved from http://www.publications.parliament.uk/pa/cm200203/cmselect/cmtran/201/201.pd (Date accessed: 20 March 2017)

ICSU and ISSC (2015) Review of targets for the sustainable development goals: the science perspective. International Council for Science perspective (ICSU) in partnership with International Social Science Council (ISSU). Available from https://www.google.co.za/#q=review+of+targets+for+the+sustainable+development+goals+the+sceince+prepective

Lekganyane, B.E. (2016). Easter Sermon by His Grace The Right Reverend Bishop B.E. Lekganyane. Boyne. Zion City Moria

Lekganyane, B.E. (2017) Easter Sermon by His Grace The Right Reverend Bishop B.E. Lekganyane. Boyne. Zion City Moria

Litman, T. (2016) Well measured: developing indicators for sustainable and livable transport planning, Victoria Transport Policy Institute (www.vtoi.org)/ (www.vtpi.org/wellmeas.) pdf

Mitchell, J.A. and Barbera, J.A. (1997) Mass gathering medical care: a twenty-five year review. Prehospital and disaster medicine, 12: 72-79

OECD (2013) Road safety annual report 2013. Organization of Economic Coordination and Development (www.oecd.org)

Republic of South Africa (1993) Occupational Health and Safety Act. Pretoria

Saudi Railway Commission (2014). Hajj 1435: Railway Commission Report. Available from: http://www.witiwand.com/en/Al_Mashaaer_Al_Mugaddassah_Southern_Line [Date accessed 9 February 2017]

Telegraph News (2017) Six Britons killed in minibus crash during pilgrimage in Saudi Arabia. Telegraph News [online] 19 January. Available from: http://www.telegraph.co.uk/news/2017/01/19/seven-britons-killed-minibus-crash-pilgrimage-saudi-arabia-reports. [Date accessed 4 June 2017]

Times of India (2016) Six Kerala pilgrims killed in Theni road accident. Times of India [online] 26 July. Available from: http://www.timesofindia.com/city/chennai/six-kerala-pilgrims-killed-in-Theni-road-accident/articleshow/53390219.cms. [Date accessed 5 July 2017]

Truth and Reconciliation Commission (2005) The Zion Christian's Response to the Truth and Reconciliation Commission. Available from: http://www.religion.uct.ac.za/...Testimony_before_the_Truth_and_Reconciliation_Commission [Date accessed 5 July 2017]

Vilakazi, H.W (2008) The Correct Development Strategy for South Africa. Pretoria. Board-Democracy Development.

Walters, H.W (2008) The correct development strategy for South Africa. Research in Transport Economics. 39 (1): 34-35

WHO (2008) Communicable disease alert and response for mass gatherings: key considerations. World Health Organization. Geneva

A STUDY OF THE FACTORS CAUSING DELAY OF RURAL ROADS AND BRIDGE CONSTRUCTION PROJECTS IN GHANA

Isaac Mensah[1], Gabriel Nani[2] and Theophilus Adjei-Kumi[3]

[1,2,3]Department of Building Technology, College of Art and Built Environment, Kwame Nkrumah University of Science and Technology, University Post Office (UPO)Private Mail Bag (PMB) Kumasi - Ghana.

[1]Department of Feeder Roads, P.O. Box 1135, Koforidua

Time overrun is a major problem to the rural road agency in Ghana as it leads to increased costs and in some cases abandonment of projects. The purpose of this study is to ascertain the factors causing delay or time overrun of rural roads and bridge construction projects in Ghana. A self – administered questionnaire was sent to 29 civil engineers and 37 quantity surveyors at the Department of Feeder Roads (DFR) to indicate their views on factors identified from literature and experience of the authors on a five point likert scale. The data was analyzed using the relative importance index and the principal component analysis. The results show that payment difficulties by the road agencies, type of funding, approval of variation order from road agency, errors in design, shortage of materials and equipment availability are the six main causes of delay on rural road and bridge construction projects in Ghana. In addition to the above factors, the principal component analysis also indicated that location of project is also a significant factor. Recommendations were then made to reduce or eliminate the impact these factors would have on the success of projects.

Keywords: bridges, delay, Ghana, relative important index, rural roads.

INTRODUCTION

One of the major factors for classifying a project as a success is the time used for its completion. When a project goes beyond its planned completion date, then the project is delayed. Delay in construction projects leads to increased costs and sometime abandonment of projects. According to Bagaya and Song (2016), delay is one of the most recurring problems in public construction projects worldwide. Construction projects go beyond the planned duration as a result of various factors. For instance, the study conducted by Amoatey and Ankrah (2017) showed that about 70% of road projects in Ghana go beyond their intended completion date by an average time overrun of 17

[1] isaacfmensah@yahoo.com

[2] gabrielnani@yahoo.com

[3] tadjeikumi@yahoo.com

Mensah, I, Nani G. and Adjei-Kumi, T. (2017) A study of the factors causing delay of rural roads and bridge construction projects in Ghana *In: Laryea, S. and Ibem, E. (Eds) Procs West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 121-139.

months up to 78 months. Also, Asiedu et al, (2016) found out that the average time overrun of public school projects from 2010 to 2013 in Ghana was 106.45%. Hoffman et al, (2007) showed that out of the 332 facility projects funded by the US Air Force, 72% of them could not be completed within the specified duration. Similarly, Odusami and Olusanya (2000) revealed that projects constructed in Lagos, Nigeria experienced an average delay of 51% of the planned duration. This is further corroborated by Aibinu and Jagboro (2002), who found out that the average time overrun of building projects in Nigeria could range from 59.23% to 92.64% depending on the value of the project. For government and private building projects in Hong Kong, Kumaraswamy and Chan (1998) found a mean percentage time overrun of 9% and 17% respectively.

Once delay occurs, the client's satisfaction is compromised and the likely consequence is increased costs for the limited budgets allocated. This further leads to abandonment of projects. Although Akomah and Jackson (2016) has conducted a study from the contractor's point of view to identify delay factors for the road sector in Ghana, there is no current study in the road sector to determine the delay factors for both road and bridge construction projects in Ghana from the employer's point of view. Amoatey and Ankrah (2017) carried out a study to determine delay factors for road projects but the unique factors impacting on bridge projects were not considered in their study. The road and bridge construction projects in Ghana have suffered from time extensions over the years and this has led to huge claims in terms of price fluctuation to the detriment of the employer. The employer and stakeholders of the road sector are dissatisfied with this development since several projects particularly at the Department of Feeder Roads experience delays. The aim of this study is to determine the factors that contribute to the delay of both road and bridge construction projects in Ghana. To achieve this aim, the following objectives were set; (i) identify the factors that cause delay of rural roads and bridge construction projects and (ii) to suggest recommendations that could be taken to mitigate them. This paper first of all reviews past studies related to the subject area by identifying factors that cause delay. Professionals at the Department of Feeder Roads with enormous experience were involved. The paper continues with the research methods employed to achieving the aim stated above. Discussions of the factors identified are then made and recommendations are proposed. Conclusions are then finally made.

LITERATURE REVIEW

A number of publications have been made on the subject worldwide and this section reviews a few some of these studies.

Amoatey and Ankrah (2017) conducted a research for road projects in Ghana by administering 160 questionnaires to professionals at the three road agencies and other donor funding organisations. The results showed that delay in finance and payment of completed work by owner, inadequate contractor experience, changes of scope by the owner during construction,

delay to furnish and deliver the site to the contractor and inflexible funding allocation for project items.

Another recent study was carried out by Famiyeh et al, (2017) in Ghana to identify the major causes of construction time and cost overruns. By administering questionnaires to consultants and representatives of contractors working on about 60 educational projects, they identified financial problems, unrealistic contract durations imposed by clients, poorly defined project scope, client-initiated variations, under-estimation of project cost by consultants, poor inspection/supervision of projects by consultants. Other factors were underestimation of project complexity by contractors, poor site management, inappropriate construction methods used by contractors and delays in the issuance of permits by government agencies. These causes were identified using the relative importance index.

Bagaya and Song (2016) carried out a research to identify the five most significant factors causing delay in the Burkinabe construction industry. They administered a questionnaire to 140 Burkinabe experts in the construction industry and the relative importance index identified the following factors as the five most important factors, financial capability of the contractor, financial difficulties of the owner, equipment availability of the contractor, slow payments for completed work, and poor subcontractor performance by the contractor.

Amoatey et al, (2015) conducted a study by administering 50 questionnaires to professionals in the Ghanaian state housing sector. The results from their survey showed that the critical factors causing delay or affecting duration are delay in payment to contractors/suppliers, inflation or price fluctuation, price increase in materials, inadequate funds from sponsors/clients, variation orders and poor financial/capital market.

In Jordan, Sweis et al (2008), identified that financial difficulties faced by the contractor and too many change orders by the owner are the leading causes (factors) of construction delay in the Jordanian construction industry.

A study carried out by Alaghbari et al (2007) in Malaysia revealed that financial problems and coordination problems are the main factors causing delay in the Malaysian construction industry.

Frimpong et al (2003) carried out a research in Ghana and found out that monthly payment difficulty from agencies, poor contractor management, material procurement and escalation of material prices are major factors affecting project delays in ground water projects in Ghana. A study was conducted by Chan (1998) by categorising the factors affecting construction duration into project scope, project complexity, project environment and management attributes. Chan (1998) showed that the factors under the project scope constitutes construction cost, building type, gross floor area, number of storeys, contract procurement and variations. The complexity of the project, according to him was made up of client's attributes, site conditions, buildability of project design and quality management. Under the category of project environment, Chan (1998) identified the factors as

physical, economic, socio-political and industrial relations. The main factors under management attributes include client/design team management attributes; construction team management attributes, communication management, productivity and organisational structures.

In the study carried out by Chan and Kumaraswamy (2002), 'communication management' variables which is categorised under management attributes, were found to have significant influence on the duration of a project. According to Chan and Kumaraswamy (2002), factors responsible for project delays can be considered as adverse manifestations of general factors that affect construction duration. They indicated that a study of the delay factors could help identify many of the significant factors influencing project duration.

Nkado (1995) in his study identified the ten most significant factors affecting project duration in the United Kingdom. Some of the factors identified by Nkado (1995) include client's specific sequence of completion, complexity of project, location and availability of construction management team.

A more recent study of the factors affecting duration of road construction projects from the contractors' point of view was conducted by Akomah and Jackson (2016) in Ghana. They identified delay in honouring payment certificates, bad weather conditions, unfavourable site conditions, consultants initiated variations, delay in instructions from consultants and difficulty in accessing bank credit as the main factors affecting duration of road projects.

Jiang and Wu (2007) opine that construction duration of a highway project depends on many factors, such as type of project, project size, weather conditions, project location, manpower, equipment and construction management.

Kaliba et al, (2008) carried out a study on cost escalation and schedule delays of road construction projects in Zambia. His findings showed that delayed payments, poor coordination on site, changes in drawing, materials procurement, changes in specifications and equipment unavailability are some of the factors leading to schedule (time) delays in road projects in Zambia.

Even though Akomah and Jackson (2016) studies were for the road sector from the contractors' point of view, likewise that of Amoatey and Ankrah (2017), no research has been done for both the road and bridge construction projects from the employer's point of view. In addition, most of the studies have found payment difficulties as a major problem impacting on duration but none of them has assessed the impact the type of funding has on the duration of construction projects. Also, the bridge construction sector is a specialized area and factors influencing this sector is project specific. As opined by Esteves (2004), each sector has its unique risk factors. As a result, a suitable risk management model of a sector must recognize these unique factors. This study addresses these gaps by identifying delay factors from the employer's representatives (professionals at DFR) point of view with

respect to bridge and road construction projects. The next section describes the research methods employed in achieving this aim.

RESEARCH METHODS

The questionnaires pertaining to twelve (12) factors affecting the duration of road and bridge construction projects identified from literature were self – administered by mailing them to professionals at the Department of Feeder Roads.

The regional offices of the department are located within ten regions of the country with their Head Office in Accra. The Engineers and Quantity Surveyors were targeted since they are the professionals who are concerned with the designs and contract administration of road and bridge construction projects at the department. The department has a total number of 78 civil engineers and 47 quantity surveyors. This represents a total entire population of 125. To determine the sample size (n) to use for the distribution of the questionnaires, the following formula adapted by Ofori - Kuragu et al, (2016) was used;

$$n = \frac{N}{1+N(e^2)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where N is the number of entire population and e is the significance level. For a confidence level of 95%, e = 0.05, N = 125. Substituting the values in equation (1), n = 125/1+125(0.05)^2. This gives n = 125/1.3125 =95.24, approximated to 95. To compensate for non – responses and non –returns of the questionnaires, add 5% of 95. This gives 4.75 which is approximately 5. Adding 95 to 5, the actual number of questionnaires to be distributed is 100.100 questionnaires were therefore administered to professionals at the Department of Feeder Roads in the second quarter of 2016 (see Table 1). Emails were first sent to them but few of them responded to the questionnaires by email. As a second step, hard copies of the questionnaires were sent to them at the regions and their Head Office in Accra and a follow up made in order to improve upon the response rate. Out of the 100 questionnaires distributed, 55 were sent to Civil Engineers (CE) and the remaining 45 were distributed to Quantity Surveyors (QS). 30 and 38 responses were received from Civil Engineers and Quantity Surveyors respectively. However, 2 of them were not fully completed by the respondents and were therefore not suitable for inclusion in the analysis. This represents a valid response rate of 66% which was considered to be very good as it was similar to the response rate of Bagaya and Song (2016) [60% for clients and 62% for contractors]. This response rate was also similar to that of Amoatey et al, (2015) with a reponse rate of 62%. The response rate was however, higher than the response rate of Olawale and Sun (2015) which was 45%.

The first part of the questionnaire was structured to determine the number of years of experience of the respondents as well as their qualification. The responses to this have not been reported in this study for lack of space. The second part of the questionnaire asked respondents to numerically indicate

12 factors identified from literature that significantly affect the duration of roads and bridge construction projects. These were done on a five point likert scale 1 (Not significant) and 5 (extremely significant).

Table 1: Questionnaire distribution and their responses in percentage

Profession	Questionnaire distributed	No of responses	No Rejected	No of valid responses	% of response
Civil Engineers	55	30	1	29	43.9
Quantity Surveyors	45	38	1	37	56.1
Total	100	68	2	66	100

These engineers and quantity surveyors are the ones in charge of the total road network in their respective regions and so the data obtained can be said to be reliable and can contribute immensely to the results of this research.

Processing of collected data

Data was analysed by using the relative importance index (RII) adopted by Badu et al, (2013) to find the ranking factor among all the factors or variables indicated in the questionnaire.

$$\text{Relative importance index RII} = \frac{\sum W}{A \times N} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

W – the weight given to each factor by the respondents and ranges from 1 to 5;

A is the highest response integer (5); and N is the total number of respondents.

To test for any agreement in ranking of the individual factors between the two professional respondents, the t-test or the p-value at 5% significance level was used to test the following hypothesis:

H_o : There is no agreement between two professional group of respondents

H_1 : There is agreement between two professional group of respondents

If t-calculated is less than t-tabulated, accept H_o and reject H_1. Alternatively, if p-value is greater than 0.05, then accept H_0 and reject H_1. The opposite is true in both alternatives (i.e reject H_o and accept H_1 if t-calculated is greater than t-tabulated or p-value is less than 0.05).

Reliability of questionnaire

Reliability analysis shows the properties of measurement scales and the items composing the scales. It can be used to ascertain the extent to which the items in a questionnaire are related to each other as well as determining the overall index of the repeatability or internal consistency of the scale as a whole. To estimate the reliability of the questionnaire, the cronbach alpha (α) determined from the equation 3 below was used:

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum V_i}{V_T}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where N = number of factors, V_i = Variance of scores on each factor and V_T = total variance of overall scores on the entire population. Using the SPSS version 17, the cronbach alpha was computed for the 15 items in the questionnaire. A summary of the reliability statistics is shown in table 2. Reynaldo and Santos (1999) opine that Cronbach's alpha value greater than 0.7 means that the survey instrument is acceptable. Since $\alpha = 0.784 > 0.70$, the questionnaire was considered reliable.

Table 2: Reliability Statistics of questionnaire

Cronbach's Alpha	No. of Items
.784	15

Principal Component Analysis (PCA)

In order to group the factors causing delay of construction projects in this study, the principal component analysis was employed. According to Mutalib et al, (2013), the principal component analysis (PCA) is a technique which is used for explaining the variance of a large set of interrelated variables by transforming them into a new or smaller set of uncorrelated variables. PCA has the ability to show the most significant variables or parameters and less significant variables (which are eventually omitted) with minimum loss of the original data. A general rule of PCA is that components should comprise of at least three variables (Durham and King 2010).

Performing the principal component analysis

An initial consideration before performing the principal component of factor analysis is the sample size. Sample size is very important in factor analysis but there are varying opinions in literature and several guiding rules are available in literature (Williams et al, 2010). For instance Hair et al, (1995) cited in Williams et al, (2010) opines that a sample size of 100 or more is most appropriate. Ahadzie (2007) contend that an average of all the communalities of the variables above 0.60 indicates adequate sample size for factor analysis. Another set of suggestions by some researchers is the sample to variable ratio, which is most often than not denoted as *N:p* ratio where *N* refers to the number of participants and *p* is the number of variables. Rules of thumb for this ratio, according to Williams et al, (2010) range 3:1, 6:1, 10:1, 15:1, or 20:1.

In spite of the disparity among researchers, this study adopted the N:p ratio criterion. In this study, the factors were administered to 66 participants or respondents (N = 66) and the variables were 12 (p =12). The ratio therefore is 5.5:1 which is close to 6:1.

Having met the criteria of sample size, the principal component analysis is performed using the followings steps adapted from Hassan et al, (2015). The SPSS version 17 was used to perform the analysis.

i. Testing for the appropriateness of using PCA.

ii. Extraction of principal components or factors and

iii. Selecting the principal components

Field (2005) opines that in order to apply the PCA the determinant R must be greater than 0.00001. The extracted components are the ones with eigen values greater than 1. The eigenvalues represent the variance explained by each component. Each component has a factor loading. Factor loadings give us an idea about how much the variables has contributed to the factor, the larger the factor loading the more the variable has contributed to that factor. It is to be noted that factor loadings are similar to weights in a multiple regression analysis representing the strength of the correlation between the variable and factor (Yong and Pearce, 2013). Once the component has been extracted, it is rotated using varimax rotation of the SPSS for a better interpretation.

Assuming that three components are extracted, then using the factor analysis model, the factors affecting the duration can be expressed mathematically as:

Duration (T) =FAC1 + FAC2 + FAC3 …… (4), where FAC1 is factor analysis for component 1, FAC2 is factor analysis for component 2 and so on.

For component 1, FAC1 = m_1 (V1) + m_2 (V2) + m_3 (V3) + m_4 (V4) ……. 5)

Where m_1, m_2 m_3 and m_4 are the component score coefficients of the individual factors (V1,V2 ..V4) in component 1.

For component 2, FAC2 = m_1 (Va) + m_2 (Vb) + m_3 (Vc) ……. (6), Va, Vb and Vc are factors in components 2

For component 3, FAC3 = m_1 (Vd) + m_2 (Ve) ……. (7), Vd and Ve are individual factors in component 3

Additional criteria that had to be met are the Kaiser – Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO statistic varies between 0 and 1, values closer to 1 is better. Kaiser (1974) cited in Field (2005) recommends values greater than 0.50 as acceptable.

The Bartlett's measure tests the following hypothesis:

H_o: The original correlation matrix is an identity matrix (all correlation coefficients are zero)

H_1: The original correlation matrix is not an identity matrix (all correlation coefficients are not zero)

This hypothesis is tested using the significance test (i.e.) whether the significant value is less or greater than 5% level of significance. If the Bartlett test is significant (that is $p < 0.05$, then H_o is rejected and H_1 accepted). The opposite is also true.

RESULTS

The results of the individual factors affecting the duration of construction projects using the relative importance (RII) and factor analysis are presented in this section.

The result of the respondents to the mean rankings of the significant factors affecting bridge and road construction projects is shown in table 3. Table 3 shows that payment difficulties from road agency was ranked first (RII = 0.8801).

Table 3: Ranking of factors affecting duration of road and bridge projects by respondents

	Frequency of Ranking by QS								Frequency of Ranking by Civil Engineers										
Other factors	1	2	3	4	5	Weighting	RII	Rank	1	2	3	4	5	Weighting	RII	Rank	Mean Weighting	Mean RII	Rank
Payment difficulties from Road agencies	0	0	2	11	24	170	0.919	1	1	2	3	7	16	122	0.841	1	146.00	0.8801	1
Type of funding :GOG/ Consolidated Fund	0	3	4	10	20	158	0.854	2	0	5	5	6	13	114	0.786	4	136.00	0.8201	2
Approval of variation order from Road agencies	0	2	5	19	11	150	0.811	4	1	0	4	15	9	118	0.814	2	134.00	0.8123	3
Errors in Design	0	2	6	14	15	153	0.827	3	0	2	6	13	8	114	0.786	4	133.50	0.8066	4
Shortage of materials	0	2	10	11	14	148	0.800	5	0	2	5	14	8	115	0.793	3	131.50	0.7966	5
Equipment availability	0	4	5	18	10	145	0.784	8	1	1	7	10	10	114	0.786	4	129.50	0.7850	6
Severe/ adverse weather conditions	0	2	9	15	11	146	0.789	6	0	3	5	13	8	113	0.779	7	129.50	0.7842	7
Type of Funding: Donor (IDA, MIDA,JICA etc)	1	6	4	9	17	146	0.789	6	2	5	3	12	7	104	0.717	9	125.00	0.7532	8
Effective communication between staff of road	1	4	10	15	7	134	0.724	9	0	4	8	11	6	106	0.731	8	120.00	0.7277	9
Location of project	2	5	10	13	7	129	0.697	12	1	2	10	12	4	103	0.710	10	116.00	0.7038	10
Delay in giving site possession	0	3	13	16	5	134	0.724	9	0	5	10	12	2	98	0.676	12	116.00	0.7001	11
Topography of road area	0	9	9	10	9	130	0.703	11	0	4	11	10	4	101	0.697	11	115.50	0.6996	12

The second ranked significant factor affecting duration is type of funding (RII= 0.82) (Government of Ghana/consolidated fund). However, the donor funded projects such as IDA, MIDA and JICA was ranked as 8th with RII of 0.7532 (see table 3). The reasons for differences in these rankings have been made under discussion section.

The third ranked significant factor impacting on duration was approval of variation orders from professionals at the agency (RII = 0.8123) and the fourth ranked factor in table 3 is error in design (RII=0.8066).

Shortage of materials was the fifth ranked (RII = 0.7966) factor by the professionals at the agency. Equipment availability on the other hand was ranked sixth with an RII of 0.7850 (see table 3). This factor was ranked 3rd by Bagaya and Song (2016) in the study conducted in Burkina Faso.

Severe/ adverse weather conditions, type of funding (donor funded -IDA, MIDA etc), effective communication between road agency and contractors were ranked 7th, 8th and 9th respectively. Severe weather conditions was also ranked 7th by the study conducted in Burkina Faso by Bagaya and Song

(2016). The other factors considered unimportant by the RII method were location of project, delay in giving site possession and topography of the site which were ranked as 10th, 11th and 12th respectively.

Testing of hypothesis

To test whether there is agreement or disagreement among the professional groups on the rankings of significant factors, the significance test at the 5% level was used. Using the SPSS, the result is as shown in table 4. Table 4 indicates that t (11) =2.608, p< 0.05 since p =0.024 implying that there is agreement between the two professional groups at the department and so the alternative hypothesis is accepted. This gives credibility to the rankings of the professionals who are directly involved in the construction of projects at the agency.

Table 4: Paired Samples Test for rankings of factors

		Paired Differences					
		Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pair 1	QS_Delay_factors - CE_Delay_factors	.02542	.03377	.00975	2.608	11	.024

To group the factors ranked above and to rename them, the principal component of the factor analysis was employed.

Principal component analysis on factors affecting duration

In this study, the identified factors were administered to 66 participants or respondents (N = 66) and the variables were 12 (p =12). The ratio therefore is 5.5:1 which is close to the recommended 6:1 in literature.

Before performing the PCA, the communalities of the variables were established (see table 5). The communalities in table 5 explain the total amount each variable shares with all other variables included in the analysis. It is very useful in deciding which variables to finally extract in the rotation and in determining the suitability of the sample size (Field 2005).

According to Field (2005), the principal component analysis can be used when the value of the determinant R is greater than 1.0×10^{-5}. Using the SPSS version 17, the determinant R is 0.02 which is greater than the specified value of 1.0×10^{-5} indicating that this requirement has been met.

The KMO and Bartlett's test of sphericity is another criterion to be met. Kaiser (1974) cited in Field (2005) recommends values greater than 0.50 as acceptable. From table 6, the KMO value of 0.789 > 0.50 satisfying the KMO sampling adequacy criterion.

The Bartlett's measure tests the following hypothesis:

Null hypothesis (H_o): All correlation coefficients are zero and the alternative hypothesis (H_1): All correlation coefficients are not zero. This hypothesis is

tested using the significance test (i.e.) whether the significant value is less or greater than 5% level of significance. If the Bartlett test is significant (that is $p < 0.05$, then H_o is rejected and H_1 accepted). From table 6, H_1 is accepted since [χ^2 (66) = 236.23, $p < 0.05$, p= 0.000] indicating that there are some relationships between the variables. This result indicates that the Bartlett's test of sphericity is met.

Table 5: Communalities of qualitative factors

	Initial	Extraction
Payment difficulties	1.000	.683
Approval of Variation Order	1.000	.658
Type of funding -IDA, MIDA, JICA	1.000	.585
GOG and Consolidated	1.000	.531
Errors in design	1.000	.594
Severe/adverse weather	1.000	.550
Material shortage	1.000	.491
Delay in giving site possession	1.000	.665
Effective communication between agency and contractor	1.000	.619
Equipment	1.000	.558
Project_Location	1.000	.704
Topography of area	1.000	.539
Extraction Method: Principal Component Analysis.		

Table 6: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.789
Bartlett's Test of Sphericity	Approx. Chi-Square (χ2)	236.230
	Degree freedom (df)	66
	Sig.	.000

The third component has type of funding (IDA, MIDA, JICA) and payment difficulties having factor loadings of 0.725 and 0.683 respectively. This component (FAC3) is renamed as *payment issues.*

Using the factor analysis model, the duration can be expressed mathematically as:

For component 1, $FAC1 = m_1 (PL) + m_2 (EC) + m_3 (EA) + m_4 (TA)$ ……. (8)

Where m_1, m_2 m_3 and m_4 are the component score coefficients of the individual factors in each component in table 8.

For component 2, $FAC2 = m_1 (VO) + m_2 (ED) + m_3 (SAW)$ ……. (9) and for component 3, $FAC3 = m_1 (TF) + m_2 (PD)$ ……. (10)

Using equations 8 through to 10 and the component score coefficient in table 8, equation 4 can be rewritten as:

T = 0.33* PL + 0.31*EC + 0.241*EA + 0.211*TA + 0.388*VO + 0.32*ED + 0.312*SAW + 0.462*TF + 0.385*PD ……. (11), where T is duration in days. The definitions of the independent variables have been made in table 8.

Table 7: Rotated Component Matrix[a]

	Component		
	1	2	3
Project Location	.807		
Effective communication between agency and contractor	.779		
Equipment Availability	.694		
Topography of area	.604		
Delay in giving site possession	.569		-.461
Approval of Variation Order		.778	
Errors in design		.728	
Severe/adverse weather		.679	
Material shortage	.459	.525	
GOG and Consolidated		.455	.434
Type of funding -IDA, MIDA, JICA			.725
Payment difficulties		.446	.683

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Table 8: Extracted most significant qualitative factors affecting duration using PCA.

FAC1	FAC2	FAC3
Location of site and communication	Compensation events	Payment issues
Project location (PL) Effective communication between agency and contractor (EC)	Approval of variation order (VO)	Type of funding (TF) : (IDA, MIDA JICA)
Equipment availability (EA)	Errors in design (ED)	Payment difficulty (PD)
Topography of area (TA)	Severe/adverse weather (SAW)	

Table 9: Component Score Coefficient Matrix

	Component		
	1	2	3
Payment difficulties	-.163	.177	.385
Approval of Variation Order	-.184	.388	.052
Type of funding -IDA, MIDA, JICA	.094	-.162	.462
GOG and Consolidated	.053	.110	.213
Errors in design	-.061	.320	-.006
Severe/adverse weather	-.019	.312	-.163
Material shortage	.090	.188	-.116
Delay in giving site possession	.180	.127	-.350
Effective communication between agency and contractor	.310	-.116	.006
Equipment availability	.241	.007	-.091
Project Location	.330	-.174	.121
Topography of area	.211	-.076	.204

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Table 10 shows the initial eigenvalues associated with each component before extraction, after extraction and rotation. The eigenvalues represent the variance explained by each component. Component 1 explains 34.624%

of the total variance, with components 2 and 3 explaining 14.056% and 11.131% respectively. The eigenvalues of these three components (factors) are greater than 1 and are those extracted. The three (3) retained components cumulatively constitute 59.811% of the total variance of the data. Tables 7 and 9 show the rotated component matrix and the component score coefficient matrix respectively with its factor loadings and the rotation method. Table 7 shows that project location (0.807), effective communication between agency and contractor (0.779), equipment availability (0.694) and topography of area (0.604) load highly on component 1 (FAC1) and this component can be described as *location of site and communication*. For the second component, approval of variation order (0.778), errors in design (0.728) and severe or adverse weather (0.679) load highly on component 2 and this component is renamed as *compensation event factors* (FAC2). For the conditions of contract (medium sized) used to administer these projects, the three factors under this component are regarded as compensation events under the contract. For instance, where a variation order is issued by the agency, the contract duration is extended upon request by the contractor. This is applicable to FIDIC and the conditions of contract for medium sized contracts issued by the Public Procurement Authority (PPA) of Ghana.

Table 10: Total variance explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.155	34.624	34.624	4.155	34.624	34.624	2.973	24.778	24.778
2	1.687	14.056	48.680	1.687	14.056	48.680	2.522	21.016	45.794
3	1.336	11.131	59.811	1.336	11.131	59.811	1.682	14.017	59.811
4	.897	7.473	67.284						
5	.702	5.850	73.134						
6	.623	5.189	78.323						
7	.578	4.819	83.142						
8	.547	4.557	87.699						
9	.466	3.882	91.581						
10	.385	3.205	94.786						
11	.368	3.066	97.852						
12	.258	2.148	100.000						

Extraction Method: Principal Component Analysis

DISCUSSION

This section basically discusses the six most significant factors indicated in table 3.

The RII in table 3 showed that this payment difficulty is ranked first. It is also obvious from the factor analysis model in equation11, that payment difficulty (38.5%) is the third most significant contributor among the twelve factors. This was expected because payment difficulty by the road agency and for that matter Government of Ghana has been a major problem for the contractors and professionals at the agency. This finding corroborates that of Mensah (2017), Amoatey and Ankrah (2017), Famiyeh et al, (2017), Akomah and Jackson (2016), Amoatey et al, (2015) and Frimpong et al, (2003) who found that delay in honouring payment certificate by the agency

were ranked first by the respondents and is responsible for delay in road projects (in the case of Mensah,2017, Amoatey and Ankrah, 2017 and Akomah and Jackson, 2016), educational projects and housing (in the study by Famiyeh et al, 2017 and Amoatey et al, 2015) and ground water projects (Frimpong et al, 2003) in Ghana respectively. This finding also agrees with Bagaya and Song (2016) whose study confirmed that payment difficulty by owner was ranked second by professionals in Burkina Faso. The finding is further corroborated by Kaliba et al, (2009) and Alaghbari et al, (2007) who found that financial difficulty or delay in payment is the main factor causing delay in Zambia and Malaysia respectively. In Ghana, most of the projects at the agency are abandoned by contractors for lack of prompt payment (Mensah 2017). As opined by Amoatey et al, (2015), the Government of Ghana is the main financier of public sector projects and disbursement of budgetary allocations to Government institutions are irregular. At the agency, contractors are expected to be paid within three months after the payment certificate is signed by the Project Manager who is the director of the agency representing the Government. The payment difficulty is normally associated with the type of funding. Donor funded projects do not normally experience payment difficulty as the funds are normally monitored by the donors, ensuring that the funds are not misappropriated. Contractors working for the agency tend to be comfortable with such projects.

Secondly, the type of funding (Government of Ghana/consolidated fund) ranked as second by RII method whereas funding type by donors was ranked 8th. The possible reason is that payments are regularly made for donor funded projects; the resources are channeled into the works by the contractors to ensure that the works are completed on time to avoid the deduction of LAD. The type of funding (i.e donor funded projects such as IDA, MIDA, JICA) is the most significant factor (46.2%) according to the factor analysis model in equation 11. Donors normally do not allow the client (Government of Ghana to channel the resources to other sectors other than the intended purpose. Thus, donor funding is not flexible to the client. In the study conducted by Amoatey and Ankrah (2017), they found that "inflexible funding allocation to project items" which is donor related as the fifth ranked factor impacting on delay of projects. Government of Ghana/consolidated fund type of funding affects the duration in the sense that by the time payments are due to contractors, the funds may have been channelled into other sectors of the economy. This affects the contractor's cash flow position which negatively impacts their work programmes. In 2012, some phases of Cocobod funded road projects from the agency suffered from this situation where contractors had to wait for one year and a half for their payment certificates to be honoured (Mensah, 2017). This led to abandonment of some of these projects. As a result, the contractors prefer the donor funded projects such as IDA, MIDA and JICA ranked as 8th with RII of 0.7532. The ranking of the donor funded projects as 8th was not surprising since it improves the contractor's cash flow position and positively impacts on the duration of such projects. Because payments are regularly made for donor funded projects, the resources are channelled into the works to ensure that the works are completed on time. It is therefore

important that professionals at the agency take into account the source of funding of a project when fixing contract duration. Approval for variation orders on the other hand was ranked third by the RII method and second (38.8%) by the factor analysis model in equation11. This factor normally occursas result of review of scope works. This factor was however, ranked third by Amoatey and Ankrah (2017), fourth and fifth by Akomah and Jackson (2016) and Amoatey et al, (2015) respectively in Ghana. Famiyeh et al, (2017) ranked this factor (client initiated variation) as fifth. Normally for road projects, the contractors are expected to carry out the clearing before certain works such as culvert construction points are located. Drainage structures such as culverts and other inventory needs may not have been incorporated in the design as long as clearing of the site had not been done. In the process, a review of the works is carried out resulting in variation orders being issued. Another important factor worth mentioning is the little time for project preparation as pointed out by Mensah (2017). This means that some of the projects are not effectively prepared before award. The consequence is the issuance of a variation order to review the works.

Furthermore, errors in design which was ranked fourth by the RII method and fifth by the factor analysis model in equation 11 is one of the important factors impacting on duration. This factor was however, ranked 8th by Amoatey et al, (2015). The professionals at the agency are given short time to effectively design a road for instance before awards are made to contractors. The effect is that there may be errors in the initial design used in the preparation of bills of quantities (BOQ) in the contract. This normally leads to variation orders (ranked as 3rd) being issued during the implementation stage of the project.

Another factor ranked fifth by the RII method was shortage of materials. The factor analysis model, however, did not consider shortage of material as a significant factor. Indeed, this factor had a small value of component score coefficient in table 9. This particular factor was very prominent from 2004 to 2008 as contractors found it difficult to get stones especially for concrete and chippings for sealing works (Mensah, 2017). To resolve this problem, some of the well-resourced contractors formed their own quarry sites for production of chippings and stones of various sizes in order to have these materials for usage of contracts awarded to them. Although this factor was ranked fifth, the impact on the duration before 2004 and beyond 2008 appears to have dwindled. This is the possible reason why Frimpong et al, (2003) found that the overall ranking of this factor was 15th by construction professionals for ground water projects in Ghana in 2003.

Lastly, equipment availability was ranked sixth by the RII method (see table 3). The factor analysis model, however, considered equipment availability (24.1%) as 8th. Most of the contractors executing projects at the agency in Ghana do not have their own equipment and tend to hire from well-resourced equipment holding firms for their projects. Sometimes, the smaller contractors have to cue in other to have the equipment released to their project site. According to Bagaya and Song, (2016), timely availability

of equipment of suitable volume and quality is essential and unavailability is a problem in landlocked countries and the Ghanaian construction industry is no exception. To ensure the availability of the equipment, the Government of Ghana has reduced import duties on them to encourage the contractors to import fleet of equipment into the country (Mensah,2017).

Further discussion based on principal component analysis (PCA)
The PCA analysis showed that the factors determined can be grouped and renamed under three different headings namely *location of site and communication, compensation events and payment issues*. Each of these components had different factors which are correlated with one another. For instance, the payment issues component had payment difficulty and type of funding as factors. These two factors refer to the same issue (i.e) payment and therefore would measure the same construct. To determine the most significant factor in the payment issue component, the factor with the highest component coefficient score (table 9) is used. Therefore for component 3, type of funding (0.462) is the most significant factor and this of course is correlated with the factor, payment difficulty. For component 1, however, the most significant factor is project location (0.330) and this factor is correlated with the topography of the area, equipment availability etc. The most significant factor for component 2 is approval of variation order (0.388) and this is correlated with the factors, errors in design and severe/ adverse weather.

Thus, using the PCA, the three most significant factors are the type of funding, project location and approval of variation orders.

RECOMMENDATION

Based on the findings made in this study, the following recommendations are made:

Payment difficulty and type of funding
The issue of payment delay and type of funding which have been found to be the most significant factors affecting project delay has to be addressed. To address this, the Government of Ghana who is mainly the employer of public projects such as road and bridge construction projects, should ensure that projects are budgeted for before awards are made. It is also important to ensure that the monies allocated to the budgeted projects are not misappropriated but used for the intended purpose. When these measures are put in place, no matter the type of funding, projects will not experience delays and abandonment. These measures will ensure that executed projects are paid within the stipulated time indicated in the contract documents. Prompt payment will also mean that accumulated interests claims by contractors for late payment, which is a burden on the limited budget will be eliminated or minimized.

Approval of variation orders and errors in design
Professionals at the Department of Feeder Roads should issue variation orders on time when the scope of works is to be revised to ensure smooth completion of the project. They should also be given ample time to design

and prepare project estimates before they are awarded. This will minimize the issuance of variation orders on contracts.

Shortage of materials
The Government of Ghana should promote the private sector manufacturing materials for the construction industry. Recently the cement producing factory, Ghacem Ltd which used to be the only company producing cement for concrete works has other competitors such as Dangote producing similar material (Mensah, 2017). In addition, quarry producing firms could be established to ensure that shortage of quarry products do not re-occur as it did from 2004 to 2008.

Equipment availability
The Government could solve this problem by reducing importation charges drastically on fleet of equipment. This can go a long way to ensure that equipment are available in the country for execution of construction projects.

Project location
Although the RII method considered this factor as unimportant, the PCA did not. The location of a project has impact on the duration because of the availability of material, rainfall pattern as well as other factors. For instance, the Axim areas of the Western region of Ghana has severe rainfall pattern than other areas of the country. Therefore, for projects in such areas, the duration given should be different from other locations.

LIMITATION OF STUDY

The findings of this study are limited to professionals at the Department of Feeder Roads only and does not take into account the views or opinions of professionals in other state institutions. In addition, the results are limited to the twelve factors indicated in the questionnaire and did not incorporate other likely factors that may have influence on the duration of both road and bridge construction projects.

CONCLUSION

The study has identified six most significant factors that contribute to delay in public projects in Ghana. These factors are payment difficulty, type of funding, approval of variation orders, errors in design, shortage of materials and equipment availability. It is important to note that the relative importance index and the principal component analysis used in this study gave different results as to which factors contribute significantly to the duration of construction projects. Recommendations have been made to professionals at the department and the government to deal with these factors in order to prevent projects from suffering from delays. From the results obtained, lack of payment to contractors is key to ensuring that projects are successful. No matter the project management tool applied in managing public projects, payment difficulty will affect the contractors' cash flow position as well as their work programme and eventually lead to delays.

It is the hope of the authors that these key factors identified would be critically given the attention that they deserve to prevent delay of future projects.

REFERENCES

Ahadzie, D.K., 2007. A model for predicting the performance of project managers in mass house building projects in Ghana. (Doctoral dissertation, University of Wolverhampton, UK). http://wlv.openrepository.com/wlv/handle/2436/15393 - Accessed 7/10/2016

Aibinu A.A and Jagboro G.O (2002), The effects of construction delays in Nigerian construction industry. International Journal of Project Management 20(8): 593-599.

Akomah B.B and Jackson E.N (2016), Contractors' Perception of Factors Contributing to Road Project Delay. International Journal of Construction Engineering and Management 5 (3): 79-85.

Alaghbari, W.E., Razali A. Kadir, M., Salim, A. and Ernawati, (2007). The significant factors causing delay of building construction projects in Malaysia. Engineering, Construction and Architectural Management, 14(2):192-206.

Amoatey, C.T., Ameyaw, Y.A., Adaku, E. and Famiyeh, S. (2015). Analysing delay causes and effects in Ghanaian state housing construction projects. International Journal of Managing Projects in Business, 8(1): 198 - 214.

Amoatey C. and Ankrah A.N.O, (2017) "Exploring critical road project delay factors in Ghana", Journal of Facilities Management, Vol. 15 Issue: 2, doi: 10.1108/JFM-09-2016-0036

Asiedu R.O, Frempong N.K and Nani G. (2016), Parametric time overrun estimation of building projects. Journal of Financial Management of Property and Construction, 21(3): 253 – 268.

Badu E, Owusu – Manu D, Edwards D.J, Adesi M. and Lichtenstein S. (2013), Rural Infrastructure Development in the Volta Region of Ghana. Journal of Financial Management of Property and Construction 18(2): 142 -159.

Chan DWM (1998), Modelling construction durations for public housing projects in Hong Kong. Unpublished PhD thesis, the University of Hong Kong, Hong Kong.

Chan D.W.M and Kumaraswamy M.M (2002), Compressing construction durations: Lessons learned from Hong Kong building projects. International Journal of Project Management 20(1): 23 – 35.

Esteves, J. (2004), "Definition and analysis of critical success factors for ERP implementation projects", doctoral thesis, Universitat Politècnica de Catalunya, Barcelona

Famiyeh S, Amoatey C. T, Adaku E, Agbenohevi C.S, (2017) "Major causes of construction time and cost overruns: A case of selected educational sector projects in Ghana", Journal of Engineering, Design and Technology, Vol. 15 (2):181-198

Frimpong Y, Oluwoye J, Crawford L (2003), Causes and cost overruns in construction of groundwater projects in developing countries (Ghana as a case study), International Journal of Project Management 21(5): 321-326.

Field A.P (2005), Discovering statistics using SPSS (2nd edition). London: Sage. Abridged version of Chapter 15 of Field (2005). www.statisticshell.com/docs/factor.pdf - Accessed 16/2/2015

Hassan Adaviriku Ahmadu, Yahaya Makarfi Ibrahim, Ahmed Doko Ibrahim and Muhammed Abdullahi (2015), Modelling building construction durations. Journal of Financial Management of Property and Construction 20(1): 65 -84.

Hoffman G.J, Jr A.E.T, Webb T.S and Weir J.D (2007), Estimating performance time for construction projects. Journal of Management in Engineering 23(4): 193-199.

Jiang Y and Wu H (2007), A method for Highway Agency to Estimate Highway Construction Durations and set Contract Times. International Journal of Construction Education and Research 3(3):199 – 216

Kaliba C, Muya M and Mumba K (2008), Cost escalation and schedule delays in road construction projects in Zambia. International Journal of Project Management, 27(5), 522-531.

Kumaraswamy M. and Chan W (1998), Contributors to Construction Delay. Construction Management and Economics 16(1):17-29.

Mensah I. (2017), Models for forecasting the duration for rural roads and bridge construction projects in Ghana. PhD thesis. Kwame Nkrumah University of science and Technology. Kumasi

Mutalib, S.N.S.A, Juahir H., Azid A., Sharif, S.M, Latif M.T, Aris A.Z, Zain S.M and Dominick D (2013), Spatial and temporal air quality pattern recognition using environmetric techniques: a case study in Malaysia. Environmental Science, Processes and Impacts 15(9): 1717 - 1728.

Nkado R.N (1995), Construction time-influencing factors: the contractor's perspective. Construction Management and Economics 13 (1): 81-89.

Olawale Y. and Sun M. (2015), Construction project control in the UK: Current practice, existing problems and recommendations for future improvement. International Journal of Project Management 33: 623 – 637.

Odusami K.T and Olusanya O.O (2000), Client's Contribution to Delays on Building Projects. The Quantity Surveyor 30: 30 -33.

Ofori – Kuragu J.K, Baiden B.K and Badu E. (2016), Key Performance Indicators for Project Success in Ghanaian Contractors. International Journal of Construction Engineering and Management, 5(1): 1 – 10.

Sweis G, Sweis R, Hammad A.A and Shboul A (2008), Delays in construction projects: the case of Jordan. International Journal of Project Management 26(6): 665-674.

Williams, B., Onsman, A. and Brown, T., (2010). Exploratory factor analysis: A five-step guide for novices. Australasian Journal of Paramedicine, 8(3): 1 – 13.

Yong A. G. and Pearce S. (2013), A beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis. Tutorials in Quantitative Methods for Psychology 9(2): 79 -94.

ACCESS TO LAND AS A CONSTRAINT TO HOMEOWNERSHIP IN KADUNA STATE, NIGERIA

Chukwuma C. Nwuba[1]
Department of Estate Management, Kaduna Polytechnic, Kaduna, Nigeria

Access to land is fundamental to homeownership. It is especially relevant to households in housing markets in which households build rather than buy their homes. The study evaluated the role of access to urban land as a constraint to homeownership in Kaduna State, Nigeria. The objective was to determine the ways access to land poses constraint to homeownership such that households who desire homeownership are constricted from accessing it. The research design was a mixed method design, the explorative sequential method. It involved interviews and cross-sectional survey in which the outcomes of the interviews were used to design the survey instrument. The survey questionnaire structured on 5-point Likert model was administered on 450 urban households in the state. Data analysis employed descriptive statistics and one-sample t test. The results showed that access to land measured by affordability and ease of transaction poses constraint to homeownership. High cost of land is the most important constraining factor. Purchase from private landowners is the most common method of land acquisition. The study concluded that difficulties in access to land constitute an important contributor to delays in accessing homeownership by urban households. Further, access to land poses constraints to homeownership but its impact differs between markets. Accordingly, to improve urban homeownership, government should invest in providing serviced land in form of site and services to households at subsidised prices. Measures to improve access to urban land for homeownership should have regard to the peculiarities of particular land and housing markets.

Keywords: access to land, homeownership, housing markets, land markets, urban housing problems

INTRODUCTION

Housing is an essential social and economic commodity. As a social good, it is fundamental to family well-being, harmony and stability. As an economic good, it is a store of wealth and an important investment avenue. Thus, housing is an issue for public policy.

[1] chuksnwuba@gmail.com

Nwuba, C. C. (2017) **Access to land as a constraint to homeownership in Kaduna State, Nigeria** *In: **Laryea**, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 140-159.

Access to land is essential to housing delivery. It is a fundamental basis for shelter and other economic activities (UN-Habitat, 2008). Indeed, facilitating access to land and securing the means of paying for the land is a most important prerequisite for the development of sustainable human settlement policy (Aluko, et al., 2004). Access to land by households is fundamental to homeownership in urban housing markets in developing countries like Nigeria where to access homeownership, households usually have to acquire land and build their homes rather than buy completed ones. Arimah (1997) found that access to land is a key determinant of the probability of homeownership in Ibadan, Nigeria. Similarly, Nwuba (2015) found that access to land is an important factor to housing affordability in Kaduna State. The implication is that measures to solve homeownership problems would require dealing with the question of access to land.

Researchers have viewed access to land as a most formidable obstacle to Nigeria's urban housing delivery (Ogu and Ogbuozobe, 2001; Olugbenga and Adekemi, 2013; Owoeye and Adedeji, 2015; Udechukwu, 2008; Ugonabo and Emoh, 2013). It is important however, to determine how access to land poses constraint and which elements of land access are most important on the issue especially with respect to homeownership. Empirical literature in this regard in Nigeria's housing markets is lean. Gbadegesin, et al. (2016) who investigated the subject in Lagos, southwest Nigeria and Stanley and Orobowale (2011) who researched on Abuja, federal capital city did not specifically address homeownership. Udechukwu (2008) who researched obstacles to individual homeownership did not focus on access to land. Moreover, none of these studies focused on Kaduna State. In fact, the vast majority of studies on land markets in Nigeria focus on the south. There are thus important research gaps in the housing market literature which need to be filled

Accordingly, this study attempted to fill the gaps by investigating the role of access to land as a constraint to urban homeownership in Kaduna State. Homeownership in this context refers to owner-occupier housing. The objective was to determine the ways access to urban land by households poses constraint to homeownership such that households who desire homeownership are constricted from accessing it. The focus was the low and middle-income households who build rather than buy their homes – households whose incomes are less than or equivalent to the terminal point of Grade level 11 in the federal civil service, the range considered low and middle cadres.

THE RESEARCH CONTEXT

Nigeria, a West African country is a classic case of rapid urbanisation and urban housing problems. Its current (2015 – 2020) urban growth rate of 4.30% (United Nations, Department of Economics and Social Affairs, Population Division, 2014) is among those on the high side. Its urban population grew from about 6,967,000 or 15.4% of the total in 1960 to 87,681,000, which was 47.8% of the total in 2015 (United Nations,

Department of Economics and Social Affairs, Population Division, 2014). This represents an increase of 1,158.5% over 55 years. Consequently, meeting urban housing needs has been a daunting task for the country and urban housing problems appear to have defied all solutions. The rapidly expanding urban population has increasingly worsened and complicated environmental and human settlement problems (Alkali, 2005).

The World Bank (2009) and Nigeria's Vision 2020 National Technical Working Group on Housing (Federal Government of Nigeria [FGN], 2009) described the housing conditions as poor by any standard. Earlier, the United Nations Centre for Human Settlement, UNCHS (1993, p46) stated thus: "housing remains one of Nigeria's most intractable problems". Furthermore, Tibaijaka (2004) noted that Nigeria was one of the most bleak cases of housing problems. The Nigeria Housing Finance Programme (2014) put the cumulative housing deficit as of 2014 at about 17 million units.

Nigeria's public housing programmes over the years have focused on direct provision of owner-occupier urban housing. However, the literature indicates that the programmes have done little to address housing problems. (Aluko, 2012; Ikejiofo, 1999; Muhammad and Bichi, 2014; Ndubueze, 2009; Nwaka, 2005). Even the recently adopted private public partnership, PPP, for urban housing delivery has a problem of affordability (Ukoje and Kanu, 2014). In contrast, the government of Botwana has made considerable efforts to ensure provision of and access to urban housing through appropriate urban land and housing policies and programmes (Mosha., 2013).

Home building by households has therefore been the primary means of accessing homeownership in Nigeria. This requires ease of access to land by households. One of the reasonings behind the promulgation of Nigeria's land law, the Land Use Act, 1978 was to make land readily available and accessible to all eligible Nigerians. However, researchers have asserted that the law has failed in this regard as it is poses constriant to access to land and consequently impedes housing delivery (Akeju, 2007; Ayedun and Oluwatobi, 2011; Bello, 2009; Ugonabo and Emoh, 2013).

Kaduna State situates in northcentral Nigeria although it belongs to the Northwest geopolitical zone. Its urban housing markets can be segmented in ways such as sectoral as in public and private housing, geographical as in cities and locations within cities, type of housing, and densities. In the major urban areas, the housing markets are particularly segmented by locations. These locations are delineated by densities – the low, the medium and the high densities.

The urban land and housing markets are dominated by the private sector especially individuals and households. Government presence in the markets is noticeable in regulations and to a lesser extent in operations in form of land allocations and public housing provisions. Except for government housing programmes, purchase of homes by households is uncommon. Households usually acquire land and build their own homes.

Growing urban population has been exerting pressure on land and housing, resulting in rising costs. Therefore, studies as this which investigate access to urban land in relation to homeownership are useful in dealing with urban housing problems.

LITERATURE REVIEW

In many developing countries, especially for the low and middle-income households, housing is a process to undertake rather than a product to purchase as it is in the advanced countries. Households generally access homeownership through a gradual building process, which they finance mostly through informal sources. In such systems, as in Nigeria, access to land by households is vital to homeownership. In Nigeria, the housing market is predominantly in undeveloped plots rather than completed housing units (Federal Government of Nigeria [FGN], 2009). This is a feature of economies in which housing markets are not well developed.

Citing various sources, the UN-HABITAT (2008) defined access to land as 'opportunities for temporary or permanent use and occupation of land …' (p5). It stated that land access is obtained by exchange, direct occupation, through membership of a family and kin groups or by allocation by government or other land owners. It defined land right as 'socially or legally recognised entitlement to access, use and control …land … (p5). Similarly, land tenure is 'the way land is held or owned … or the set of relationships legally or customarily defined among people with respect to land (p5).

Omirin (2002) conceptualised land accessibility with four elements– availability, affordability, ease of transaction, and security of tenure. Implicit from the conceptualisation is that for a group to be described as having access to land, usable land with secure tenure has to be physically available and economically affordable to them with ease of transaction to obtain it. Some Nigerian studies have employed this conceptualisation to analyse or explain access to land (Aluko, et al., 2004; Babajide, 2014; Odum and Ibem, 2011). This concetualisation guided this study. The study evaluated the role access to urban land measured by these elements, plays in constraining homeownership.

Findings have revealed challenges with land availability and tenure security in urban land acquisition in Akure, western Nigeria (Owoeye and Adedeji, 2015). In Rivers and Ogun States,high cost of land, tenure security and land transaction/transfer difficulties were respectively found to be the most importnant land access constraining factors (Chukwuemeka and Kalu, 2016; Oladehinde, et al, 2017). In contrast, Gbadegesin et al, (2016) found that in Lagos security of tenure was the most important while availability was the least important accessiblity factor.

Availability

Availability is a function of the quantity of land available in any city and more importantly the portion of it that is in the market or can be brought to the market in the short run. For urban housing, useability is an important factor in the availability of land. Findings from Abuja and Minna, Nigeria

showed that residents access land mostly by purchase from informal land markets. (Babatunde, et al., 2014). Ogu and Ogbuozobe (2001) identified purchase from 'government acquired areas', acquisition from landowners and acquisition through traditional land holdings as the sources from which Nigeria's urban dwellers can legally acquire land for housing development.

In a study of informal land delivery process in six African cities including Enugu, Nigeria, Rakodi and Leduka (2004), concluded that the informal land delivery systems are the main channels of supply of land for housing. They further concluded that the informal systems are effective in delivering land for housing and that they play larger role than the formal and public sector land systems do. Indeed, for the urban poor and the substantial segment of the low- and moderate-income groups there is no option but to access land and housing through the informal markets (Durand-Lasserve, 2006).

In recent times, public servants in Nigeria have attempted to overcome some of the challenges of accessing urban land for homeownership through group purchase and formalisation by staff cooperative societies. Odum and Ibem (2011) found that this method has advantages such as enabling access to urban land with secure tenure at reduced costs, avoiding double payments and taking away the risks which individual buyers could face due to ignorance in land market operations.

Availability is an important element because land has to be available before it can be accessed. Yet, there are other important elements which are discussed below.

Affordability

In the simplest term, affordability is the ability to pay for land. A household's access to land is limited to their ability to pay. Nwuba et al (2015) found that cost of land has a negative impact as a determinant of urban homeownership affordability. They stated that land prices generally determine access to urban residential land in Kaduna State. Similarly, Makinde, (2014) observed that high price of land is a major constraint to urban housing delivery in Nigeria. Aluko, et al (2004) indicated that the costs of acquiring land in the informal markets in Lagos State could be as high as four times the cost of acquiring equivalent plot of land from the state government.

Households cannot access land if they cannot afford it no matter how much of it is available. Thus, affordability is also an important factor in access to land.

Ease of transaction

Ease of transaction is viewed in terms of the process of getting through the land market and formalising transactions as provided by law to obtain valid and secure land titles. Under the Land Use Act alienation of urban land requires the consent of the Governor. Umeh (2007) has argued that the powers conferred upon the governors constitute major constraint to healthy land market.

The World Bank (2009) observed that the costs for formalising land transactions in Nigeria were cumulatively the highest in the world. On the other hand, Doing Business, 2012 ranked Nigeria 180 out of 183 economies in registering properties with 13 procedures, 82 days and 20.8 percent of property value (The World Bank, 2012). In addition, findings indicated that outdated information storage system, political influence and delay in processing are some of the problems encountered in land acquisition through direct grant from the government in Kaduna (Yakub, 2014). Aluko, et al (2004) noted that the procedure for perfection of title after purchase of land in Lagos State is cumbersome, bureaucratic, costly and lengthy.

High transaction costs are capable of causing market failure because they limit the ability to transact. (Marx, 2007). The result is that land transactions are forced outside official channels and most titles are informal. As Nwuba (2015) has stated, informality predominates Nigeria's urban land markets. Marx (2007) has asserted that for South Africa, formality and informality had become so inter-twined that they were no longer of much value in explaining urban land market. To overcome the deficiencies of the formal land delivery system, it is necessary to integrate the informal delivery system into the decision-making machinery of land supply for housing, security of tenure, land servicing and development control. (Kombe and Kreibich, 2000). In view of the foregoing, this investigation covered access to urban land through the formal and the informal markets.

Security of Tenure

Security of tenure gives confidence to market operators. Citing different sources, the UN-Habitat (2008, p5) defined security of tenure in three ways. First, the degree of confidence that land users will not be arbitrarily deprived of their rights over land. Second, "the certainty that an individual's right to land will be recognised by others and protected in cases of specific challenges". Third, "the right of all individuals and groups to effective government protection against forced evictions". However, security of tenure does not derive only from formal legal forms but also from other aspects and instruments (UN-Habitat, 2003). Payne, (2001) indicated that to households, perceptions of tenure security were as important as legal status.

Providing titles to land with instruments such as certificates of occupancy, title registration and documentation of transactions are important aspects of security of tenure. However, land purchasers in Nigeria most often do not register their titles and formalise their transactions due to such factors as ignorance, high processing costs, delays and lengthy process involved, extortion of money by officials, and government insensitivity (Babatunde, et al., 2014; Olanrele and Agbato, 2014). In Lagos State, Thontteh and Omirin (2015) found some problems of land registration – lack of institutional framework, high land charges, high cost of registration and inadequate technical skills. Findings have also revealed dissatisfaction in title registration process by land market operators in Nigeria (Babajide, 2014).

Secure tenure rights should be promoted as a means to achieving sustainable urban development (UN-Habitat/OHCHR, 2016).

Access to urban land has become topical due to worsening urban housing problems. Access to land connotes availability of usable land with secure tenure which people can access at affordable costs with ease of transactions. Access to land by urban households is particularly essential to homeownership in housing systems operating in many developing countries in which households acquire land and build their homes themselves.

RESEARCH DESIGN AND METHODS

The research was a mixed method, the exploratory sequential design. This is a mixed method research involving a qualitative study followed by a quantitative study in which a phenomenon is explored qualitatively first and the outcomes of the qualitative study are used to develop the quantitative study such as designing the instrument for the quantitative study (Cameron, 2009; Creswell, 2014; Creswell and Plano Clark, 2007). The instrument design model of the method was adopted. The process involved interviews first, followed by the development of survey instrument from the outcomes of the interviews and then a cross-sectional survey. The rationale for adopting this design was to situate access to land and its elements within the research context to enable the development of an appropriate instrument for a quantitative study.

The population comprised 705,322 regular urban households in Kaduna State. The 2006 national census regular household population of 1,115,974 in the state (National Population Commission (NPC), 2010) was updated to 2016 with the national annual average population growth rate of 2.65% (2005 – 2010) and 2.67% (2010 – 2015) (United Nations, Department of Economic and Social Affairs, Population Division, 2015). The following formula was applied in the updating:

$P_t = P\,(1+i)^t$ ……1

where Pt is the estimated population in the year t

P is the base population

i is the average annual population growth rate, and

t is the number of years for the update

The result was 1,451,280 households. The urban household population was then estimated at 48.6%, the country's proportion of urban population to the total in 2016 (United Nations, Department of Economic and Social Affairs, Population Division, 2014).

Thereafter, the sample size was determined with the Taro Yamane Sample size formula

$$n = \frac{N}{1+N(e)^2}$$

……2

Where n = sample size required.

N is the population size

e is the margin of sampling error expressed in decimal.

Applying the formula, the minimum sample size required at 5% margin of error is 400 households. A sample size of 450 households was accordingly selected and surveyed.

Table 1: Sample Size Distribution

Senatorial District	No of Households (per 2006 census)	City Surveyed	Sample Size	Percent
North	366,017	Zaria	148	32.9
Central	419,886	Kaduna	169	37.6
South	330,071	Kafanchan, Zonkw	133	29.5
Total	1,115,974		450	100.0

For efficient sample distribution, the study employed stratified two-stage cluster sampling scheme. The population was stratified into three based on the senatorial districts in the state. Sample allocation was proportionate. Kaduna city was surveyed in the Kaduna Central Senatorial District, Zaria was surveyed in Kaduna North while Kafanchan and Zonkwa were surveyed in Kaduna South (Table 1). Cluster sampling was then employed with the wards in each city as clusters. The sample frame was the list of wards in each city obtained from the National Population Commission. Households were then subsampled in the wards through random process. Household heads represented the households.

DATA COLLECTION

Interviews based on the land accessibility elements (Omirin, 2002) and outcomes from the literature review were employed in the first stage to explore the various aspects of access to land and the ways they constrain homeownership in the study area. The respondents were asked to explain the ways the various aspects of these elements constitute limitations to their bid to have their own houses. Twenty households were interviewed. The interviews were semi-structured.

The results of the interviews were employed to design the survey questionnaire. The questionnaire construct measuring constraints to homeownership was structured on Likert model with a 5-point scale ranging from 5 for strongly agree to 1 for strongly disagree, and 3 for neutral. The respondents were asked to rate the variables on the scale.

The validity and reliability of the questionnaire were measured based on a random sample of 50 households. The validation was done with the Kendall's coefficient of concordance (W). Kendall's W measures the degree of agreement or association among several categories of respondents. To validate the questionnaire, the null hypothesis that there is no agreement between the variables was tested at 5% level of significance. The result

showed $p < 0.05$. Accordingly, the null hypothesis was rejected, an indication that the instrument was valid.

The reliability was measured by the Cronbach's alpha statistic. The Cronbach's alpha obtained was 0.84 which is an indication that the instrument was reliable.

DATA ANALYSIS AND RESULTS

Analysis of the interview data was by deductive approach. The first stage was coding to align responses to themes based on the land accessibility elements and other set themes. In subsequent stages, new themes were added where necessary until there was no further information requiring a new theme. The outcomes were then analysed in themes and descriptive narrative was used to summarise the most salient results.

The results showed that the most significant constraint to homeownership posed by access to land is affordability. The respondents said that land costs were too high, especially when compared to their incomes. The most common way they acquire land is by purchase from private owners. The other elements posed constraints in diverse ways. Land availability problem centred on the lack of access roads and basic amenities in places where the households buy land. Many respondents who have bought land waited for some time before gaining access to develop them. Some provided amenities by themselves. The results also revealed diverse land instruments. Overall, access to land is a significant challenge to households who desire homeownership.

Analysis of survey data employed descriptive statistics and two-tailed, one-sample t-test. Using the Likert ratings, the variables were ranked in order of their importance based on their mean. The t test was used to test the statistical significance of constraints posed by each land accessibility element at 5% level of significance.

Respondents' Demographic Characteristics

Table 2 contains the summary statistics of the respondents' demographic characteristics. A majority of 77.8% were male household heads while 22.2% were female. Also, the majority of the household heads, comprising 80.9% were married while only 19.1% were single. Owner-occupier households comprised 40% of the sample while tenants at the different levels of the housing market made up 60%. Overall, the sample has a good spread over different categories of households. It is thus a good representative of the population.

Table 2 contains the summary statistics of the respondents' demographic characteristics. A majority of 77.8% were male household heads while 22.2% were female. Also, the majority of the household heads, comprising 80.9% were married while only 19.1% were single. Owner-occupier households comprised 40% of the sample while tenants at the different levels of the housing market made up 60%. Overall, the sample has a good spread over

different categories of households. It is thus a good representative of the population.

Table 2: Summary Statistics of Respondents' Demographic Characteristics

Characteristics	Frequency	Percent	Cum percent
Sex			
Male	350	77.8	77.8
Female	100	22,2	100.0
Marital Status			
Married	364	80.9	80.9
Single	86	19.1	100.0
Age bracket of respondent (years)			
Less than 30	68	15.1	15.1
30 – 39	154	34.2	49.3
40 – 49	142	31.6	80.9
Above 50	86	19.1	100.0
Educational level			
No formal education	8	1.8	1.8
Primary school	18	4.0	5.8
Secondary education	116	25.8	31,6
Degree/other tertiary education	308	68.4	100.0
Tenure Status			
Owner-occupier	180	40.0	40.0
Tenant building own house	72	16.0	56.0
Tenant owning land but yet to start building	110	24.4	80.4
Tenant not owning land but planning to acquire	88	19.6	100.0
Household Size			
1	38	8.4	8.4
2 – 4	146	32.5	40.9
5 – 7	144	32.0	72.9
8 – 10	56	12.4	85.3
Above 10	66	14.7	100.0
Household Income Bracket (Naira per month)			
18,000 and below	94	20.9	20.9
18,000 – 38,000	48	10.7	31.6
38,001 - 58,000	84	18.7	50.3
58,001 – 78,000	36	8.0	58.3
78,001 – 98,000	71	15.7	74.0
98,001 – 118,000 (approx.)	117	26.0	100.0
No of Years respondent has worked			
1 – 5	114	25.3	25.3
6 – 10	96	21.3	46.6
11 – 15	88	19.6	66.2
16 – 20	36	8.0	74.2
Over 20	116	25.8	100.0

Source: Field Survey, 2017

Land Acquisition Process

The data in Table 3 indicate that urban households acquire land mostly through purchase from private landowners. A majority of 68% acquired their land through this process as against just 10% who got their land by direct government allocation. A significant minority of about 22% inherited their land. In addition, agency is an important activity in the land markets. A majority of 50.4% purchased their land through intermediaries.

Interestingly, local land agents play a much larger role than registered estate surveying firms. They are the most important intermediary source with about 26.8% buying their land through them as against only 15.4% for registered estate surveying firms. Purchasing land directly from the owners is the highest single means of purchase, recording as high as 46%.

Table 3: Summary Statistics of Land Acquisition Processes

Variable	Frequency	Percent	Cumulative percent
How land was acquired			
If you have land or building, how did you acquire the land?	14	3.9	3.9
Direct state government allocation	22	6.1	10.0
Direct local government allocation	246	68.0	78.0
Purchase from private landowners	80	22.0	100.0
Inheritance from family/community land			
If you purchased your land, how did you buy it?			
Through a registered estate surveyor	38	15.4	15.4
Through a lawyer	8	3.3	18.7
Through a local land agent	66	26.8	45.5
Direct from the landowner	122	49.6	95.1
Through other intermediaries	12	4.9	100.0
If you purchased or inherited your land, did you register your title with the Lands Ministry?			
Yes	96	29.4	29.4
No	230	70.6	100.0
If you registered your title documents, what problems did you encounter in the process?			
High cost of the registration	72	75.0	N/A
Long process	84	87.5	N/A
Delays	64	66.7	N/A
If you did not register your title documents, what were your reasons			
Don't think it is necessary	150	65.2	65.2
Don't know about registration	80	34.8	100.0
If you have not got land yet, what is the reason?			
High cost of land	84	95.5	95.5
Have not found suitable land	4	4.5	100.0

Source: Field Survey, 2017

Furthermore, majority of land purchasers do not register their titles. Over 70% of respondents who purchased or inherited their land did not register their titles. However, a significant minority of 29% registered. This is a remarkable proportion in land markets where title registration is generally low. Registration comes with problems, the most significant being long process. Over 87% of the respondents who registered their titles encountered the problem. Over 75% said they encountered high costs. Interestingly, a majority of about 65% of the respondents who did not register their title do not consider registration necessary and 35% are ignorant of registration. This is an indication that majority of landowners are ignorant of the importance of registration of titles.

The findings also demonstrate that high cost is the most significant barrier to access to land. A whopping 95.5% of the respondents who do not have

plots said high cost prevented them. This demonstrates that land cost is an important determinant of access to land.

Nature of Titles

Table 4: Nature of Respondents' Titles

Nature of title on the land	Frequency	Percent	Cumulative percent
Statutory Right of Occupancy	68	18.8	18.8
Customary right of occupancy	92	25.4	44.7
No formal title	202	55.8	100.0
Evidence of formal title on the land			
State C of O	68	18.8	18.8
Local government C of O	92	25.4	44.2
No C of O	202	55.8	100.0
If the land has C of O, the C of O is::			
In your name	88	55.0	55.0
Previous owner's name	72	45.0	100
Evidence of your own title on the land			
What kind of documents do you have for the land in your name?			
State C of O	60	16.6	16.6
Local government C of O	28	7.7	24.3
Power of Attorney	19	5.2	29.5
Sale agreement	144	39.8	69.3
Deed of assignment	35	9.7	79.0
Purchase receipt	35	9.7	88.7
Others	3	0.8	89.5
No evidence of title	38	10.5	100.0

Source: Field Survey, 2017

As Table 4 shows, the level of land titling is low. Over 55% of landowners do not have formal title to the land, which is either statutory or customary right of occupancy as provided by the Land Use Act, 1978. Only about 44% have certificate of occupancy as evidence of title to their land. Even so, as much 45% do not have the C of O in their names. The most common evidence of title is sale agreement. Other evidences include purchase receipt, deed of assignment and power of attorney. The issue of concern however is that these documents are scarcely registered. As a result, security of tenure is hampered.

Constraints to homeownership posed by Access to Land

Table 5 contains data on constraints to homeownership posed by access to land. From the results, high cost of land, a variable of affordability, poses the highest constraint. The respondents agreed with a mean rating of 3.96 that this variable poses constraint to homeownership. A substantial majority of about 72.4% of the respondents actually agreed that the variable is a constraint. Only 12% disagreed while about 15.6% were neutral. The second most important is also a variable of affordability – high cost of land relative to incomes of households. Respondents scored the variable 3.94 to agree that it is a constraint. Again, a significant majority of 72% of the respondents agreed that it is constraint while just 9.3% disagreed. The remaining 18.7% were neutral. A variable of ease of transaction, difficulty

in registering title ranked third. Respondents rated it a mean of 3.92 to agree that it is barrier to homeownership. Again, a majority of 70.7% agreed that the variable is a constraint while 9.3% disagreed. The remaining 20% were neutral.

Table 5: Ranking of constraints to homeownership posed by elements of access to land

Response items	N	Mean	Remark	Rank
The following land-related factors are/were constraints to building my own house when I desired to build				
Affordability		*3.95*		
General high cost of residential land	450	3.96	Agree	1
High costs of residential land compared to my income	450	3.94	Agree	2
Availability		*2.97*		
Scarcity of residential land	450	2.75	Neutral	12
Scarcity of serviced residential land	450	2.93	Neutral	8
Lack of access road to plots	450	3.09	Neutral	6
Lack of basic amenities in residential layouts	450	3.12	Neutral	5
Security of Tenure		*2.66*		
Land not having C of O	450	2.92	Neutral	9
Land not having title documents	450	2.90	Neutral	10
Fear that government might say we are squatters, demolish the buildings and evict us	450	2.87	Neutral	11
Fear that government might acquire the land and evict us	450	2.94	Neutral	7
	450	2.13	Disagree	14
Land dispute	450	2.20	Disagree	13
Because of fake land documents				
Ease of transaction		3.71		
The process of buying land is difficult	450	3.49	Neutral	4
The process of registering title is difficult	450	3.92	Agreed	3

Source: Field survey, 2017

The findings also indicate that the least important constraint is posed by a variable of security of tenure, land dispute which ranked bottom of the scale with a mean of 2.13. Respondents disagreed that it is a barrier. A substantial majority of 72% disagreed whereas just 11.1% agreed. About 16.9% were neutral. The next least important constraint is fake title document. Respondents scored it 2.2 to disagree that it is a constraint. A majority of 68.9% disagreed while only 14.2% agreed. Again, about 16.9% were neutral. The respondents were neutral on the rest of the variables. Nonetheless, the fear of eviction by the government calls for concern. A significant minority of 31.6% feared eviction as a result of compulsory acquisition of land by the government. Similarly, as much as 28.9% feared being evicted as squatters. This is a demonstration of the precarious land tenure situations of many urban households.

Overall, of the four elements of land accessibility, affordability is the most important constraint to homeownership. It is followed by ease of transaction. The respondents agreed that these elements pose constraint to homeownership while they are neutral about availability and security of tenure. Under availability which ranked third, the most important constrains are lack of basic amenities and lack of access roads. Security of

tenure is the least important. Nevertheless, issues of land titling and fear of eviction are still important areas to look into. As much as 36% of respondents considered not having a C of O a barrier while over 33% agreed that lack of title document of any sort posed constraints to their bid to access homeownership

Hypothesis test

Two-tailed one-sample t-test was performed on the data to test the significance of the constraints to homeownership posed by four elements of access to land. The null hypothesis is that each of these elements do not pose significant constraint to homeownership. As the questionnaire is on 5-point Likert scale, the hypothesized value is 3. Using the 5% level of significance, the null hypothesis is rejected if $p < 0.05$ and the constraints is considered significant. If the t-value is positive, the constraint is considered significant while if the t-value is negative, the constraint is considered significant in the opposite direction.

Table 6: One sample t test for constraints to homeownership posed by access to land

	Test Value = 3		
Land accessibility element	t-stat	Sig.	Remark
Affordability	17.02	0.000	Significant
Availability	-0.53	0.599	Not Significant
Security of Tenure	-5.31	0.000	*Significant
Ease of transaction	12.60	0.000	Significant

*Negative significance

The test results in Table 6 show strong evidence against the null hypothesis for affordability and ease of transaction ($p < 0.05$). The null hypotheses are therefore rejected and the inference is that the elements pose significant constraints to homeownership. On the other hand, the results for availability did not provide sufficient evidence against the null hypothesis ($p > 0.05$). The deduction therefore is that land availability does not pose significant constraints to homeownership. Again, the test results indicate that security of tenure is significant but negative, a demonstration that the element is not important in access to land as barrier to homeownership. The inference from the results is that access to land measured by affordability and ease of transaction is a constraint to urban homeownership in Kaduna State.

DISCUSSION OF RESULTS

Some of the findings of the research are consistent with previous studies. The findings on sources of land acquisition lends support to the assertions that the Land Use Act has failed in its objective of making land readily available and accessible to Nigerians (Akeju, 2007; Ayedun and Oluwatobi, 2011; Bello, 2009; Ugonabo and Emoh, 2013). In particular, the finding that the principal way households acquire land is through purchase from private landowners supports Babatunde, et al (2014) and Owoeye and Adedeji (2015). The failure of the Land Use Act to make land available to those who

need it has contributed to the high cost of urban land and the major role that private landowners play in the land markets. The law has therefore not been effective in advancing homeownership. The implication is that there is need for reform in the implementation of the Act.

The finding that purchase from open market is the principal means of acquiring land will explain why affordability element constitutes the most important barrier to homeownership. The finding suggests that access to land is a function of economic ability of households. The implication is that the government needs to invest more to ease access to land for homeownership by providing serviced lands in form of site and services at subsidised prices to households.

The results support Chukwuemeka and Kalu (2016) and Oladehinde, et al (2017) on the role of high cost of land in access to land but contradict them on the role of security of tenure. The findings on the relative importance of the elements of land access contradict Gbadegesin et al, (2016). It can therefore be inferred that access to land poses contraints to homeownership but in divergent ways across markets. The implication is that measures to ease access to land for homeownership will differ across markets and should be tailored to the perculier needs of each market.

The difficulty in land acquisition process may have informed the relatively high rate of use of agents in the markets. However, although agency plays important role, it is noteworthy that landowners are still the most important single group of players as a means of land purchase. This suggests that there is still room for expansion of the agency service in this segment of the market. It is also instructive that the local agents play bigger role in the market than the registered estate surveyors do. The finding suggests that the local agents are closer to the people than the registered surveyors are. The situation may also be because it is the lower segment of the land market in which participants may have the perception that the services of the registered surveyors are not affordable.

Furthermore, the findings demonstrate a high level of ignorance about registration of titles. This means that a greater percentage of land transactions are not captured by official records. This has implication for government revenue and the level of information that can be obtained from the lands registry about land ownership and transactions. The implication is that there is need for government and other stakeholders to embark on public enlightenment on registration of land titles and transactions.

The problems associated with registration of titles and the high level of lack of formal titles to land have implications for the land market, especially with respect to security of tenure and ease of transactions. Without a formal title and evidence to it, proving land ownership will be difficult. These problems make transactions difficult. The result is market failures. These failures spiral into the housing market and worsen the already existing housing problems. The implication is the necessity for the government to streamline the process of land titling, minimise the costs, and embark on mass land titling project. It is necessary to point out that the state government has

taken important step in this direction by establishing the Kaduna Geographic Information Services which handles land titling and registrations and other land related transactions. Investigations from the agency revealed that it has a target of 30 days for processing applications for title registration and issuance of C of O. However, there is still need to make the transaction more affordable by reducing the costs.

Access to land remains a significant challenge to urban homeownership. Unless the problem is adequately addressed, access to homeownership will continue to be a daunting task to urban households, particularly those in the lower and middle income groups.

CONCLUSIONS AND RECOMMENDATIONS

Access to land is a crucial factor in urban households' ability to enter homeownership. Due to the prevailing housing system, urban households generally must first access land before they can access homeownership. The study investigated access to land by urban households as a constraint to homeownership in Kaduna State, Nigeria. The findings demonstrated that access to land measured by affordability and ease of transaction constitute constraint to homeownership. High cost of land is the most important limiting factor. Other limiting factors are difficulties in land acquisition process and land registration process. The findings also revealed that purchase from private landowners is the major way urban households acquire land. Moreover, most landowners who acquire land outside government allocations do not register their titles and a sizable proportion of landowners have no formal title to their land. In addition, most landowners are ignorant of either registration of titles or its importance.

It can be inferred from the findings that difficulties in access to land constitute an important contributor to delays in accessing homeownership by urban households. Poor access to land particularly regarding affordability is a major factor in the failure of many urban households to access homeownership. Thus, to promote urban homeownership, the government should make substantial investments in providing serviced residential layouts in form of site and services schemes and make plots available at subsidised prices to households.

It can further be concluded that access to land poses constraints to homeownership but its impact differs between markets. Accordingly, measures to improve access to land for housing should have regard to the peculiarities of particular land and housing markets.

This study is subject to some limitations. It focused on access to land to investigate constraints to homeownership. Improving access to land alone is not sufficient to deal with urban homeownership problems. The questions of cost of building and access to housing finance will also have to be dealt with. It is suggested that research be conducted on these subjects in the study area.

REFERENCES

Akeju, A. A. (2007). *Challenges to providing Affordable Housing in NIgeria.* Paper presented at the 2nd Emerging Urban Africa International Conference on Housing Finance in Nigeria held at Abuja October 17 - 19, 2007

Alkali, J. L. S. (2005). *Planning Sustainable Urban Growth in Nigeria.* s.l., held at ECOSOC Chambers, United Nations Chambers, New York on 6th June, 2005.

Aluko, B. T., Olaleye, A. & Amidu, A. (2004). *Problems of Land Delivery for Housing Development.* Rotterdam, Fraunhofer, pp. 601 - 610.

Aluko, O. (2012). The effects of Land Use Act on sustainable housing provision in Nigeria: the Lagos State experience. *Journal of Sustainable Development,* 5(1), pp. 114 - 122.

Arimah, B. C. (1997). Determinants of housing tenure choice in Ibadan, Nigeria. *Urban Studies,* 34(1), pp. 105 -124.

Ayedun, C. A. & Oluwatobi, A. O. (2011). Issues and challenges militating against the sustainability of affordable housing provision in Nigeria. *Business Management Dynamics,* 1(4), pp. 1 - 8.

Babajide, O. (2014). Evaluation of end-user's satisfaction on land title registration process in Akure, Nigeria. *Covenant Journal of Research in the Built Environment,* 2(2), pp. 176 - 189.

Babatunde, A. A., Kemiki, O. A., Abdulkareem, S. & Fabunmi, F. (2014). Analysis of activities of land administration machineries in Abuja and Minna, Nigeria. *Journal Of Environmental Science, Toxicology And Food Technology,* 8(1), pp. 31 - 38.

Bello, M., (2009). *Squatter Settlement, Accessibility of Land and the Urban Poor.* Eilat: FIG Working Week 2009, 3 - 8 May.

Cameron, R., (2009). A sequential mixed model research design: design, analytical and display issues. *International Journal of Multiple Research Approaches,* 3(2), pp. 140 - 152.

Chukwuemeka, E. & Kalu, I. U., (2016). Socio-economic factors affecting accessblity of land for real property investment in Obio/Akpor L.G.A, Nigeria. *Journal of Scientific and Engineering Research,* 3(2), pp. 119 - 124.

Creswell, J. & Plano Clark, V., (2007). *Designing and Conducting Mixed Method Research.* Thousand Oaks: Sage.

Creswell, J. W., (2014). *Research Design: Quantitative, Qualitative, and Mixed Method Approaches.* 4th ed. Los Angeles: Sage.

Durand-Lasserve, A., (2006). Informal settlements and the millenium development goals: Global policy debates property ownership and security of tenure. *Global Urban Development, 2 (1),* pp. 1 - 15.

Federal Government of Nigeria [FGN], (2009). *Report of the Vision 2020 National Technical Working Group on Housing.* Abuja: FGN.

Gbadegesin, J. T., Van der Heijden, H. & Boelhouwer, P., (2016). Land accessibility factors in urban housing provision in Nigeria cities: case of Lagos.. *Land Markets and Housing Policy 1 (11).*

Ikejiofor, U., (1999). The God that failed: a critique of the Public Housing in Nigeria, 1975 - 1995. *Habitat International, 23 (2),* pp. 177 - 188.

Kombe, W. J. & Kreibich, V., (2000). Reconciling informal and formal land management: an agenda for improving tenure security and urban governance in poor countries. *Habitat International,* Volume 24, pp. 231 - 240.

Makinde, O. O., (2014). Housing delivery system, need and demand. *Environ Dev Sustain,* Volume 16, pp. 49 - 69.

Marx, C., (2007). *Do Informal Land Market Work for Poor People? An assessment of three metropolitan cities in South Africa.* :Urban Land Bank.

Mosha., A. C., (2013). Low-icome access to urban land and housing in Botwana. *Urban Forum,* Volume 24, pp. 137 - 154.

Muhammad, M. & Bichi, A. M., (2014). Constraints and challenges on housing provision in Kano City, Nigeria. *International Journal of Advancements in Research & Technology,* 3(6), pp. 4 - 23.

National Population Commission [NPC], (2010). *2006 Population and Housing Census of the Federal Republic of Nigeria. Housing Characteristics and Amenities Tables; Priority Tables (LGA), Vol II,* Abuja: NPC.

Ndubueze, O. J., (2009). *Urban Housing Affordability and Housing Policy Diilemmas in Nigeria,* s.l.: . Unpublished PhD thesis, University of Birmingham. Retrieved December 30 2009 from http://ethesis.bham.ac.uk.

Nigeria Housing Finance Programme, (2014). *About Us: Nigeria Housing Finance Programme.* [Online] Available at: https://www.housingfinance.gov.ng

Nwaka, G. I., (2005). The urban informal sector in Nigeria: towards economic development, environmental health and social harmony.. *Global Urban Development , 1(1),* pp. 1 - 11.

Nwuba, C. C., (2015). *Development of a Model for Measurement of Urban Incremetal Housing Affordability.* Unpublished PhD thesis, University of Nigeria, Nsukka: s.n.

Nwuba, C. C., Kalu, I. U. & Umeh, J. A., (2015). Determinants of homeownership affordability in Nigeria's urban housing markets. *International Journal of Housing Markets and Analysis,* 8(2), pp. 189 - 206.

Odum, C. O. & Ibem, E. O., (2011). Securing urban land for housing among low-income earners in Sub-Saharan Africa: Case study of workers' co-operative society, Enugu, Nigeria. *Human Geographies,* 5(1), pp. 61 - 75.

Ogu, V. I. & Ogbuozobe, J. E., (2001). Housing policy in Nigeria: towards enablement of private housing development. *Habitat International,* Volume 25, pp. 473 - 492.

Oladehinde, G. J., Popoola, K., Fatusin, A. & Adeyeni, G., (2017). Land accessibility charcteristics among migrants in Yewa North Local Government Area of Ogun State, Nigeria. *Asian Research Journal of Arts & Social Sciences,* 2(1), pp. 1 - 12.

Olanrele, C. O. & Agbato, S. E. (2014). Lnad right registration and property development for poverty eradication and slum clearance in Nigeria. *Journal of Design and Built Environment,* 14(2), p. 1 13.

Olugbenga, E. O. & Adekemi, O., (2013). Challenges to housing delivery in metropolitan Lagos. *Research in Humanities and Social Science, 3 (20),* pp. 1 - 8.

Omirin, M. M., (2002). *Issues on Land Accessibility in Nigeria.* Lagos, University of Lagos, pp. 18 - 27.

Owoeye, O. J. & Adedeji, Y. M. D., (2015). Urban land acquition for sutainable housing delivery in Akure, nigeria. *International Journal of Developing Societies,* 4(1), pp. 10 - 20.

Payne, G., (2001). Urban land tenure policy options: titles or rights?. *Habitat International,* Volume 25, pp. 415 - 429.

Rakodi, C. & Leduka, C., (2004). *Informal Land Delivery Processes and Access to Land for the Poor: A Comparative Study of Six African Cities.* Birmingham: International Development Department, School of Public Policy, the University of Birmingham.

Stanley, A. M. & Orobowale, O., (2011). *Factors Influencing Land Accessiblity for Housing Development in Abuja, Nigeria.* Reading, West African Build Environment Research (WABER).

The World Bank, (2009). *Housing Finance.* Washington, DC.: World Bank. Retrieved May 11, 2011 from http://siteresources.worldbank.org/INTAFRSUMAFTPS/Resources/Making_Finance_Work_for_Nigeria.pdf.

The World Bank, (2012). *Doing Business 2012: Doing Business in a More Transparent World.* Washington, DC: The World Bank/ the International Finance Corporation..

Thontteh, E. O. & Omirin, M. M., (2015). *Land Registration Within the Framework of Land Administration Reform in Lagos State.* 21st Pacific- Rim Real Estate Society Conference. Kuala Lumpur, Malaysia, 18-21 January, 2015

Tibaijaka, A. K., (2004). *Africa on the Move: An Urban Crisis in the Making. A Submission to the Commission for Africa..* Nairobi: United Nations Centre for Human Settlements (UN Habitat). Retrieved March 18, 2011 from http://www.unhaabitata.org/downloads/docs/462683992.

Udechukwu, C. E., (2008). Obstacles to individual home ownership in Nigeria. *International Journal of Housing Markets and Analysis,* 1(2), pp. 182-194..

Ugonabo, C. U. & Emoh, F. I., (2013). The major challenges to housing development and delivery in Amambra State of Nigeria. *Civil and Environmental Research,* 3(4), pp. 1 - 19.

Ukoje, J. E. & Kanu, K. U., (2014). Implementation and challenges of the mass housing scheme in Abuja, Nigeria. *American Internationa Journal of Contemporary Research,* 4(4), pp. 209 - 218.

Umeh, J. A., (2007). *Land Policies in Developing Countries.* A Lead Paper presented to the CASLE Regional Seminar on 'Survey Resources for Development' in Kaduna, Nigeria, 14 - 17 March, 1983. Enugu: Institute of Development Studies.

UN-Habitat/OHCHR, (2016). *Habitat III Isuue Papers, 9 - Urban Land.* New York: UN-Habitat/OHCHR.

UN-Habitat, (2003). *Handbook on Best Practices, Security of Tenure, and Access to Land.* Nairobi: UN-Habitat.

UN-HABITAT, (2008). *Secure Land for All.* Nairobi: UN-HABITAT.

United Nations Centre for Human Settlements [UNCHS], (1993). *National Trends in Housing Production Practices, Volume 4, Nigeria.* Nairobi: UNCHS.

United Nations, Department of Economic and Social Affairs, Population Division, (2014). *World Urbanisation Prospects: The 2014 Revision, CD-ROM Edition..*:United Nations, Department of Economic and Social Affairs, Population Division.

United Nations, Department of Economic and Social Affairs, Population Division, (2015). *World Population Prospespects: The 2015 Revision, DVD Edition..*:United Nations, Department of Economic and Social Affairs, Population Division.

Yakub, A. A., (2014). An appraisal of the procedures for direct grant and conversion of statutory right of occupancy in Kaduna, Nigeria. *Journal of African Studies and Development,* 6(10), pp. 179 - 189.

ALTERNATIVE DISPUTE RESOLUTION TECHNIQUES IN REAL ESTATE COMMERCIAL AND CONTRACTUAL DISPUTES: THE CASE OF AKURE, NIGERIA

M. B. Ogunleye[1] and U. Y. Ajani[2]
[1,2]*Department of Estate Management, Federal University of Technology, Akure, Nigeria*

It is inevitable that disputes arise in real estate matters considering the nature and complexities of real estate matters involving various parties, entities and often involving large sums of money. The aim of this study is to examine alternative dispute resolution (ADR) techniques in real estate commercial and contractual disputes with a view to identifying the causes of real estate disputes and the ADR techniques mostly used in resolving such dispute. The sampled populations for the study were the practicing Estate Surveying &Valuation Firms and the occupants of residential properties in Akure, Nigeria. Data was collected through administration of structured questionnaires and analysed using descriptive statistical tools and factor analysis. The research revealed that the major causes of real estate disputes are evictions by land owner; multiple sales/allocations of land; illegal/improper uses of land; disputes over the payment for using/buying land; violent land acquisitions, clashes and wars over land; leasing, subleasing and sales as opined by the respondents. The research also revealed that the most widely used methods of dispute resolution by the respondents are negotiation, conciliation and arbitration. The research concluded that adoption of ADR in the resolution of real estate cases would reduce the complexity of court litigation; reduce costs and ensure timely resolution of conflicts with all parties been satisfied based on the verdict.

Keywords: alternative dispute resolution, real estate cases, mediation

INTRODUCTION

Disputes about real estate are common and inevitable in modern societies including Nigeria. Real estate disputes are often an unavoidable part of owning, developing or occupying real property and contractual relationships. Graham (2015) described real estate as a chimera, performing very different functions and seen different depending on the nature and starting point of the parties. Disputes in real estate matters are influenced by the nature of real estate activities which usually involves two or more parties. Therefore, in the course of real estate commercial and contractual relationships, real estate disputes

[1] ogunleyedelem@yahoo.com
[2] ajaniusmanyusuf@yahoo.com

Ogunleye, M. B. and Ajani, U. Y. (2017) Alternative dispute resolution techniques in real estate commercial and contractual disputes: the case of Akure, Nigeria In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 160-177.

inevitably arise between parties who are not satisfied by the performance of the other party or as a result of a breach in contract. Real estate disputes may arise between parties, landlord and tenants, amongst professional in real estate matters, inter-estate firms' interactions, intra- firms' relationship, construction contracts, loan disputes, sales of property and so many other forms of disputes. Lebovits and Hildago (2010) further identified real estate disputes to include residential and commercial landlord-and-tenant disputes, conflicts between cooperative boards and shareholders, and problems involving construction, leasing, subleasing, sales, broker-client relationships, broker-agent relationships, appraisals, foreclosures, property-management issues, real estate partnerships and other associations. Also, according to Chartered Institute of Arbitrators (nd.) forms of commercial and contractual real estate duties involve rent reviews, lease disputes, proposed development and investment, property occupation and use related factors, real estate transaction matters, residential occupation disputes amongst others. They further noted that real estate commercial and contractual disputes are not closed as they are dynamic and will continue to evolve.

Real estate related disputes often have extensive negative effects on economic, social, spatial and ecological development. This is especially true in developing countries and countries in transition, where land market institutions are weak, opportunities for economic gain by illegal action are widespread and many poor people lack access to land (Rivera, 2015). Land related disputes can have disastrous effects on individuals as well as on groups and even entire nations. Many disputes that are perceived to be clashes between different persons, companies and entities are actually disputes over land and related natural resources (Wehrmann, 2008). According to Olawore (2103) real estate disputes often leads to endless and most times irreversible acrimony when the process of resolving the disputes become tendentious and frustrating; one action leads to a reaction of higher gravity and the cycle continues ad infinitum.

Odgaard (2006) stated that real estate disputes are not a new phenomenon. However, some of the disputes have changed in nature; on the increase, becoming more complex and violent. Existing mechanisms to deal with the conflicts, have therefore become insufficient and costly (Huber, 2008). According to Lebovits and Hildago (2010), the increasing trend of real estate disputes across the world, has led to a growing trend towards resolving disputes through alternative dispute resolutions (ADR) across the globe.

According to Okpaleke (2014), the very complex nature of real estate investment and the inevitable interactions and relationships involving customers, clients and organizations cutting across the entire real estate value chain sometimes results in disputes. Nubi and Babawale (2013) however classified dispute as an emerging form of risk in real estate investment which appears not to have been sufficiently correlated and addressed despite the contractual, multi-disciplinary and capital intensive nature of real estate investment which is evident in literature.

Ojielo (2004) research indicated that if disputes or conflicts are not addressed properly, it can lead to negative effects such as loss of life, loss of property, abuse

of human rights, displacement of persons and cause pain. Olukolajo (2012) also stated that when disputes are not properly addressed the chance for escalatory responses increases which can ultimately lead to violence and long-term fission of society and also leads to accumulation of animosity, hatred, loss of live, loss of properties and prejudice. Leonard (2013) in the same line also argued that disputes between parties in real estate can begin with petty squabbles and escalate into cancerous disputes.

Lebovits and Hidalgo (2010) research also revealed that the nature of real estate involving a lot of interwoven relationships between various individuals of varying backgrounds forms a basis for potential dispute between the parties. Okpaleke (2014) also noted that real estate disputes when not well managed and resolved will hamper the associated returns and overall multiplier benefits to the economy.

A breach in commercial and contractual relationships in real estate matters allows for the aggrieved party a wide range of options and alternatives to seek to redress and awards based on the nature of dispute. Such methods include litigation and various alternative dispute resolution methods. Although several means of dispute settlement are being evolved from such legal expedition, yet the appropriateness of a particular means is of great importance for effective and efficient resolution of the dispute (Atilola and Dugeri, 2014). Lebovits and Hildago (2010) emphasized the importance of alternative dispute resolution methods as it provides an efficient, cost-effective method, relives the courts' dockets and promotes compromise between the parties and ensures peace to the parties. ADR is confidential and less time consuming. The use of alternative dispute resolution methods in resolving real estate commercial and contractual disputes in Nigeria today is of utmost significance when many African citizens have lost faith in the ability of their nations' courts to provide timely or just closure to their grievances (Uwazie, 2011). However, real estate contractual and commercial disputes can be addressed by appropriate research on global paradigm shift of dispute resolution in real estate business and investment as offered by alternative dispute resolution methods such as mediation, arbitration, negotiation, expert witness, facilitation/moderation, conciliation and several other traditional methods of alternative dispute resolution (Okpaleke, Otegublu, Emele, 2014). This has enhanced the increasing pursuit of alternative dispute resolution (ADR) as a fair, appropriate and effective means of resolution of disputes in various business spheres (Rickman andVencappa, 2009; Aina, 2012). The question then is What are the causes of real estate commercial and contractual disputes in Akure? What Alternative dispute resolution techniques are available in solving commercial and contractual real estate disputes in the study area? What are the factors influencing the choice of an alternative dispute resolution method in the settlement of real estate commercial and contractual disputes in the study area? Therefore, this paper examines alternative dispute resolution techniques in real estate commercial and contractual disputes; using Akure, Nigeria as a case study.

LITERATURE REVIEW

Concept of dispute

Rasmussen and Brunson (1996) defined disputes and conflicts as the expressed differences between two or more individuals and interdependent groups over real or perceived incompatible goals or resources. Sidaway (1996) stated that in a conflict situation each party attempts to destroy, injure, thwart, influence or control the behavior of another party. According to Martinelli and Almeida (1998) disputes and conflicts refers to disagreements, public complaints, and protests involving arguments, physical assault, violence and lawsuits. Feelings of unfairness and injustice, suspicion, anger, emotion, and mistrust lead to conflict. Buckles (1999) opined that disputes occurs because of difference in values, beliefs and interests, ambiguity over responsibility and authority, poor communication, and unwillingness to respond to social, political, cultural, technological, economic and social changes. According to Albert (2003) disputes means to clash, or engage in a fight or simply a confrontation between individuals or groups. Faleti (2006) describes disputes as a fluid and infinitely elastic concept which connotes disagreement, dispute or controversy in ideas or viewpoints held by two or more individuals/groups.

Agbola and Kassim (2007) observe that the main conflict perspectives often read in the literature are Marxism, named after Karl Marx (1818-1883), and the conflict structuralism (the Weberian sociology) named after Max Weber (1864-1920). Karl Marx is credited with the development of the Conflict Theory. The basic insight of the theory is that human beings are sociable but conflict-prone-animals. The radical structural theory of conflict, represented by the Marxist dialectical school, sees incompatible interests based on competition for resources which, in most cases, are assumed to be scarce, as being responsible for social conflict (Collier, 2000, cited in Faleti, 2006). The theory looks at social problems like economic exclusion, injustice, poverty, disease, exploitation, and inequality as sources of conflict.

According to Oni *et. al* (2010) disputes are a natural part of human interaction and it is common amongst occupiers of land and buildings which have been the concern of many individuals and body corporate. According to Wahab and Odetokun (2014) disputes is the construction of a special type of reality and may be viewed as occurring along cognitive (perception), emotional (feeling), and behavioural (action) dimensions.

Karl Max Conflict Theory as related to real property

Conflict theory is a theory propounded by Karl Marx that claims society is in a state of perpetual conflict due to competition for limited resources. It holds that social order is maintained by domination and power, rather than consensus and conformity. According to conflict theory, those with wealth and power try to hold on to it by any means possible, chiefly by suppressing the poor and powerless.

Conflict theory has been used to explain a wide range of social phenomena, including wars and revolutions, wealth and poverty, discrimination and domestic violence. It ascribes most of the fundamental developments in human history, such as democracy and civil rights, to capitalistic attempts to control the masses

rather than to a desire for social order. The theory revolves around concepts of social inequality in the division of resources and focuses on the conflicts that exist between classes.

The theory was also referred to Marxism or Class theory: According to Rummel (nd.) there are six elements in Marx's view of class conflict.

- Classes are authority relationships based on property ownership.
- A class defines groupings of individuals with shared life situations, thus interests.
- Classes are naturally antagonistic by virtue of their interests.
- Imminent within modern society is the growth of two antagonistic classes and their struggle, which eventually absorbs all social relations.
- Political organization and Power is an instrumentality of class struggle, and reigning ideas are its reflection.
- Structural change is a consequence of the class struggle.

According to Rummel (nd.) Marx highlighted the role of property ownership, whether of land or the means of production, in dominance and power. Historically, Marx saw primary social relations, culture, and ideology as reflecting property relationships. Moreover, political power, the state, was the instrument for maintaining and protecting property relations, and in mature capitalist society, the business of the state was that of the bourgeoisie.

Zeitlin (1973), argue that Marx recognized the separation of ownership and control as simply a transformation in capitalism, realizing that those who control do so in the name of the capitalists and share their class interests. Rummel (nd.) stated that property is that over which one legitimately exercises exclusive control. It is a right granted by society (i.e., the state) to authoritatively exercise sovereignty over the property: to exclude others from it or to regulate them in its use. That property which is socially significant establishes a relationship of domination and subordination among people (e.g., property in slaves, in land or resources, or in capital). In essence, then, property ownership is an authoritative role; relations of property, as between worker and factory owner, are relations of authority at the state level. It is partially for these reasons that class conflicts emerging from such authoritative roles are struggles over state power. For ultimately, the class that controls the state controls property rights.

Causes of real estate disputes

Disputes can be classified as controversy, conceptual disputes, conflict of interest, or developmental disputes. Controversy - a controversy occurs when one person's ideas, information, conclusions, theories, and opinions are incompatible with those of another and the two seek to reach an agreement. In conceptual disputes, incompatible ideas exist simultaneously in his or her mind or when information being received does not seem to fit with what one already knows. An individual experiences conceptual conflict when engaged in controversy as ideas and arguments are presented that are incongruent with one's original position. Conflict of Interests also known as interpersonal disputes occurs when the actions of one person attempting to maximize his or her goals prevent, block, or

interfere with another person attempting to maximize personal goals. Developmental disputes occur when there are incompatible activities between adult and child based on the opposing forces of stability and change within the child cycles in and out of peak intensity as the child develops cognitively and socially (Johnson and Johnson, 1995).

Another form of dispute is known as intractable and is characterized as being protracted, irreconcilable, violent, of a zero-sum nature, total, and central, with the parties involved having an interest in their continuation. They are demanding, stressful, painful, exhausting, and costly both in human and material terms (Azar, 1985; Goertz and Diehl, 1993; Kriesberg, 1998). In all cases, disputes are a natural part of human interaction and people in disputes, whether at the individual or group level, perceive that their goals or interests are contradicted by the goals or interests of the other party; and according to Bar-Tal (2000), outbreak of disputes is dependent on the appearance of particular perceptions, beliefs, attitudes, and motivations, all of which must change for conflict resolution to occur.

According to Amy (1987) there are three general sources of disputes: misunderstanding, interests, and values. Burton (1990) was of the opinion that only those differences associated with values are conflicts and those involving information or interests classified as disputes. Misunderstanding- based disputes surface when there is no adequate access to available information or there are differing interpretations of such information (Rasmussen and Brunson, 1996).

According to Lebovits and Hildago (2010) Real estate disputes could be caused by disputes arising from residential and commercial landlord-and-tenant disputes, conflicts between cooperative boards and shareholders, and problems involving construction, leasing, subleasing, sales, brokerclient relationships, broker-agent relationships, appraisals, foreclosures, property-management issues, real estate partnerships and other associations.

In his study of conflicts between landlords and tenants in Lagos State, Nigeria, Kehinde (2010) notes that conflicts were caused by house renovation (16.0%), refusal to pay for utility bill (5.3%), intolerance (5.3%), parking space (1.3%), and use of generating set (1.3%), among others. The study however only focused on disputes arising from landlord and tenants relationships and did not examine other real estate commercial and contractual disputes as well as the means of solving such conflicts through the use of ADR which is the focus of this study.

According to Oni *et.al* (2010) disputes exists whenever incompatible activities occur. An activity that is incompatible with another is one that prevents, blocks, or interferes with the occurrence or effectiveness of the second activity. Disputes can be as small as a disagreement or as large as a war. It can originate in one person, between two or more people, or between two or more groups (Deutsch, 1973).

Domestic disputes may arise from housing difficulties, unsanitary residential environments or as a result of co-sharing of facilities and amenities. An unclean environment is observed to cause misunderstanding and consequently conflict among residents, especially those of rented apartments. Narrating the causes of

conflict in Kenya, Amman and Duraiappah (2011) aver that deteriorating environmental and social welfare conditions have resulted in an increase in disputes between the indigenous inhabitants of the district and the newcomers, with violent and bloody outcomes in many cases.

According to Graham (2015), there are different forms of commercial and contractual real estate disputes. The most common but not a full list of areas of dispute for includes the following categories;

1. Viability of projects
2. Poor contract drafting
3. Changing nature and requirements of the parties over time
4. Unexpected market shifts and the law of unexpected consequences
5. Lack of good title and impact of easements/restrictive covenants
6. Tenant procurement and the terms of occupation
7. Programme overruns
8. Effective planning permission
9. Unreasonable planning condition
10. The interpretation of the planning permission such as density of development, public open space and other spatial matters.
11. Costs of development and their reasonableness
12. Impact of taxation and unforeseen and new statutory requirements creating hurdles
13. Ground condition complications and flood risk alleviation
14. Materials selection and specification
15. The accuracy of the final development account, the original appraisal in terms of income, capital values and project costs
16. The date on which the completed project should be valued
17. Measurement and floor area calculations (RICS Code of Measuring Practice)
18. The basis of valuation
19. The final valuation
20. Profit share
21. Payment dates and late payment issues
22. Overage payments and allocation

Methods of resolving real estate disputes

According to Oyeshola (2005), there are many ways to resolve conflicts, but conflicts can be resolved using two basic approaches, namely: peaceful negotiation or arbitration and force. Resolving conflicts by force is generally inadequate and can make the conflict protracted and difficult to manage. Most societies, therefore, prefer peaceful resolution to open combat and they all have

a framework of laid-down conventions or rules by which conflicts are resolved. According to Wardak (2005), the existing body of literature confirms that the nature and causes of conflicts and the mechanisms for resolving them are deeply rooted in the culture and history of every society.

According Oni *et.al* (2010) a number of techniques have been developed in resolving conflict in a society, these include: inaction, negotiation, facilitation, mediation, arbitration, court action, non-violence, violence, conflicts escalate, with variety of processes used to deal with them. Psychological perspective, the cognitive approach to the analysis of conflict has recently emerged and attained prominence. The cognitive approach emphasizes the representation of a conflict in the participants' awareness. This does not necessarily imply that such representations are distorted or unreal. The approach recognizes that conflicts are often based on political, economical, military, or societal events; however, in order for conflicts to be operative, they must be first identified as such in minds of the group members (Axelrod, 1976; Eldridge, 1979; Falkowski, 1979; Rasmussen and Brunson, 1996).

Lebovits and Hildago (2010) carried out a study on alternative dispute resolution in real estate matters; the New York Experience. The study identified various alternative dispute resolution methods that can be used in real estate disputes such as negotiation, mediation and arbitration. The advantages and disadvantages of alternative dispute resolution methods were also examined by the study. The study concluded that alternative dispute resolution methods are effective alternative to litigation. The study however did not involve any methodology and was based in New York while this current research would empirically determine the use of various alternative dispute resolution methods in the settlement of real estate cases using Akure, Nigeria as a case study.

Edith and Comfort (2013) carried out a study on alternative dispute resolution strategies for sustainable development in Africa; insights from Nigeria. The study focused on reported cases of conflicts in Nigeria and the incorporation of alternative dispute resolution into the framework for sustainable development. The study concluded that there is a need to seek alternatives in managing conflicts in Nigeria. The study also did not consider contractual and commercial real estate disputes and focused on the issues of resource control and reported cases of conflicts in Nigeria. This present study would however examine the use of various alternative dispute resolution methods in the settlement of real estate cases in Akure, Nigeria.

Rosecana, John and Hauwa (2014) also carried out a research on the application of arbitration for effective dispute resolution in the Nigerian banking sector. The study examined the circumstances of commercial disputes in the banking sector and several reviews of case laws on disputes in the banking sector. The study therefore concluded that banks should adopt any of the alternative dispute resolution process and use the courts as the last resort. This current research would however focus on real estate and not banking sector.

Bello (2014) also carried out a study on arbitration as a panacea for investment disputes. The study sought to show arbitration as a dispute resolution mechanism in resolving or acting as a remedy for investment disputes both

locally and internationally. The study revealed that in Nigeria, certain statute makes provision for the settlement of investment dispute through arbitration. The study however was not empirical and only a review of the use or arbitration and did not consider other forms of alternative dispute resolution methods.

Gogo (2014) carried out a study on some aspects of the law and practice of commercial arbitration In Nigeria. The research specifically examined some aspects of the law and practice of commercial arbitration in Nigeria under the Arbitration and Conciliation Act, 1990. It also examined the multi-door courthouse which integrates alternative dispute resolution process into the regular court system. the research however revealed that the initiative of Lagos state in providing multi-door court house activities should be encouraged. The study however was only a review of a law and was not applicable to settlement of real estate cases.

Abubakar (2015) examined the prospects and constraints of modern methods in commercial dispute resolution through a arbitration in Nigeria. The study reviewed the practice of arbitration as an alternative dispute resolution method. In the same vein, Adeola (2015) also carried out a comparative legal analysis of the application of alternative dispute resolution to banking disputes. The research revealed that two hurdles facing commercial activities today include how to resolve disputes quickly and the least cost involved in a manner that it will not affect the nature of their activities. The study concluded that disputes arising in the financial services sector could be and should be settled through any of the ADR mechanisms. The study only focused on the banking sector while this current research would focus on real estate contractual and commercial matters.

Graham (2015) conducted a study a surveyor's tale of property development, the issues in contractual arrangements and the nature of disputes. The study highlighted several areas and forms of disputes as related to commercial and contractual disputes. The study however was a review of various processes and nature of disputes involved in property development and contractual matters and did not examine the alternative dispute resolution methods used in solving such disputes which is the prerogative of this current research.

STUDY AREA

Akure, the study area is the capital of Ondo State, Nigeria. It is a medium-size, but rapidly growing urban centre located on latitude 70 15' North of the Equator and 50 15' East of the Greenwich Meridian. It is located within the tropical rain forest region of Nigeria. It became the capital city of Ondo State and a Local Government headquarters in 1976. Consequently, there was heterogeneous massing of people and activities in the city (Ministry of Works and Housing, 1980). The total area is approximately 41.2km^2 and it lies on a relative plain of about 250m above the sea level. The population of the city grew from 38, 852 (Thirty-two thousand, eight hundred and fifty-two) in 1952 to 71,106 (Seventy-one thousand, one hundred and six) in 1963. Its population was estimated to be 112,850 (One hundred and two thousand, eight hundred and fifty) in 1980; and 157,947 (One hundred and fifty-seven thousand, nine hundred and forty-seven) in 1990 (Ondo State of Nigeria, 1990). The last census conducted in 2006 put the

city's population at 353,211 i.e. Three hundred and fifty-three thousand, two hundred and eleven (NPC, 2006). The city's morphology has changed over time hitherto from a small province to assume its present status with its came attendant land and housing problems, as experienced in similar medium sized urban centres in Nigeria.

RESEARCH METHODS

The questions for this study then are; What are the causes of real estate commercial and contractual disputes in Akure? What Alternative dispute resolution techniques are available in solving commercial and contractual real estate disputes in the study area? What are the factors influencing the choice of an alternative dispute resolution method in the settlement of real estate commercial and contractual disputes in the study area? Therefore, this paper examines alternative dispute resolution techniques in real estate commercial and contractual disputes; using Akure, Nigeria as a case study. The research design is a survey research and the target population of this study comprises the practicing Estate Surveying and Valuation firms in Akure and occupants of residential properties in Akure. According to the Directory of the Nigerian Institution of Estate Surveyors and Valuers (2017) there are twenty-four (24) practicing Estate Surveying and Valuation firms in Akure. Due to the few number of practicing Estate Surveying and Valuation firms, the totality of the Practicing Estate Surveying and Valuation Firms would be considered as the sample size. The occupants of residential properties were purposively sampled based on the number of different cases accumulated from several modes of alternative dispute resolution available in Akure which is put at 189.

Structured questionnaires were administered on the practicing Estate Surveying and Valuation firms in Akure to elicit information on alternative dispute resolution in the settlement of commercial and contractual real estate cases in Akure, Nigeria.

Questionnaires were sent out to the respondent's i. e. practicing Estate Surveying and Valuation firms in Akure and the selected occupants of residential properties. Thus, a total of Two Hundred and Thirteen (213) questionnaires were sent out to practicing Estate Surveying and Valuation firms in Akure of which a total of 161 were completed and retrieved which was then used for the analysis. Descriptive and inferential statistics was employed to analyze the data.

DATA ANALYSIS AND DISCUSSIONS

There are different categories of commercial and contractual real estate disputes. This system of classification builds upon the nature of real estate activities and transactions between the parties. The different opinions of Estate Surveyors and Valuers and the occupants of residential properties on the causes of real estate conflicts are as presented in table 1. The opinions of the Estate Surveying and Valuation firms implies that the major causes of real estate disputes are evictions by land owners, multiple sales/allocations of land and illegal/improper uses of land which were ranked as 1st. 2nd and 3rd respectively. From the occupants' perspective on the other hand, the major causes of commercial and

contractual real estate disputes are disputes over the payment for using/buying land, violent land acquisitions, including clashes and wars over land; and leasing, subleasing and sales which were ranked 1st, 2nd and 3rd respectively. This clearly indicates that Estate Surveyors & Valuers and occupants of residential properties should carry out their commercial and contractual obligations in compliance to the codes of conduct and avoid any dispute.

Table 1: Respondents Opinion on the Causes of Real Estate Conflicts in Akure.

S/N	Causes of Real Estate Conflicts in Akure	Estate Surveyors & Valuers		Occupants	
		Mean	Rank	Mean	Rank
1	Viability of projects	3.86	21	3.89	15
2	Poor contract drafting	3.43	33	3.59	25
3	Changing nature and requirements of the parties over time	3.09	39	3.10	32
4	Ownership disputes due to lack of land registration	4.52	9	4.35	8
5	Unexpected market shifts and the law of unexpected consequences	4.05	17	4.06	11
6	Multiple sales/allocations of land	4.81	2	4.69	3
7	Tenant procurement and the terms of occupation	4.43	12	3.99	13
8	Programme overruns	3.81	22	3.77	19
9	Violent land acquisitions, incl. clashes and wars over land	3.38	34	4.71	2
10	Evictions by land owners	4.95	1	4.05	12
11	Effective planning permission	3.81	22	3.81	18
12	Unreasonable planning condition	3.57	28	3.54	27
13	Disputes over the payment for using/buying land	4.33	13	4.73	1
14	Disputes over the value of land	3.95	19	3.86	16
15	Costs of development and their reasonableness	3.48	31	3.45	28
16	Destruction of property	3.38	34	3.23	30
17	. Materials selection and specification	3.19	37	3.21	31
18	Sales of someone else's private property	4.24	15	4.29	9
19	The accuracy of the final development account, the original appraisal in terms of income, capital values and project costs	4.52	9	4.14	10
20	The date on which the completed project should be valued	3.67	26	3.74	20
21	Measurement and floor area calculations (RICS Code of Measuring Practice)	3.48	31	2.93	34
22	The basis of valuation	4.57	7	3.26	29
23	Illegal/improper uses of land	4.76	3	4.52	7
24	The final valuation	4.19	16	3.91	14
25	Profit sharing	4.00	18	3.72	21
26	Payment dates and late payment issues	3.67	26	3.62	24
27	Unauthorized sales of common or collectively owned property	3.52	29	3.59	25
28	Overage payments and allocation	3.38	34	2.10	38
29	Appearance of particular perceptions	3.90	20	3.71	22
30	Beliefs of the parties	4.62	5	4.54	6
31	Attitudes of the parties	4.52	9	2.96	33
32	motivations of the parties	3.52	29	2.50	35
33	residential and commercial landlord-and-tenant disputes	4.62	5	2.29	37
34	conflicts between cooperative boards and shareholders	2.29	40	2.09	39
35	problems involving construction	4.33	13	2.44	36
37	property-management issues	4.57	7	4.57	5
38	leasing, subleasing and sales	4.67	4	4.69	3
39	Client-agent relationships	3.81	22	3.86	16
40	Foreclosures	3.76	25	3.71	22

Table 2: Dispute resolution options available to real estate disputants in the study area

S/N	Dispute resolution options	Estate Surveyors & Valuers		Occupants	
		Mean	Rank	Mean	Rank
1	Litigation	4.00	5	4.06	5
2	Conciliation	4.43	1	4.33	2
3	Mediation	4.19	4	4.15	4
4	Arbitration	4.24	3	4.22	3
5	Expert Witness	3.71	6	3.74	10
6	Negotiation	4.43	1	4.39	1
7	Facilitation/Moderation	3.62	8	3.68	9
8	Adjudicators	3.70	7	3.91	6
9	Palace Dispute Settlement Center	3.57	9	3.86	7
10	Ijoko Ojogbon	3.52	10	3.82	8

Several methods of resolutions available to real estate disputants are as presented in table 2. The research revealed that the most widely used methods of dispute resolution by the Estate Surveyors and Valuers and occupants of residential properties are negotiation, conciliation and arbitration. Lebovits and Hildago (2010) described negotiation as a nonbinding proceeding in which two or more participants attempt to reach a joint decision on matters of common concern when they are in actual or potential disagreement or conflict. Negotiation tends to be an informal process that does not require a third-party neutral. The parties in dispute attempt to reach an agreement using their negotiating skills and leverage. Adeola (2015) described conciliation as a process in which a third party, called a conciliator, restores damaged relationships between disputing parties by bringing them together, clarifying perceptions, and pointing out misperceptions. The conciliator may or may not be totally neutral to the interests of the parties. Successful conciliation reduces inflammatory rhetoric and tension, opens channels of communication and facilitates continued negotiations. Frequently, conciliation is used to restore the parties to a pre-dispute status quo, after which other ADR techniques may be applied. Conciliation is also used when parties are unwilling, unable, or unprepared to come to the bargaining table. Conciliation, though similar to mediation is fundamentally different in some aspects. Rosecana *et. al.* (2014) on the other hand described arbitration as a process of setting an argument or disagreement in which the people or groups on both sides present their opinions and ideas to a third person or group. It is an alternative dispute resolution mechanism employed in resolving dispute or grievances outside a court system. Redfern and Hunter (1991) posit that in its origin the concept of arbitration as a method of resolving dispute was simple. As revealed from the research, the use of expert witness amongst the occupants of residential properties unlike the Surveyors is tantamount to seeking the judgement of other highly placed or elderly person for his opinion. The occupants on the other hand opine to the use of the palace dispute settlement center and the use of Ijoko-Ojogbon as the methods also used for dispute resolution which was ranked 7th and 8th respectively. The research also revealed that the use of the traditional methods were more advantageous to the poor and uneducated people in Akure,

hence, the government should provide appropriate incentives for the development of the traditional ADR methods.

The study also used the conduct of a Principal Component Analysis (PCA) to explore the various factors influencing the choice of a particular dispute resolution method. The results are shown in Table 3-5. The data displayed factorability potential based on the Bartlett's test of sphericity. Six components were identified and these together explained 80.692 per cent variance, with high impact emanating from first, second and third components as implied from the percentage of variance.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.463
Bartlett's Test of Sphericit	Approx. Chi-Square	1848.138
	Df	136
	Sig.	.000

Table 4: Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Panel of adjudicators	3.544	20.845	20.845	3.126	18.387	18.387
Cost of adjudication	3.165	18.618	39.463	2.627	15.453	33.839
Conciliatory overtures of the syste	2.487	14.630	54.093	2.330	13.708	47.548
The resolution process	1.939	11.406	65.499	2.199	12.937	60.485
The Strengths and Limitations of the Customary Justice System	1.485	8.736	74.235	1.933	11.368	71.853
the process	1.098	6.457	80.692	1.503	8.839	80.692
Formality and flexibility	.938	5.521	86.212			
Selection of adjudicators	.673	3.960	90.173			
Qualification of the adjudicators	.463	2.726	92.899			
Choice of venue	.345	2.027	94.926			
Possibility of appeal	.281	1.654	96.579			
Nature of decision	.180	1.060	97.639			
Expeditious	.128	.752	98.391			
cost effective	.098	.574	98.966			
face saving	.089	.522	99.488			
maintains relationships often destroyed in adversarial proceedings	.055	.326	99.814			
focuses the parties on their real interests	.032	.186	100.000			

Extraction Method: Principal Component Analysis.

With a clear cut at sixth point from the Scree plot (the Figure below), three factors were extracted for rotation using Varimax method.

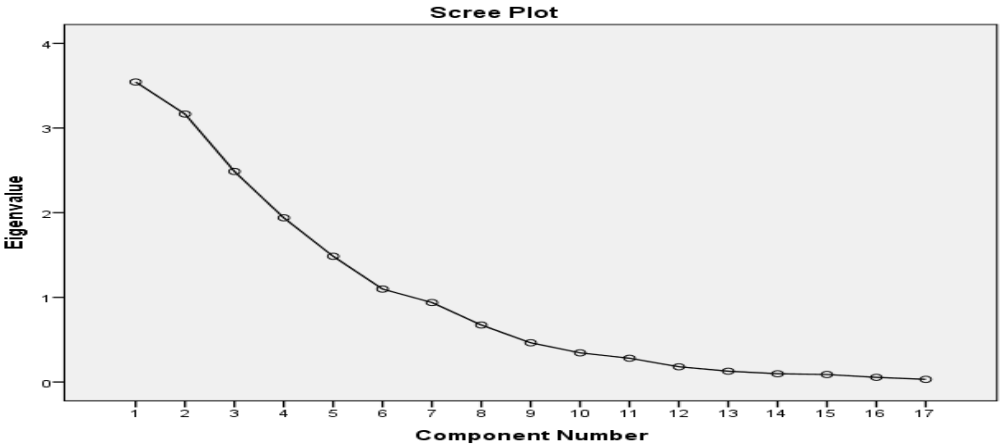


Figure 1: Scree Plot from Principal Component Analysis

Table 5: Rotated Component Matrix

	Component					
	1	2	3	4	5	6
Panel of adjudicators	-.891	.161	.001	-.075	-.151	.164
Cost of adjudication	-.262	.781	-.016	-.013	.426	-.011
Conciliatory overtures of the system	-.464	.367	-.228	-.209	-.376	-.107
The resolution process	-.246	.581	-.139	.552	-.159	-.307
The Strengths and Limitations of the Customary Justice System	-.155	.197	-.172	-.033	.853	-.034
the process	-.440	-.011	-.052	.009	.024	.764
Formality and flexibility	.336	-.242	-.508	.202	.525	-.103
Selection of adjudicators	.328	.216	-.054	-.212	-.155	.771
Qualification of the adjudicators	-.071	-.060	-.301	.887	-.056	.010
Choice of venue	.010	.774	.164	-.172	-.062	.357
Possibility of appeal	.845	.157	.001	.027	-.145	.097
Nature of decision	.437	.801	-.005	-.130	.087	.037
Expeditious	.750	.035	.367	-.176	-.065	-.023
cost effective	.152	-.219	.070	.872	.224	-.155
face saving	.172	.098	.795	.011	-.043	-.043
maintains relationships often destroyed in adversarial proceedings	-.141	-.110	-.595	-.136	-.663	.130
focuses the parties on their real interests	.060	-.185	.850	-.340	-.054	-.004

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.

The rotated component matrix indicates sufficient loading on six components. The dominant variables on the first component are panel of adjudicators, possibility of appeal, expeditious nature of the method and nature of the decision. These have a common theme centred on the nature of the use of the appeal. The second component centres on the nature; cost of adjudication and the choice of venue being high loading factors hence the name "Cost and Resolution Process". On the third component, formality and flexibility of the process, face saving approach and maintains relationships often destroyed in adversarial proceedings possess significant loadings on the 3rd component; hence the name "Flexibility and Relationship maintenance". "Qualification of the adjudicators" named for the components on the 4th loading and the name "The Strengths and Limitations of

the Customary Justice System" and "Selection of adjudicators" have been named based on the 5th and 6th components respectively.

Table 6: Effect of conflicts on real estate transactions

Effect of conflicts on real estate transactions	Estate Surveyors & Valuers		Occupants	
	Mean	Rank	Mean	Rank
Land and real property related conflicts often have extensive negative effects on economic, social, spatial and ecological development	3.71	7	3.67	7
Disastrous effects on individuals as well as on groups and even entire nations	4.24	3	4.19	3
Lack of access to land and sometimes loss of live.	3.91	5	4.11	5
Hamper the associated returns and overall multiplier benefits to the economy	4.67	1	4.54	1
Adverse impacts and as part of risk management procedure	2.95	10	3.12	10
The chance for escalatory responses increases which can ultimately lead to violence and long-term fission of society	3.05	9	3.27	9
Leads to accumulation of animosity, hatred, loss of live, loss properties and prejudice	4.05	4	4.14	4
Abuse of human rights, displacement of persons and cause pain	3.33	8	3.56	8
Loss of return on investment	4.52	2	4.45	2
Reduction in the investment opportunities for the economy	3.86	6	3.83	6

Commercial and contractual real estate disputes can have disastrous effects on individuals as well as on groups and even entire nations. The various effects on real estate transactions revealed hampering the associated returns and overall multiplier benefits to the economy; loss of return on investment; disastrous effects on individuals as well as on groups and entire nations and its effects on leading to accumulation of animosity, hatred, loss of live, loss of properties and prejudice were ranked 1st, 2nd, 3rd and 4th respectively. Lack of access to land and sometimes loss of live was ranked 5th. There is a need to possibly avoid real estate commercial and contractual disputes if necessary through patience and good human relationship so as avoid loss of associated returns and loss of investment. The professional should be diligent in their professional services while the occupants should also instil good value and moral in commercial and contractual matters.

CONCLUSION AND RECOMMENDATIONS

Major causes of real estate commercial and contractual disputes have been identified in the course of the research to include evictions by land owners, multiple sales/allocations of land and illegal/improper uses of land, disputes over the payment for using/buying land, violent land acquisitions, including clashes and wars over land and leasing, subleasing and sales. Alternative dispute resolution methods in the settlement of real estate disputes have been advocated based on congestion, cumbersomeness, delays in the resolution court cases, expensive and increase in the number of court cases. It is also evident that several alternative dispute resolution methods are available in Akure including the traditional systems and a more recent use of "ijoko-Ojogbon" by some of the

occupants of residential properties in the study area. The nature of the appeal, cost and resolution process were relevant factors influencing the choice of a particular method of ADR method. There is no gainsaying the fact that disputes happen in all spheres of life however; adoption of ADR in the resolution of real estate cases would reduce the complexity of court litigation; reduce costs and ensure timely resolution of conflicts with all parties been satisfied based on the verdict.

The research therefore made the following recommendations;

i. Estate Surveyors and Valuers have important roles to play in real estate/property investment by ensuring that they perform their duties and functions in compliance to the codes of conduct and avoid any professional malpractice and negligence.

ii. The government should provide appropriate incentives for the development of the traditional ADR methods.

iii. There is a need for patience, understanding and peace amongst all while involved in real estate transactions as neither of the parties must be under duress or compulsion and must act in his/her best interest and for self purpose only and educate the residents on the need for peaceful cohabitation and avoidance of any act of forgery.

iv. The professional should be diligent in their professional services while the occupants should also instill good value and moral in commercial and contractual matters.

v. The Nigerian Institution of Estate Surveyors and Valuers and other allied professionals in the construction industry should make appropriate recommendations and guidance notes to aid appropriate maintenance of properties in the country and ensure sustainability.

REFERENCES

Abubakar, M. S. (2015) Modern Trends in Commercial Dispute Resolution Through Arbitration in Nigeria: Prospects and Constraints. *Journal of Marketing and Consumer Research www.iiste.org ISSN 2422-8451 An International Peer-reviewed Journal. Vol.8, 2015*

Adeola, A. O. (2015) A Comparative Legal Analysis of the Application of Alternative Dispute Resolution (ADR) to Banking Disputes. *Journal of Law, Policy and Globalization www.iiste.org ISSN 2224-3240 (Paper) ISSN 2224-3259 (Online) Vol.38, 2015*

Agbola, T., & Kassim, F. (2007) Housing Developmen and Management: a book of readings. Ibadan, Nigeria. *Department of Urban and Regional Planning, Faculty of Social sciences, University of Ibadan*

Aina, K. (2012) Commercial Mediation:Enhancing economic growth and the courts in Africa. *Lagos: NCMG and Aina Blankson LP.*

Atilola, B., & Dugeri, M. (2010). Naional Industrial Court of Nigeria and proposed Alternative Dispute Resolution Centre: *A Road Map.*

Bello, A. T. (2014) Arbitration: A Panacea for Investment Disputes. *Arabian Journal of Business and Management Review (OMAN Chapter) Vol. 4, No.2; September. 2014*

Buckles, D. (1999). Cultivating Peace: Conflict and Collabration in Natural resource Management.

Chartered Institute of Arbitrators (nd.) The Use of ADR in Property Related Disputes. *CIARB, London, United Kingdom*

Edith, E. O. and Comfort, R. O. (2013) Alternative Dispute Resolution Strategies for Sustainable Development in Africa: Insights from Nigeria. *Journal of Management and Entrepreneurial Development Volume 3, Number 1, 2013 © 2013 Insuderc Academic Publishers*

Gogo, G. O. (2014) Some Aspects of the Law and Practice of Commercial Arbitration In Nigeria. *Journal of Law and Conflict Resolution. Vol 6(4) 67-77. August, 2014.*

Graham, F. C. (2015) Property Development, the Issues in Contractual Arrangment and The Nature of Disputes. *CIARB Centenary Conference Birmigham: 22nd to 24th January, 2015.*

Huber, M. (2008). Universal Land Registry to Support Independent Economic Development in Tanzania. Tanzania.

Lebovits, G., & Hildago, L. R. (2010). Alternative dispute resoultion in real estate matters: The New York experience. *Cardozo of Conflict Resolution, 11* (437), 440-466.

Martinelli, D., & Almeida, A. (1998). Negotiation, Management and System Thinking. *Journalof Systemic Practice and Action, 11* (3), 19-34.

Ministry of Works and Housing, Akure, Ondo State, Nigeria. (n.d.). Akure Master Plan 1980-2000.

Nubi, T., & Babawale, G. K. (2013). Land Development, Risk and Investment Analysis in Nigeria. *Estate Surveyors and Valuers registration board of Nigeria (ESVARBON) national mandatory continuing professional development (MCPD) workshop on Land Management Policy and Risk Analysis in Real Estate Investment. Abuja, Nigeria.*

Odgaard, R. (2006). *Land Rights and LAnd Conflicts in Africa: the Tanzanian Case.*Tanzania: DIIS.

Ojielo, O. (2004). Alternative Dispute Resolution. *CENGOS Annual General Meeting.*Owerri.

Okpaleke, F. (2014). Resolving Real Estate Dispute Through Alternative Dispute Resolution (ADR) in Lagos State. *Unpublished MSc Dissertation of Departemnt of Estate Management, University of Lagos* .

Okpaleke, F., Otegbulu, A., & Emele, C. (2014). Mitigating Risk Impact of Disputes on Real Estate Business and Investment in Lagos: The Alternative Dispute Resolution (ADR) Approach. *Convenant Journal of Business and Social Sciences (CJBSS), 6* (1),23-56.

Olukolajo, M. A. (2012). Managing Conflicts relating to Property Management: The role of Estate Surveyoes in Lokoja. *Depaartment of Estate Management, Federal University of Technology, Akure, Nigeria* .

Oyesola, O. (2005). Conflict and Context of Conflict Resolution. *Ile-Ife:Obafemi Awolowo University Press.*

Redfern and Hunter; (1991) "The Law &Practice of International Commercial Arbitration 2nd ed" P. 22

Rivera, J. (2015). Real Estate Dispute Resolution. Retrieved February 2016, *from Legal Match: http://www.legalmatch .com*

Rosecana, G. A., John, N. A. and Hauwa, A. (2014) The Application of Arbitration for Effective Dispute Resolution In the Nigerian Banking Sector. *International Journal in Advanced Research in Social Engineering and Development Strategies Vol. 2 No. 1, Oct. 2014, ISSN Print: 2315-8379, Online: 2354-161x © Science Publishing Corporation*

Rummel, R. J. (nd.) Understanding Conflict and War: Vol 3: Conflict in Perspective. *Chapter 5: Marxism, Class Conflict and the Conflict Helix*

Uwazie, E. E. (2011). Alternative Dispute Resolution in Africa: Preventing Conflict and Enhancing Stability. *AFRICA SECURITY BRIEF* , 211-216.

Wehrmann, B. (2008). *Land Conflicts: A oractical guide to dealing with land disputes.* Eschborn: GTZ

AN ASSESSMENT OF BUILDING COLLAPSE CHARACTERISTICS AND SUSPECTED CAUSES OF COLLAPSE IN LAGOS STATE AND ABUJA - NIGERIA

Okosun Blessing[1], Abdulganiyu Oke[2] and Olagunju R. E.[3]
[1&2]Department of Quantity Surveying, Federal University of Technology, Minna, Nigeria.
[3]Department of Architecture, Federal University of Technology, Minna, Nigeria.

The spate of building collapse in Nigeria has continually been on the increase over the years. This study assessed collapsed building characteristics (such as location, usage, number of floors, and number of casualties/fatalities) and suspected causes of building collapse in Lagos State and Abuja. Charts and percentages were employed as descriptive analysis while Spearman correlation was used to determine the relationship between variables. A sample of 55 cases of building collapse was drawn from the study area. The study found out that residential and commercial buildings were more prone to collapse, the numbers of collapsed buildings have been on the increase, and that structural failure was a major cause of building collapse. It was concluded that suspected causes of building collapse have a significant impact on characteristics of collapsed buildings. It was recommended that advanced laboratory facilities should be made available to conduct autopsies on collapsed buildings which would reveal the minute details of the collapse.

Keywords: buildings, characteristics, collapse, structural failure, suspected causes

INTRODUCTION

Construction industry plays an important role in the process of sustainable economic growth and development of any nation and more than 50% of the gross fixed capital budget in Nigeria normally takes the form of construction output (Wase, 2004). Building Industry (a sub sector of the construction industry) is the most complex of all the industries in the Nigerian economy today (Akindoyeni, 2002). The basis of its complexity is on the fact that all other industries and sectors of the social economy depend on it for the environment in which they operate.

[1] blezy2003@yahoo.com
[2] abdganioke@futminna.edu.ng
[3] rembenz@gmail.com

Okosun, B., Abdulganiyu, O. and Olagunju, R. E. (2017) An assessment of building collapse characteristics and suspected causes of collapse in Lagos State and Abuja - Nigeria In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 178-194

The building industry has witnessed various unpalatable occurrences in the past recent years. Building collapse has been one of the salient issues and this incident has continued to occur unabated in most major cities of the country.

Buildings serve as shelter for man and his activities in an environment which must be safe for man (Odulami, 2002). However, these same buildings have been posing threats and dangers to people either during or after construction as a result of its collapse. Building construction styles are constantly changing with the introduction of new materials and techniques of construction. Consequently, the work required in the design and construction stages of building involves choosing materials, components and structures that will meet the expected building standards. Failure to attain these standards in materials, design and construction can result in building collapse (Tauheed, 2005).

Building collapse occurs when a building falls down or falls in suddenly, often breaking apart. Any structure will probably give evidence of being unsafe before actual collapse. Building collapse is an extreme case of building failure. Ogunsemi (2002) defines building failure as "an incident resulting from malfunction due to errors of design, workmanship, maintenance or the use of faulty materials". While Kaminetzy (1991) defines building failure as an act of omission of occurrence or performance. He attributes it to lack of success, non-performance insufficiency and loss of strength and cessation of proper functioning. According to Chinwokwu (2000), failures for structural collapse were caused by human mistakes, events due to limitation of knowledge of structural behavior or anticipated environmental phenomena. A study carried out by (Ogunsemi, 2002) showed that poor workmanship and use of substandard material amount to about 37% of the total causes of building collapse in Nigeria.

It is common to hear of building collapse as an everyday issue in Nigeria with its attendant losses of lives and property. The sites of building collapse scattered across the length and breadth of Nigeria is quite alarming that it is unimaginable what effects it will have on the building industry and Nigeria economy as a whole. One could imagine what edifices these buildings would have been if only they were constructed accordingly. Building collapse is a topical issue in several cities in Nigeria. Dada (2002) averred that "building collapse has become a recurring decimal, a worrisome menace, a national nightmare and enduring embarrassment". It has been reported that Nigeria especially LagosState has become the "World's junk-yard" of collapsed buildings worth billions of naira (Famoroti, 2005). It is quite unimaginable that a country blessed with so great potentials in its construction industry can experience such magnitude of building collapse. Udom (2008) affirmed that, as a people, Nigerians have been too careless and carefree with the kind of houses they build. He recalls that before independence, "buildings erected in Nigeria were in compliance with global standards. Surprisingly, from the oil boom of 1970s till now, all manner of illicit activities, unwholesome professional practices have crept into Nigeria system, just as armed robbery came at the end of the civil war. People just

want their jobs done, caring little or nothing for professionalism. With this, substandard, pseudo and sharp practices came in along with quacks who would tell whoever wants to hear that they are Quantity Surveyors or Valuers or even Engineers".

Naturally, shelter in the form of building is amongst the three (3) basic needs of life universally accepted and recognized as essential for life sustenance and survival. The need to provide shelter for man and his daily activities has always been an utmost priority. Udom (2008) further affirmed thatthe Nigerian government has desperately continued to make concerted effort in the area of quantitative (but not qualitative) supply of mass housing through budgetary and policy provisions, but surprisingly, the rate at which the existing ones are collapsing all over the country have assumed an alarming proportion and calls for an urgent attention.

Buildings are meant to provide conveniences and shelter to the people but the same building has become danger traps to some people. Buildings are expected to meet certain basic requirements such as buildability, design performance, cost effectiveness, quality, safety and timely completion (Odusola, Atta and Ayangade, 2002). Ayininuola and Olalusi (2004), point out that the professionals contribute to the building collapse because they undertake building construction all alone without consultation with the rest of the building team. In Nigeria, materials and components are displayed in the market without legal approval number and there are no restrictions to the kind, quality and even the sizes of such materials. Nigerians have been too carefree and careless with the kind of houses they build and have not been enlightened on the implications of substandard building construction. The subject of building collapse is no longer a grey area in research. Large gaps in knowledge still exist as a result of happenings in the building construction industry such as, location of building collapse, usage of building, and number of floors of collapsed building, which have not been fully researched. It is against this backdrop that this study aimed to establish a relationship between building collapse characteristics and suspected causes of building collapse in Nigeria and proffer recommendations based on the findings. The following specific objectives are;

1. To collect, collate and tabulate the reported cases of building collapse according to the characteristics of collapsed buildings (suspected causes of collapse, location of collapsed building, use of collapsed building, number of floors in collapsed building, number of losses in collapsed building).
2. To establish the relationship between the suspected causes of building collapse and the use of collapsed building.
3. To establish the relationship between the suspected causes of building collapse and the number of floors in collapsed building.
4. To establish the relationship between the suspected causes of building collapse and the number of losses in collapsed building.

LITERATURE REVIEW

Concept of building collapse

Building collapse, though a common phenomenon in the world over is more rampant and devastating in the developing countries (Sodare and Usman, 2006). Many cases of building collapse have been recorded in Nigeria and have been observed to cut across all building categories (private, corporate and public). A study carried out by Folagbade (2002), showed that over time, 76% of reported cases of building collapse were private buildings which are more prone to building collapse than all other forms of buildings. Building collapse according to Bamidele (2000) as cited in Ogunsemi (2002) is classified into three (3) categories; Practical collapse, Progressive collapse and Total or sudden collapse.

Structural failures in buildings in Nigeria

There are some serious occasions when structural collapse provides opportunities for designers to learn some new lessons. Engineering failures represent instances when the engineer conjectures are falsified and are therefore central to the growth of the engineering professional knowledge (Oyewande, 1992).

Building failure in Nigeria are attributed as 50% of the causes being due to design faults on design faults, 40% to faults on construction site and 10% to product failure as asserted by Oyewande (1992). Those that are usually first accused of professional negligence are any of the following persons; the architect, structural engineer, the contractor and planning authority officials. The inability of the architect and especially the structural engineer to properly carry out his own part of the work, to see to the fact that the right number and sizes of reinforcements are used, the inability of the town planning authorities to ensure that architectural and structural designs (and structural calculations) comply to design principles before approvals are given, leads to structural failures. Major structural failures of buildings are today remarkably known in Nigeria because many are described in the print media. These failures become known to the public, because someone is killed or seriously hurt, not just to discredit the structural engineer, the builder and the other professionals involved in the collapsed buildings.

Characteristics of collapsed buildings in Nigeria

1. Use of collapsed building
2. Location of collapsed building
3. Number of floors in collapsed building
4. Number of losses in collapsed building
5. Suspected causes of building collapse

1. Use of collapsed building

The usage of collapsed buildings is in form of residential, commercial, industrial and mixed used buildings. Mixed use is a type of building used for a combination of different purposes. Most mixed use buildings discovered

in the course of this research are mostly a combination of residential and commercial purposes. These mixed buildings are more prone to collapse due to modifications, extra load on the weight of structure, and so on.

2. Location of collapsed building

A common consideration in the case study areas (Lagos and Abuja) is the environmental aspect. Commercial viability of a location makes more people want to build houses especially storey structures in area, because more people will jostle for space to exhibit or get contact with their customers or client or have shelter over their head. Some locations are routes to a lot of places so high vehicular and human traffic is usually associated with such places, hence more commercial activities. There will always be influx of people and buildings will keep springing up in these locations. The demand for housing is continually on the increase. Due to this, developers just want to erect structures to meet the demand for housing for all not to taking into consideration the type of foundation to be used, design factors, professional involvement, approval from Town Planning Authorities, adequate supervision amongst other factors. Most part of Lagos state is said to be waterlogged as it is close to the water. The soil in these areas are sandy and loose soil, they are not strong or compacted soils. If the right type of foundation is not used, the building may soon become visibly damp, cracks will be notable, structural failure may occur which will then lead to its collapse. Most of the buildings that collapsed in the Abuja area are majorly due to use of substandard material, non-approval of building plans by Town Planning Authorities and poor supervision. This could be seen in the case of the 4-storey commercial shopping plaza which collapsed in the year 2008 in Abuja. Historically, Lagos state is a very old settlement in which most of the buildings have become dilapidated over time. These structures will need to be audited. Where there is need for rehabilitation or demolition of such buildings, these should be carried out.

3. Number of floors in collapsed building

When the number of floors in a structure is abruptly increased without the improvement in the founding members the load in the member is increased and the tendency is for the supporting columns to fail or the pad foundations fail in bearing. Such failure will be sudden and very disastrous. In other to increase the number of storey of an existing building, the structural Engineer must expose one or two foundations to determine the area of bearing and calculate the new load with a view to determining the possibility of the new load being supported by the existing foundation. Checking the soil bearing capacity via penetrometer test would not be out of place for certainty. Failure to carry out these investigations and load analysis may result in eventual collapse of the structure. Building developers are advised to also insure buildings 2-storey and above.

4. Suspected causes of building collapse

According to (Onyemachi and Uji (2005), causes of building collapse in Nigeria can be classified into two factors mainly;

a. Natural phenomena

b. Artificial/man-made factors

A. Natural phenomena

These may occur in the form of storm, flood, exceptionally high wind or hurricane, thunder, lighting, volcanic eruption and earthquake. These natural phenomena are referred to a "natural disaster" or "the act of God" (Onyemachi and Uji, 2005). From a newspaper survey conducted by Arayela and Adam (2001) on the reported cases of incidents of collapsed buildings in Nigeria, it was revealed that many buildings collapsed as a result of rainstorm. Example includes three-storey residential building, Iju-Ishaga, Lagos (September 1999). No one has power or control over natural occurrence, but may be minimized if Environmental Impact Assessment (EIA) is made mandatory to be made available by all developers or building approval applicants before commencement of any building project construction. This will help to determine the feasibility of constructing the building on the proposed site.

B. Man-made/artificial factors

Arayela and Adam, (2001) produced by listing various types of man-made factors responsible for building collapse. These include the following: -

i. Foundation failure
ii. Faulty foundation
iii. Inadequate brief and design deficiencies
iv. Design errors
v. Poor quality of building materials
vi. Poor workmanship
vii. Poor maintenance
viii. Misuse and abuse of building/modification of building
ix. Collapse of building induced by fire
x. Improper supervision and monitoring during construction
xi. Owner-contractor syndrome
xii. Use of non-professionals in building construction
xiii. Excessively rushed construction
xiv. The role of professionals and other participants in the building industry.

RESEARCH METHODOLOGY

A survey-based approach was employed in this study which aimed at bringing together as many reported cases of building collapse in Lagos and Abuja as possible. This approach allows the collection of a wider body of data than would have been possible with any other approach. Only collapsed buildings in Lagos and Abuja were covered in the survey. Lagos is in the Southwest and has in recent times witnessed the most numerous incidences of building collapse. Abuja is located in the North Central Nigeria, and is home to a growing number of buildings collapsed. Both have, at one time or the other, been Federal Capitals of Nigeria. The paper established a relationship between the suspected causes of collapse and characteristics of collapsed building which include number of floors, usage of the building, location of the building, year of building collapse and casualties/fatalities of collapsed buildings. The study covered a time frame of eighteen (18) years (1998-2008). A sample size of 55 cases of building collapse was obtained for the study via purposive sampling technique. 11 Local Government Areas were considered in the study area. Secondary data was collected for this research. The historical data were obtained from newspaper dailies, publications and NEMA. The data were analyzed using charts (for graphical presentations) and percentages as descriptive analytical tool. While Spearman rank correlation was employed as an inferential tool to establish the relationship between the selected variables.



Figure 1: Map Showing Categorized LGAs of 55 cases of Collapsed Buildings in Lagos
Source: Bohr (2006)

RESULTS AND DISCUSSION

Graphical presentation of data

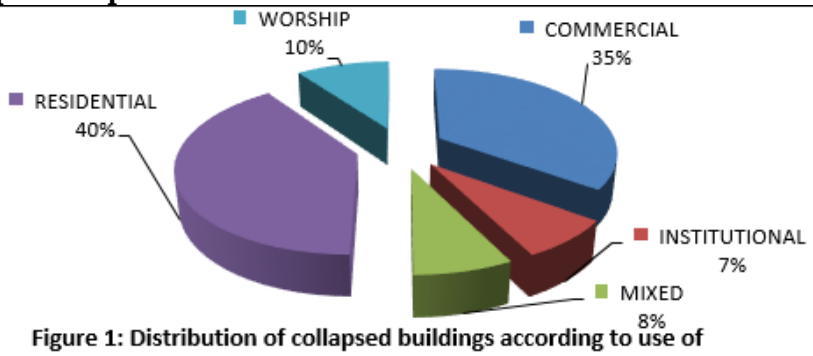


Figure 1: Distribution of collapsed buildings according to use of buildings only

Figure 1, above showed the distribution of collapsed buildings classified according to usage of buildings only. It was observed that 40% were used for residential purposes, 10% for worship purposes, 35% were of commercial usage, 7% were of institutional use and 8% for mixed use. A higher level of threat thus exists towards residential and commercial buildings than other building uses. Common ground might be found in the fact that, in the absence of strict application of town planning laws, conversion of use rife in Lagos, as in most other urban areas of Nigeria. Buildings designated as residential are easily converted to commercial when returns on rents for commercial buildings are higher.

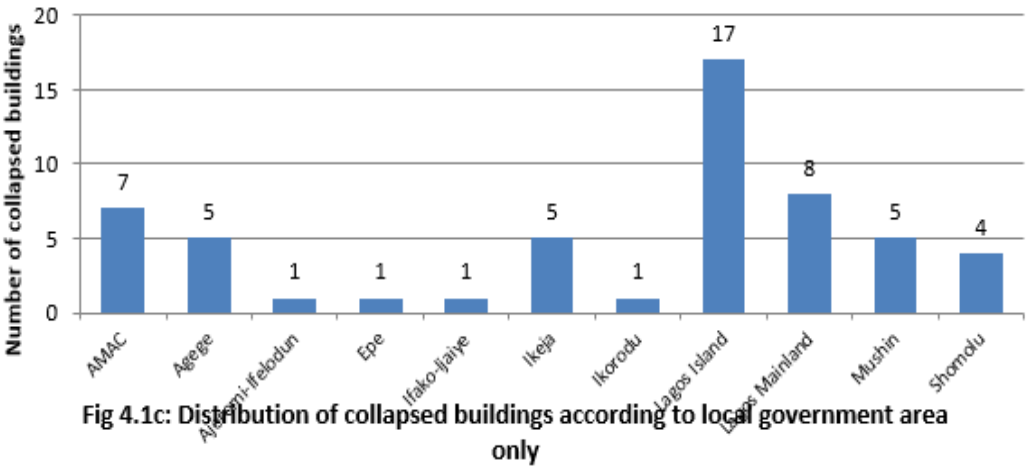


Fig 4.1c: Distribution of collapsed buildings according to local government area only

The above analysis in Figure 3, showed the number of collapsed buildings recorded in each Local Government Area. Out of the 55 numbers of collapsed buildings analyzed, 15 buildings collapsed in Lagos Mainland, making it the local government area with the highest number of collapsed building. Epe, Ifako-Ijaiye, Ikeja and Lagos Island LGAs of Lagos state recorded the least numbers of collapsed buildings. 5 buildings collapsed in Ajeromi-Ifelodun and Shomolu LGA. 2 collapsed in Ikorodu LGA, 8 collapsed in Mushin LGA, and 4 collapsed in Agege LGA and Abuja Municipal Area Council respectively.

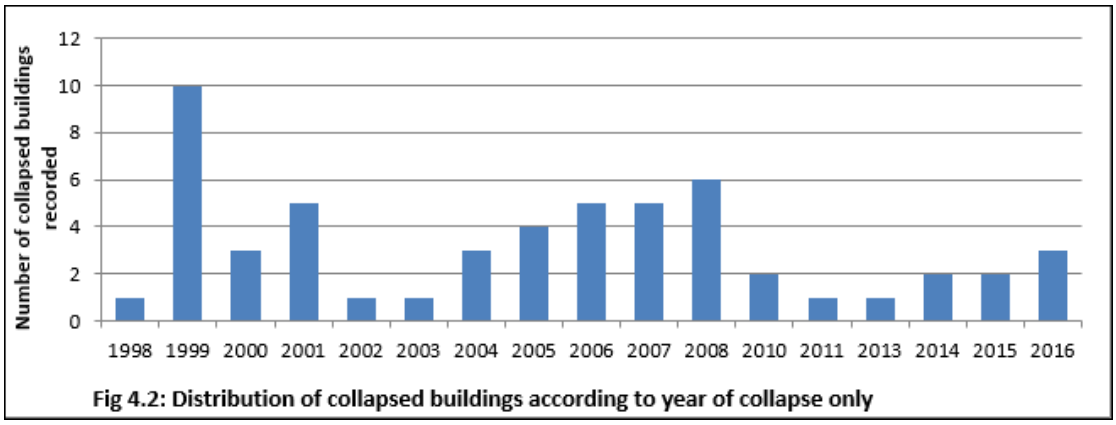


Fig 4.2: Distribution of collapsed buildings according to year of collapse only

In Figure 4 above, the number of collapsed buildings was classified according to the years that such collapse occurred. 10 buildings collapsed in 1999, which was the highest annual tally recorded. In 1998, 2002 and 2003, the least numbers of collapsed buildings were recorded (1 number respectively). 3 numbers of collapsed buildings occurred in the year 2000 and 2004, 5 numbers on the year 2001, 200, 2007, 4 numbers in the year 2005 and 6 numbers in the year 2008, making 2008 the year with the second highest number of collapsed buildings during the study period. From cursory observation, the trend discernible appears quite worrying. Since 2004, the numbers of collapsed buildings have been on the increase, except for a slight, temporary decline in 2007, 2010 - 2013. Should this trend continue, it would have dire consequences for public safety in the study area.

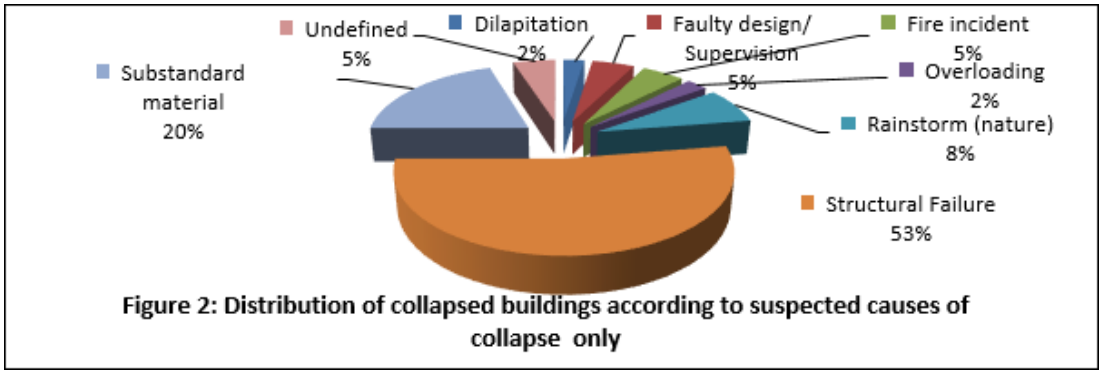


Figure 2: Distribution of collapsed buildings according to suspected causes of collapse only

The pie chart in Figure 2 above, showed the distribution of collapsed buildings according to suspected causes of collapse. It would be seen from the chart that all the recorded cases of collapsed buildings, 53% were majorly attributed to structural failure showing the highest value of suspected causes, 29% was attributed to substandard material while 2% as the least was attributed to dilapidation and overcrowding.

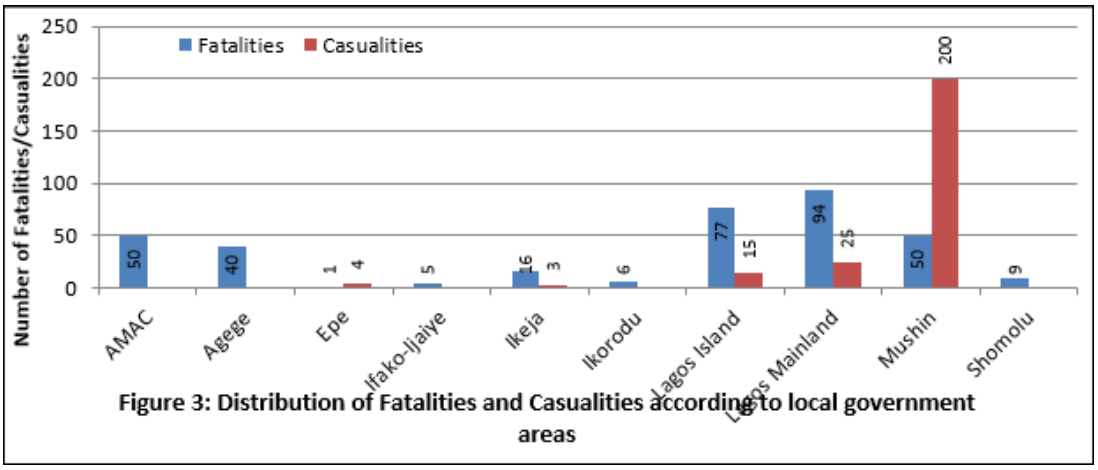


Figure 3: Distribution of Fatalities and Casualities according to local government areas

The number of deaths and injured persons recorded in the numerous cases of building collapse that occurred are studied on a location (spatial) basis in Figure 3. The chart showed that Mushin LGA recorded the highest number of casualties (200 injured persons), followed by Lagos Mainland (25) and Lagos Island (15). The foregoing raises issues of a lack of infrastructural facilities within those LGAs where most fatalities/casualties have occurred. Such infrastructures include firefighting stations, good road networks, functional elevators in high rise buildings, fire hydrants and other safety equipment and facilities, well equipped hospitals and well trained Rescue teams. In most cases, the occupants of these buildings are not given any warning signs of the impending collapse of the building, such as cracks in the walls, deflections of slabs and beams, and other types of structural defects. Until very recent times, most LGAs in the study period did not have a disaster management facility or plan. Where trained rescue teams are available, it takes a longer time for them to get to the scene of the collapse. A lack of basic training/techniques in rescue operations is most common however, resulting in death of the trapped victims. This reason has been adduced as part of why the fatalities that occurred in AMAC, FCT numbered up to 50 (Jummai, 2008). Traffic congestion in Lagos state also contributes to the death of some casualties en-route to the hospital for adequate treatment.

In terms of deaths, building collapses in Lagos Mainland (94 deaths), Lagos Island (77), Mushin (50) and Abuja Municipal Area Council (AMAC), FCT (50) recorded the highest figures in that order.The bulk of fatalities/casualties appeared to have occurred in LGAs that have low and medium income earners. The resultant overcrowding might give rise to pressure on and overheating of electrical circuits leading to fire outbreaks which may result in building collapse and death of the occupants. Also worthy of mention is poor development control, observable as improper monitoring/supervision of non-approved structures added by landlords/developers (in the name of "high profit pursuits") on poor foundations. These also usually result in building collapse and deaths of the occupants. The coefficient of determination, (R^2) from the correlation analysis obtained for location and number of casualties was 15.68%; both of these are indicative of poor levels of association between test variables.

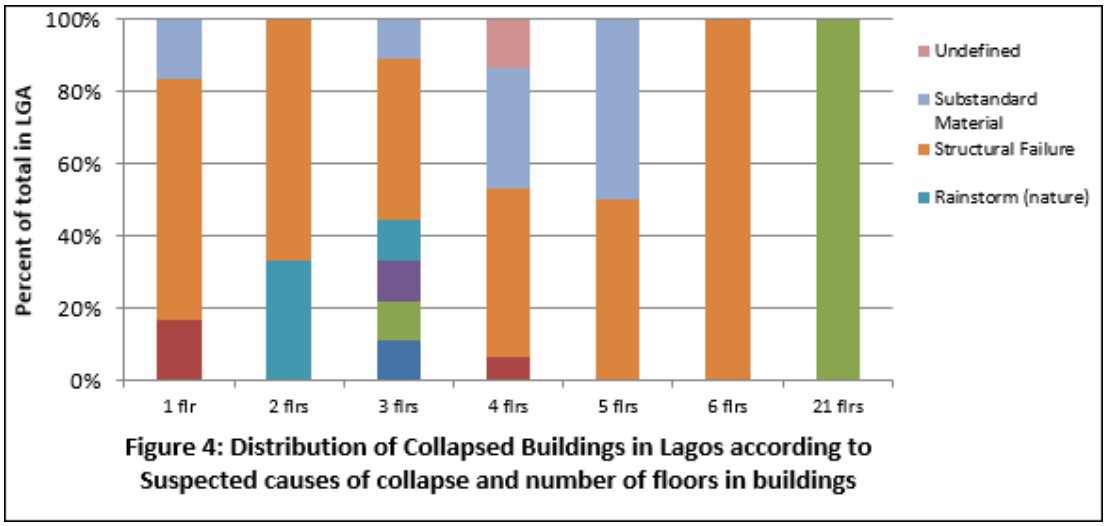


Figure 4: Distribution of Collapsed Buildings in Lagos according to Suspected causes of collapse and number of floors in buildings

Figure 4, the distribution of collapsed buildings according to the number of floors in the building and the factors suspected to be responsible for the collapses. Undefined causes were observed mainly in buildings having 4 floors. Substandard materials were the leading cause of collapse in buildings having 5 floors. Furthermore, structural failure caused the highest number of collapses in buildings having 6 floors; it was the least important factor in buildings with 3 floors. Rainstorm (forces of nature) was responsible for the most collapses in buildings of not more than 2 floors. The highest number of buildings which collapsed due to overloading had only 3 floors. Fire outbreak was the cause of collapse of a building with 21 floors. Faulty design/supervision was the most important cause of collapse of buildings with only 1 floor. On the basis of height of a building, the suspected causes of collapse in order of importance are: (1) Faulty design/supervision (1 floor only); (2) Rainstorm (forces of nature) (2 floors only); (3) Overloading (3 floors); (4) Undefined causes (4 floors); (5) Substandard materials (5 floors); (6) Structural Failure (6 flrs).

The data gotten for the study were first ranked before using spearman correlation analysis to analyse them. A total of eight (8) experiments were carried out. The value of the spearman correlation was positive and very low. The resulting R^2 value was also low (less than 1%) except in two out of the eight experiments carried out where the R^2 value was above 1% (15.68 & 6.66) %. The value of the probability that the results obtained were due solely to chance was higher than 0.05. It was thus concluded that the dependent variable (characteristics of building collapse) and the independent variable (suspected causes of collapse), do not exhibit any significant levels of relationship (see table 1).

Table 1: Correlation analysis of factors associated with building collapse

Experiment No	Variables X_1	X_2	Spearman Correlation	R^2 (%)	Significance value	Inference
1	Location	Type of use of building	0.068	0.46%	0.675	Statistically non-significant correlation
2	Location	Year of building collapse incident	0.017	0.03%	0.915	Statistically non-significant correlation
3	Location	Suspected causes of building collapse	0.001	0.00%	0.994	Statistically non-significant correlation
4	Location	Number of fatalities	-0.140	1.96%	0.438	Statistically non-significant correlation
5	Location	Number of casualties	-0.396	15.68 %	0.379	Statistically non-significant correlation
6	Suspected Causes	Type of use of building	-0.019	0.04%	0.909	Statistically non-significant correlation
7	Suspected Causes	Number of floors	0.258	6.66%	0.108	Statistically non-significant correlation
8	Suspected Causes	Number of fatalities	-0.018	0.03%	0.920	Statistically non-significant correlation

DISCUSSION AND IMPLICATION OF FINDINGS

i. Building collapses appeared to be centred on four LGAs in Lagos (Lagos Mainland, Mushin, Ajeromi-Ifelodun and Shomolu). This could imply that there exist similarities in some collapse-related factors such as the age of housing settlements, the materials employed in settlement construction, the geological nature of the areas, the nature of population-densities in settlements, application of town planning regulations. This is in line with Arayela and Adam (2001) findings. Such similarities, if proven, would point out the direction that further research should pursue. The finding further implies that, at least in the short term, efforts need to be concentrated on residential and commercial-oriented buildings. These usually form the bulk of the housing stock in most urban areas.

ii. From the findings, an upward trend exists since 2003 in the numbers of buildings that collapse annually which has become worrisome. This could be as a result of various factors responsible for this continual occurrence posing threats to the lives of individuals. Should this trend continue it would have grave consequences for public safety in the study area. The need for Research that would allow the accurate prediction of the number of building collapses that would occur annually if this menace is not curbed; is another implication of the finding.

iii. The major cause of structural failure which occurs in these LGA encompasses the problem of Quality Control in the building industry, poor construction techniques, substandard material and

workmanship in the locations of collapse, pervasions and perfections in building regulations, giving rise to collapse of buildings. When a building collapse, most of its structural components and materials will be damaged often beyond re-use, while capital investments in most cases are not recoverable. This kind of situation, more than often leads to bankruptcy on the part of the investor and high economic implications on the nation's economy. Prospective investors/developers are discouraged from investing in projects where these collapses mostly occur. Incessant building collapse is a threat on the sustainable development of the built environment. Adjacent structures are at risk due to vibrations caused by rescue operations. The collapsed site eventually becomes a 'junk-yard' or a 'relaxation spot'. Consideration should be given to the issue of structural failures as it can be combated at the initial stage of construction before actual collapse occurs, if the right equipment and techniques are provided.

iv. Physical damage and psychological trauma are the aftermath effects of building collapse, the degree of which is often beyond easy prediction. Depending on the nature and extent of damage of building collapse incidents, the effects are felt most in all human endeavours. These effects include loss of human life, and loss of materials and capital investments, as well as psychological pains the rate of fatalities and casualties that occur in building collapse is attributed to poor response of rescue teams who are ill-equipped and technically unskilled in rescue operations. The case can be seen in the collapse of the 5-storey plaza in AMAC, FCT where National Emergency Management Agency (NEMA) was poorly disposed/ ill-equipped to effectively manage the crises and so many people lost their lives even with the presence of rescue teams. Physical hazards, from electrical equipment, noise, vehicles and heavy equipment, sharp objects falling, uneven or unsteady working surface area are major causes of injuries and fatalities at building collapse in rescue operations. These hazards become a severe health risks (cancer, heart burn) after an operation.

v. Most of the buildings collapsed occurred between 1-6 storeys and above and could be traced to structural failure, substandard material, modification of building and non-approval of building plan. The finding further imply that more attention should be given to buildings above two floors to be on an insurance scheme so as to prevent workers and investment being deployed there assuming for some structural and administrative reasons certain things are not complied with resulting in the partial or full collapse of the building with the attendant economic loss. If insurance is set place, it will minimise the risk involved.

vi. This analysis is further strengthened by the fact that nearly 5000 houses previously tested by the state government, 300 were found to be structurally defective and hazardous to occupants majorly in Lagos-Island, Ajeromi-Ifelodun LGA, Somolu and Kosofe LGA. Some

of the houses obstructed drainage, leading to flooding in such areas (Olutayo, 2009). The results point towards the probability that the problem of building collapse in Nigeria is actually a problem of Quality Control in the building industry. Most of the major causes of collapse studied in this work could be eliminated with better Quality Control of the construction process. "In an attempt to cut cost, developers resort to the use of low quality materials because of the high cost of building materials" (Adebayo, 2005).

vii. Structural failure was seen to be the major cause of building collapse especially with buildings above 6 floors. This finding is in line with (Oyewande, 1992 and Ogunsemi, 2002; Ayedun *et al*, 2012). The use of a blanket term such as structural failure might not be unconnected with the unavailability of facilities of an advanced nature to conduct autopsies on collapsed buildings. Such post-mortem examination would reveal minute details of the collapse, and the last few hours or days of operation of the building could be recreated and studied. In the absence of such advanced knowledge techniques and equipment, building collapse in Nigeria are usually classified under the blanket term, "structural failure".

CONCLUSION AND RECOMMENDATIONS

The study assessed the characteristics of collapsed buildings (location, usage, number of floors, and number of casualties/fatalities) and suspected causes of building collapse in Nigeria. Residential and commercial buildings were more prone to collapse in the study area. There exists an upward trend in building collapse since the year 2004 which appears quite worrisome. Structural failure was the major cause of building collapse which accounted for majority of the fatalities that occurred. The paper recommends the following:

1. Facilities of an advanced nature should be made available to conduct autopsies on collapsed buildings. Such post-mortem examination would reveal minute details of collapse and the last few hours or days of operation of the building could be revealed and studied
2. Technical education should be encouraged by both the government and the private sectors, so as to ensure training of competent skilled labour (artisans, craftsmen) for building industry in Nigeria.
3. Standard Organization of Nigeria (SON) should strengthen its staff by organizing training seminars and workshops, enhancing its human resources, provision of efficient equipment in order to carry out Quality Control test on building materials; SON should also standardize local construction methods in respect of unique traditional building materials available in Nigeria.
4. This study also realizes that there exists a disaster management facility in the country, but are poorly disposed to manage crisis of high magnitude. The study thus, recommends that these facilities

(FRSC, NEMA, NSCDC, Red Cross Team, and Critical Rescue International) should be provided with adequate equipment to perform in cases of building collapse. Rescue teams should be given basic training in structural performance of buildings, concrete properties, risks, team concepts, tool requirements and rescue techniques/operations. Building designers should be encouraged to prepare a detailed emergency response plans before a building is built.

5. The Nigeria Institute of Town Planners in collaboration with organizations responsible for approval of building plans should monitor buildings that are not approved, unauthorized and addition of extra floors on existing buildings without due considerations with the structural engineers.
6. Soil test, Environmental Impact Assessment (EIA) and structural analysis needs to be made mandatory to be submitted along with the building plans to Planning Authorities by all the developers. This will help the building team to know what foundation type is to be used and precaution to take in order to avoid building collapse due to settlement and other foundation problems.
7. Massive public enlightenment campaign should be carried out by professional bodies in collaboration with regulatory agencies and the media to make the public aware of the implications of patronizing quacks, unapproved design and construction process and to report such cases that might result to building collapse. The cases of building collapse should be reported and documented for further studies.
8. A special Building Collapse Unit (BCU) should be created under the existing statutory Town Planning structures. This BCU should do nothing other than:
   a) Field surveys of the housing stock, using advanced technology to establish the level of "safeness" and "proneness" to collapse.
   b) Maintenance of an electronic database of all properties along with their level of 'safeness'.
   c) Periodic phased demolitions of buildings that have exceeded their useful life. This 'demolition schedule' should be forwarded to Development Control Sections/Departments for appropriate action.
9. Auditing of buildings within Ebute-Metta, Lagos Island, Ajeromi-Ifelodun, Mushin and part of Lagos Mainland (old and new buildings); to ascertain their physical and structural stability. These buildings should be subjected to Non-destructive Laboratory Test and Soil Test. The exercise will afford government to:

a. Avert the collapse of distressed buildings either through appropriate recommendations for their rehabilitation or outright demolition.

b. Publishing of identified buildings in the newspapers for public awareness.

10. Insurance companies should mandate building owners or developers to obtain insurance on the building against collapse and loss of lives and properties.

REFERENCES

Akindoyeni, A. (2002). Professionalism in Building Design and Construction. In DR. Ogunsemi (Ed.), Building Collapse: Causes, Prevention and Remedies, (Pp 1-13). *The Nigerian Institute of Building*, Ondo State.

Arayela.O. and Adam J.J. (2001). Building Disasters and Failures in Nigeria: Causes and Remedies. *AARCHES Journal*. 1(6), 71-76.

Ayedun, C. A., Durodola, O. D., and Akinjare, O. A. (2012). An Empirical Ascertainment of the Causes of Building Failure and Collapse in Nigeria. *Mediterranean Journal of Social Sciences.* 3(1), 313 – 322.

Ayininuola, G.M. &Olalusi, O.O. (2004) Assessment of Building Failures in Nigeria, Lagos and Ibadan Case Study. In *African Journal of Science and Technology*. 5(1). Pp 73-78.

Bohr, B (2006) *Map of the Local Government Areas of Lagos.* Retrieved from http://de.wikipedia.org/wiki/Benutzer. on 26th May 2012.

Chinwokwu, G. (2000). The Role of Professionals in Averting Building Collapse. Proceedings of a 2-Day Seminar of the Nigerian Institute of Building (Lagos State Chapter) on Building Collapse: Causes, Prevention and Remedies, Lagos Airport Hotel, Ikeja, Lagos, 3rd – 4th May. Pp 12-28

Dada, M.O. (2002). How Did You Produce That Building? *The Anchor*, Wednesday, April 24, p.11.

Famoroti, F. (2005). Before the Next Collapse. The Punch (p.9)

Fasakin, J.O. (2002). Building Collapse in Ondo State of Nigeria- Preventive Town Planning Standards and Regulations. In D.R. Ogunsemi (Ed.), Building Collapse: Causes, Prevention and Remedies, (Pp 40-49). The Nigerian Institute of Building, Ondo State.

Kaminetzky, D. (1991). *Design and Constructing Failures; Lessons from Forensic Investigation*. U.S; McGraw int'l.

Odulami, A.A. (2002). Building Materials Specification and Enforcement on Site. In D.R. Ogunsemi (Ed.), Building Collapse: Causes, Prevention and Remedies, (Pp 22-27). *The Nigerian Institute of Building,*Ondo State.

Ogunsemi, D.R. (2002). Cost Control and Quality Standard of Building Projects. In D.R. Ogunsemi (Ed.), Building Collapse:Causes, Prevention and Remedies, (Pp 88-94). *The Nigerian Institute of Building,* Ondo State.

Olusola, K.O., Atta, O. &Ayangade, J.A. (2002). Quality and Structural Strength of Sandcrete Blocks Produced in Ile-Ife: A Preliminary Investigation. *Journal of Environmental Technology, Federal University of Technology, Akure*, 11(1), 136-142.

Onyemachi, T.U. &Uji, Z.A. (2005) Building Failure and its Implications on Real Estate Investments in Nigeria. *AARCHES Journal*. 4(1), 57-63.

Oyewande, B. (1992) *A Research for Quality in the Construction Industry*. In Builder's Magazine, June-July Ed., Lagos.

Sodare, O.T., &Usman, E. (2006). Building Collapse: Stakeholders Proffer Solutions on Way Forward. Retrieved February 12, 2015 from http//www.daily sunngr.com

Tauheed I. A. (2005). Curbing the Collapse of Buildings in Nigeria: An Issue for Individuals and Building Professionals. Federal University of Technology, Minna.

Udom, C. (2008). Tackling the Discomforting Cases of Frequent Building Collapse. Retrieved 19th March 2016 from http://www.businessday online.com/index.php.

AN ASSESSMENT OF COST IMPACTS OF BUILDING ELEMENTS ON THE OVERALL CONTRACT SUM

Victor I. Opara[1], Emmanuel O. Fatoye[2] and Raymond C. Enenmoh[3]
[1,2,3]Department of Quantity Surveying, Lagos State Polytechnic, Ikorodu, Lagos

Cost is an important player in measuring the successes of any construction project and building elements form part of this cost. Ignorance of the cost implication of these elements can lead to project not fulfilling its goals. The aim of this research is to determine the cost impacts of building elements on the overall contract sum with a view to establishing the likely percentage of cost escalation of the elements of future proposed projects. The objectives are to identify the factors affecting cost of building elements on the overall contract sum and to determine the impacts of cost of such building elements on the overall contract sum. Data were collected from both secondary and primary sources. The primary data were from structured interviews administered on Consultant Quantity Surveyors while the secondary data were from archival information retrieved from past successfully executed building projects like residential buildings, students' residential hostels, warehouses, and high-rise office complex. The data collected were analysed using statistical tools. The study revealed that fluctuation tops the list of factors affecting cost of building elements. About 99.6% of the difference between initial and the final contract sum was due to the variations in the cost of the building elements while the remaining 0.4% could be explained by other unseen or unknown variables. The building element that has the highest impact on final cost of construction project was Services with an average of 16.74% increase. The findings of this study will be beneficial to construction cost management stakeholders in predicting overall cost of future construction projects with little or no cost escalation. It is recommended that Initial Contract Sum of construction projects should be estimated based on the model provided in this study.

Keywords: building, building elements, contract sum, cost, projects

INTRODUCTION

A building is a permanent or temporary structure enclosed within exterior walls and a roof, which provides shelter for the various needs of man. It is universally acknowledged as the second most essential human need, after

[1] primewaters@yahoo.com
[2] emmanfatoye@yahoo.com
[3] raymondchike2000@yahoo.com

Opara, V. I., Fatoye, E. O., and Enenmoh, R. C. (2017) An assessment of cost impacts of building elements on the overall contract sum In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 195-207.

food and is a major economic asset in every nation, without building there will be no housing and without house there will be no development whatsoever. According to (Muhammad et al., 2008), a building project is completed through a combination of many events and interactions, planned or unplanned, over the life of a facility with changing environment. Building elements can be said to be the materials, component parts and methods of construction that go into making a building. These elements are the basis of construction and they can include the foundations, frames, upper floor, roof, doors, windows, finishes, services etc.

(Memon et al., 2011) stated that cost is among the major considerations throughout the project management life cycle and can be regarded as one of the most important criteria of projects success. However, the building construction sector in Nigeria is faced with a lot of problems, among which the final cost of execution always exceeds the budgeted cost in relation to the cost allocated to various elements of the building. Clients in construction industry are usually compelled to pay for unbudgeted increase in project costs at varying degrees which (Omole, 1999) attributed to wrong cost estimation. The growing need for construction of all types coupled with a tight monetary supply has provided the construction industry with a big challenge to cut cost. This study is therefore aimed at assessing cost impacts of building elements on the overall contract sum with a view to establishing the likely percentage of cost escalation of the elements of future proposed projects.

The objectives are to identify the factors affecting cost of building elements on the overall contract sum and to determine the impacts of cost of building elements on the overall contract sum and rank them in their order of severity. The contract sum of construction in normal circumstance is expected to be the sum of the following cost: Materials, Labour, Site Overheads, Equipment/Plant, Head Office Cost and Profit but in other parts of the world particularly in Nigeria, there are other costs to allow for. These costs according to (Dada, 2012) have obvious negative implications for the key stakeholders in particular, and the industry in general. To the client, high cost implies added costs over and above those initially agreed upon at the onset, resulting in less return on investment. To the end user, the added costs are passes on a higher rental/lease costs or prices. To the consultants, it means inability to deliver value for money and could tarnish their reputation and result in loss of confidence reposed in them by clients. To the contractor, it implies loss of profit through penalties for non-completion, and negative word of mouth that could jeopardize his/her chances of winning further jobs, if at fault.

Every building project involves choice of building materials which has obvious effect on the cost of building element that make up the contract sum of the project. Variation on building materials to be used on a construction site can have effect on the cost allocated to the element which invariably affects the contract sum.

The result from the study will be useful to construction industry participants on how to prevent variations on cost-sensitive building elements and fluctuations of building materials from escalating the overall construction cost. It will assist employer to have value for money on his investment and repose more confidence in construction consultants.

LITERATURE REVIEW

Building elements can be said to be the materials, component parts and methods of construction that go into making a building. These elements as identified and listed in standard method of measurement (SMM1) for building works are foundations, frames, upper floor, stairs, roof, doors, windows, services, finishes and painting and decorating. (Tas and Yaman, 2007) stated that Functional elements of a building are divided into nine different groups using the BMBS cost classification system, are slab on ground, floors and stairs, external walls, windows, external doors, internal walls, internal doors, roof, superstructure (finishes, fittings/fixtures, services and painting and decorating. The expectation of any building owner and his commissioned consultants is to ensure that the final project cost falls within the initial estimated budget, or at least very close to it**.** Most construction project are being completed at costs much higher than initial estimated which indicate that initial cost estimates on construction projects can hardly be relies upon by clients (Achuenu & Kolawole, 1998)

It has been generally established that in the execution of building projects, the final contract sums more often than not differ from the sum for which the contract has been awarded (Oberlender and Trost, 2001). (Frimpong et al., 2003). conducted a survey and identified the major contributors of cost differences in Ghana to be, inflation, Fluctuation, inadequate cash flow during construction, planning and scheduling deficiencies, bad weather, and deficiencies in cost estimates. (Azhar et al., 2008). Investigation on cost overrun causes in the construction industry of Pakistan showed that fluctuation in prices of raw materials, unstable cost of manufactured materials, high cost of machineries, additional work, improper planning, and unsupportive government policies were responsible (Enshassi et al., 2009). In their survey identified fluctuations in the cost of building materials, improvements to standard drawings during construction stage, design changes, and inaccurate quantity take-off as the major causes of cost overruns in construction projects of Gaza. (Kaliba et al., 2009) also carried out a study to determine the contributors of cost escalations in road construction projects in Zambia. The findings of the study showed that the main causes of cost escalation included, scope changes, schedule delays, strikes, technical challenges, inflation, and local government pressure. (Ameh et al., 2010) observed that fluctuating prices of materials, frequent design changes, economic instability, high interest rates charged by banks on loans, and fraudulent practices including kickbacks were the factors for high of cost of telecommunication projects in Nigeria. (Cunningham, 2013) also explained that the cost of construction work is influenced by a wide range of factors. These include the identity and priorities of the client, the

nature of the project and who is responsible for developing its design, the choice of procurement options, the prevailing market conditions, and legislative constraints. (Odeyinka et al., 2009), in budgetary reliability of bills of quantities (BOQ) in building project procurement stated that the difference between the budgeted cost and the final cost differed greatly depending on project type. The study revealed that housing projects had a percentage deviation from the BOQ between −3.42% and +3.85%, educational projects, had deviation between −3.69% and +17.05% and commercial projects between −19.94% and +19.92%. This shows that there are a vast difference between the initial cost and the final contract sum with commercial projects.

(Drohan, 2009) opined that the levels of inflation on the final contract sum vary amongst Member States UN, and can be as low as 1-2% or as high as 10% per annum. In some of the states that will accede to the EU in future, higher inflation rates may be more typical. According to (Folorunsho, 2000), Fluctuation and variation accounts for 15% and 18% respectively of projects undertaken in IBWA (International bank for west Africa limited.)

In a study of risk impacts on the viability between tender sum and final account, (Odeyinka 2010) investigated, 28 risk factors affecting building projects, concluded that the significant risk factors impacting the variability between tender sum and final account relate to the level of design information or lack of it at the pre-construction stage. Those significant risk factors include 'variations and 'unexpected site conditions'.

PROBLEM STATEMENT / RESEARCH QUESTION

As the title indicates, the work is about cost impact of building element on the overall cost of contract sum. The problem of high contract sum of all aspects of construction is becoming obvious, consequently, substantial increases are being observed in projects. The high increase stem from the cost allocated to each building element that makes up the contract sum which is caused by the price of materials, labour and plants needed to execute each item of work. This substantial increase has brought about loss of client confidence in consultants, added investment risks, inability to deliver value to clients, and disinvestment in the construction industry. (Yusuf, 2007) The assessment of the building elements that impact negatively on the overall contract sum therefore form the basis for this study

RESEARCH DESIGN AND METHODS

The Ex-post facto research design was adopted for this research, it is systematic empirical inquiry in which the researcher does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulated.

The Modal Instance Sampling technique which is a form of purposive sampling was used for this study. A sample size of 24 completed building projects from the Mainland District of Lagos State, Nigeria, were selected

out of a population of 226 completed projects within the District. The focus on this District was based on its commercial/economic status, concentration construction projects, professionals and good representation of the population. Data were collected from both secondary and primary sources. The primary data were from structured interviews administered on Consultant Quantity Surveyors while the secondary data were from archival information retrieved from past successfully executed building projects like residential buildings, students' residential hostels, warehouses, and high-rise office complex. The selected building projects were those whose bills of quantities were prepared in elemental format for ease of cost analysis. The information collected in respect of the completed projects were initial contract sum, final account sum based on individual building element. Others are the amount of variations, inflations, fluctuations and claims.

The reliability of the data collected stem from the fact that the award of the projects followed standard building procurement system and was also free from any form of fraud at both pre- and post-contract stages.

The data were analyzed using Statistical Package for Social Sciences (SPSS 19) and the results were accordingly. The multiple regression data analysis method was adopted since it is used to predict some outcome or criterion variable. The general premise of multiple regression is similar to that of simple linear regression. The multiple regression equation takes the form of

$$y_i = c + b_1 x_{1i} + b_2 x_{2i} + b_3 x_{3i} + \ldots + b_k x_{ki} + e_i$$

The b's are the regression coefficients, representing the amount the dependent variable y changes when the corresponding independent x, changes 1 unit. The c is the constant, where the regression line intercepts the y axis, representing the amount the dependent y will be when all the independent variables are 0

Data Collection

The data collected for this research is a secondary data on different building projects from archival information on elemental bases at both initial contract sum and final contract sum. The parties to a contract and consultants were the source of this information.

Analysis and Results

The background and demographic features of the respondents are explained, empirically, using data collected from the oral structured interview are as shown in Table 1. About 45.8% percent were HND holders, 37.5% were BSc holders and 16.7% was HND holders. All are 100% professionally qualified. Respondents with over ten years of working experience in the construction industry were about 83.3%. Organisations with over ten years of working experience in the construction industry were about 80.4%. The professionals were employed in Quantity Surveying consultancy organisations. These findings were indications that the respondents were knowledgeable enough about the study matter and, by inference, high level of reliability of their response.

Table 1: The background and demographic features of the respondents

S/N	Demographic Characteristics	Frequency	Percentage	Total %
1	Profession (N = 24)			
	Quantity Surveying	24	100	100
2	Academic Qualification (N = 24)			
	HND	11	45.8	
	B.Sc.	9	37.5	
	M. Sc.	4	16.7	100
3	Professional Qualification (N = 24)			
	Corporate member	14	58.3	
	Fellow	4	16.7	
	Government Registered	6	25	100
4	Experience in the construction industry (Years) (N = 24)			
	≤10	1	4.2	
	10-20	20	83.3	
	21-30	3	12.5	100
5	Nature of respondents' organisation (N = 24)			
	Private	24	100	100

It can be seen from Table 2 that the factor that mostly affect the cost of building element on the overall contract sum is fluctuation with an average of 11.28% over the initial contract sums. This is followed by inflation (11.05%), Variation (8.60%) and claims 1(.42%). The overall % increase of these factors on the contract sum is 8.09%

Table 2: Factors affecting cost of building elements on the overall contract sum

	Foundation	Frames and Upper floor	Stairs	Roof and Roof covering	Walls	Windows and Doors	Services	Fittings and Fixture	Finishes	Painting	**Aver. %**	**Ranking**
Fluctuation	23.02	12.85	6.20	13.50	8.88	9.16	14.72	8.11	9.01	7.33	11.28	**1**
Inflation	12.78	18.59	5.26	13.39	8.19	11.64	18.75	8.33	8.28	5.32	11.05	**2**
Variation	10.24	9.58	3.04	-5.28	2.52	-2.11	33.49	5.65	21.92	6.90	8.60	**3**
Claim	0.00	0.00	2.95	0.00	6.58	2.73	0.00	-3.33	2.09	3.17	1.42	**4**
									Overall average		8.09	

Table 3 shows the impact of building elements on the overall contract sum. It can be observed that Services rank first among the elements with an average of 16.74% increase on the initial contract sum. Foundation ranked second with 11.51% while Finishes ranked third with 10.33%. This is followed by Frames and Upper Floors and Walls with 10.25% and 6.54% respectively. The element with the least impact is Stairs with 4.36%.

Table 3: Impacts of cost of building elements on the overall contract sum

BUILDING ELEMENTS	VARIATION %, Diff.	INFLATION %, Diff.	FLUCTUATION %, Diff.	CLAIM %, Diff.	overall %	Ranking
SERVICES	33.49	18.75	14.72	0.00	16.74	1
FOUNDATIONS	10.24	12.78	23.02	0.00	11.51	2
FINISHES	21.92	8.28	9.01	2.09	10.33	3
FRAMES AND UPPER FLOORS	9.58	18.59	12.85	0.00	10.25	4
WALLS	2.52	8.19	8.88	6.58	6.54	5
PAINTING AND DECORATING	6.90	5.32	7.33	3.17	5.68	6
ROOF AND ROOF COVERING	-5.28	13.39	13.50	0.00	5.40	7
WINDOWS AND DOORS	-2.11	11.64	9.16	2.73	5.35	8
FITTING AND FIXTURES	5.65	8.33	8.11	-3.33	4.69	9
STAIRS	3.04	5.26	6.20	2.95	4.36	10

In order to identify the impact of cost of building elements on the overall contract sum, multiple regression equation will be used

$$y_i = c + b_1x_{1i} + b_2x_{2i} + b_3x_{3i} + \ldots + b_kx_{ki} + e_i$$

Where y represents Final Contract Sum and the x's represents the Building Elements Cost, the b's represent the impact (coefficient) of each cost on the final contract sum, the c is the constant, where the regression line intercepts the y axis, representing the amount the dependent y will be when all the independent variables are 0; while the e represents the residual, the difference between the initial contract sum and the final contract sum by the model. The results of the regression analysis using SPSS is indicated in Tables 4, 5 and 6 respectively.

Table 4: Model Summary of the Final Contract Sum

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.998[a]	.996	.992	11,076,533.15

a. Predictors: (Constant), Painting and Decorating, Fitting and Fixtures, Roof and Roof Covering, Walls, Services, Finishes, Foundations, Stairs, Windows and Doors, Frames and Upper Floors

Table 4 provides the correlation coefficient and coefficient of determination (r^2) for the regression model. A coefficient of .998 suggests there is a strong positive relationship between building elements and final projects' final contract sum while r^2 = .996 suggests that 99.6% of the variance in the contract sum can be explained by the variations in the building elements while the remaining 0.4% could be explained by other unseen or unknown variables. In other words, the final contract sum is strongly predicted by the variations in the building elements. Analysis of Variance (ANOVA) of the

Final Contract Sum Model in Table 5 shows that the model is statistically significant ($p < 0.05$).

Table 5: Analysis of Variance (ANOVA) of the Final Contract Sum Model

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	3.631E17	10	3.631E16	295.930	.000a
	Residual	1.595E15	13	1.227E14		
	Total	3.647E17	23			

a. Predictors: (Constant), Painting and Decorating, Fitting and Fixtures, Roof and Roof Covering, Walls, Services, Finishes, Foundations, Stairs, Windows and Doors, Frames and Upper Floors
b. Dependent Variable: Final Contract Sum

Table 6: Coefficients of the Final Contract Sum Model

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	-2800079.98	34680412.15		-.598	.560		
Foundations	-.946	.829	-.086	-1.141	.275	.059	16.835
Frames and Upper Floors	3.360	.772	.694	4.355	.001	.013	75.508
Stairs	2.818	8.089	.040	.348	.733	.026	39.153
Roof and Roof Covering	4.065	2.447	.149	1.661	.121	.042	23.792
Walls	-1.462	1.092	-.101	-1.340	.203	.059	16.838
Windows and Doors	2.701	.905	.277	2.986	.011	.039	25.507
Services	.583	.242	.153	2.406	.032	.083	12.053
Fitting and Fixtures	-.170	.999	-.007	-.171	.867	.204	4.896
Finishes	-.485	.299	-.139	-1.623	.129	.046	21.793
Painting and Decorating	3.425	4.005	.074	.855	.408	.045	22.284

a. Dependent Variable: Final Contract Sum

Table 6 shows that the final contract sum is -₦2, 800,079.98 when it is not affected by any cost. This value represents c in the multiple linear regression model, where the slope intercept y-axis (Final contract sum) when x's (building elements) are all 0. This might not have any economic meaning since the cost cannot be negative.

From the analysis, the p-value is 0.560 which is greater than 0.05 or 5% level of significant, meaning that the constant is not significant. This means that without the independent variables the dependent variables cannot exist on their own.

Finally, the t-test in the second row tells us whether the ks2 variable is making a statistically significant contribution to the predictive

From the expression:

$$y_i = c + b_1x_{1i} + b_2x_{2i} + b_3x_{3i} + \ldots + b_kx_{ki} + e_i$$

$$y = -2800079.98 - 0.95x_1 + 3.36x_2 + 2.82x_3 + 4.07x_4 - 1.46x_5 + 2.70x_6 + 0.583x_7 - 0.17x_8 - 0.49x_9 + 3.43x_{10}$$

Where

y = Final Contract Sum

c = Constant value of the Final Contract sum

x_1 = Foundations

x_2 = Frames and Upper Floors

x_3 = Stairs

x_4 = Roof and Roof Covering

x_5 = Walls

x_6 = Windows and Doors

x_7 = Services

x_8 = Fitting and Fixtures

x_9 = Finishes

x_{10} = Painting and Decorating

The impact of each of the building element is explained as follows. If there is no initial cost of building elements, then there is no final contract sum. A naira increase in the cost of foundation may lead to N0.95 decreases in the final contract sum. A naira increase in the cost of frames and upper floors will significantly increase the final contract sum by N3.36. A naira increase in the cost of stairs will increase the final contract sum by N2.82. A naira increase in the cost of roof and roof covering will increase the final contract sum by N4.07. A naira increase in the cost of walls will decrease the final contract sum by N1.46. A naira increase in the cost of windows and doors will significantly increase the final contract sum by N2.70. A naira increase in the cost of services will significantly increase the final contract sum by N0.58. A naira increase in the cost of fittings and fixtures will decrease the final contract sum by N0.17. A naira increase in the cost of finishes will decrease the final contract sum by N0.49. A naira increase in the cost of painting and decorating will increase the final contract sum by N3.43.

Table 7: t-Test: Two-Sample Assuming Equal Variances for Initial and Final Contract Sum

	Initial	**Final**
Mean	12,256,233	13,102,986
Variance	9.8E+13	1.12E+14
Observations	10	10
Degree of freedom	18	
t Stat	0.18492	
P(T<=t) one-tail	0.427678	
t Critical one-tail	1.734064	

The t-Test in Table 7 is to test whether the Final Contract Sum is not significantly greater than the Initial contract sum. The result of the analysis shows that the final contract sum is significantly greater than the initial contract sum at 5% level of significance. Any observed difference between the initial contract sum and the final contract sum may be due to variations in the cost of building elements. This means that if good decision is made concerning the initial contract sum based on the result of multiple regression model / equation, then the final contract sum may not be different from the initial contract sum.

DISCUSSION OF RESULTS

The study has revealed that the various building elements that makes-up the overall contract sum in a Building project are Foundations, Frames and Upper floors, Roof and Roof coverings, Stairs, Walls, Windows and Doors, Services, Fitting and Fixtures, Finishes, and Painting and Decorating. The findings also show that the factor that mostly affect the cost of building element on the overall contract sum is fluctuation with an average of 11.28% over the initial contract sums while inflation is next by 11.05%.

The study reveals that Services had the most impact among the elements with an average of 16.74% increase on the initial contract sum. This can be attributed to the fact that services element is a specialist work whose scope is not fully detailed at the time of tender. Foundation is second with 11.51%. This is as a result of unforeseen state of the substructure element. Finishes is third with 10.33%. Since finishes are part of the last stage works, any likely changes affect its cost due to time factor. The overall impact of cost of building elements on the contract sum has been identified. The result of the analysis shows that 99.6% of the variation in the final contract sum can be explained by the variations in the cost of the building elements while the remaining 0.4% could be explained by other unseen or unknown variables not included in the model.

The analysis also shows that the final contract sum is zero when the costs of the building elements are zeroes. A naira increase in the cost of foundation, cost of walls, cost of fittings and fixtures, and cost of finishes may lead to reduction in the final contract sum or make it the same value or having no effect. On the other hand, a naira increase in the cost of frames and upper floors, cost of stairs, cost of roof and roof covering, cost of windows and doors, cost of services, and cost of painting and decorating will increase the final contract sum. These costs have positive effect.

Our findings also show that we are 95% sure the final contract sum is not significantly greater than the initial contract sum. However, there could be difference, that is, the final contract sum could be greater than that of the initial contract sum in reality but statistically we say that such difference is not obvious per se. The differences are outcome of uncertainty and variability, which is 6.9% inflated. These values are the overall average for initial contract sum and the final contract sum of all the 24 building types.

New projects
However, the expression above cannot be used for new projects. It is therefore better to adopt the model without a constant. The constant value $-2{,}800{,}079.98$ is the value of the final contract sum when all the cost of the building elements is zeroes. Since it is a negative value, and such value for economic reasons should be non-negative. Hence, such constant value should be zero, meaning that when all the cost elements are zeroes, then the final contract sum will be zero.

The model formulated for predicting and forecasting the final contract sum without a constant is given by:

$$y = -0.95x_1 + 3.36x_2 + 2.82x_3 + 4.07x_4 - 1.46x_5 + 2.70x_6 + 0.583x_7 - 0.17x_8 - 0.49x_9 + 3.43x_{10}$$

CONCLUSION AND RECOMMENDATION

Building elements that makes-up the overall contract sum of a building project are foundations, frames and upper floors, roof and roof coverings, stairs, walls, windows and doors, services, fitting and fixtures, finishes, and painting and decorating while the factors affecting cost of building elements on the overall contract sum are variation, inflation, fluctuation and claims.

It is therefore concluded that, if everything remains constant, a naira increase in the cost of foundation may lead to N0.95 decreases in the final contract sum. If everything remains constant, a naira increase in the cost of frames and upper floors will significantly increase the final contract sum by N3.36. If everything remains constant, a naira increase in the cost of stairs will increase the final contract sum by N2.82. If everything remains constant, a naira increase in the cost of roof and roof covering will increase the final contract sum by N4.07. If everything remains constant, a naira increase in the cost of walls will decrease the final contract sum by N1.46. If everything remains constant, a naira increase in the cost of windows and doors will significantly increase the final contract sum by N2.70. If everything remains constant, a naira increase in the cost of services will significantly increase the final contract sum by N0.58. If everything remains constant, a naira increase in the cost of fittings and fixtures will decrease the final contract sum by N0.17. If everything remains constant, a naira increase in the cost of finishes will decrease the final contract sum by N0.49. If everything remains constant, a naira increase in the cost of painting and decorating will increase the final contract sum by N3.43.

Finally, it is concluded that the model formulated for predicting and forecasting the final contract sum is given by:

$$y = -0.95x_1 + 3.36x_2 + 2.82x_3 + 4.07x_4 - 1.46x_5 + 2.70x_6 + 0.583x_7 - 0.17x_8 - 0.49x_9 + 3.43x_{10}$$

The various building elements that makes-up the overall contract sum as aforementioned, must be properly looked at and cost distributed to each to

get the initial contract sum because the sum up of these elements give the final contract sum.

More so, apart from taking cognizance of the building elements and their associated cost, some external factors that can determine the variation in the cost of these building elements must be considered. These factors are also very important. They are variation, inflation, fluctuation and claims.

It is recommended that Initial Contract Sum of construction projects should be estimates based on the model provided in this study.

For instance, if everything being equal, a naira increase in the cost of frames and upper floors will significantly increase the final contract sum by N3.36. For this element, the forecasted the final contract sum should be computed by multiplying the amount of the element by N3.36. This should be done for each of the building elements that affect the final contract sum positively. The ones that affect the final contract sum negatively should not be used for the computation for precautionary purpose. However, if these elements that are inversely proportional to the final contract sum are to be used, they must not be used individually but with the entire model. This study has revealed that 95% of the final contract sum is too significantly greater than the initial contract sum. The differences are outcome of uncertainty and variability, which is 16.9% on the elements. These values are the overall average for initial contract sum and the final contract sum of all the 24 selected building types.

The implication of this research is that with the formula derived, the final accounts will be less than contract sum of future projects, which becomes an advantage to the employer. The employer would have achieved value for the money committed into the project. This would also restore client confidence in consultants and prevent disinvestment in the construction industry.

This study was limited to Mainland district of Lagos State, Nigeria in the South west geopolitical zone of Country due to economic, time and other logistics reasons. The study focus on building projects, further studies can be carried out on other types of construction projects where the regression model can be tested.

REFERENCES

Ameh, O.A., Soyingbe, A.A. and Odusami, K. T. (2010) "Significant factors causing cost Overruns in telecommunication projects in Nigeria," *Journal of Construction in Developing Countries*, vol. 5, no. 2, pp. 49–67.

Azhar, N., Farooqui, R.U. and Ahmed, S. M. (2008). "Cost overrun factors in construction Industry of Pakistan," Proceedings of the 1st International Conference on Construction in Developing Countries (ICCIDC–I) "*Advancing and Integrating Construction Education, Research & Practice", Karachi, Pakistan,* August. pp.4-5.

Cunningham, T. (2013) "Factors Affecting the Cost of Building Work—An Overview", *Dublin Institute of Technology*.

Enshassi, A., Al-Najjar, J. and Kumaraswamy, M (2009). "Delays and cost overruns in the Construction projects in the Gaza Strip," *Journal of Financial Management of Property and Construction*, vol. 14, no. 2, pp. 126–151.

Frimpong,Y., Oluwoye, J. and Crawford, L. (2003). "Causes of delay and cost overruns in construction of groundwater projects in developing countries; Ghana as a case study," *International Journal of Project Management*, vol. 21, no. 5, pp. 321–326,

Kaliba,C., Muya, M. and Mumba, K. (2009)."Cost escalation and schedule delays in road construction projects in Zambia," *International Journal of Project Management*, vol. 27, no. 5, pp. 522–531

Dada, M.O. (2012). "A Second look: Stakeholder Perceptions of Some Issues in Design-Bid-Build Procurement Practice in Nigeria". *Journal of Sustainable Development* , 5(1): 55 - 63.

Drohan, B (2009) Estimates based a detailed scope of works and on tender prices, *Dublin Institute of Technology*

Memon, A. H., Rahman, I. A and Azis, A.A. (2011). "Preliminary study on Causative factors leading to construction cost overrun". *International journal of Sustainable Construction Engineering and Technology 2*(1), pp.57-71.

Muhammad S., Rizwan, U.F,and Sarosh H.L. (2008). "Assessment of critical success factors for construction projects in Pakistan". First International Conference on Construction in Developing Countries (ICCIDC–I) "*Advancing and Integrating Construction Education, Research & Practice*". August 4-5, 2008, Karachi, Pakistan

Tas, E., Yaman, H., (2007) A building cost estimation model based on functional elements, *Engineering Construction and Architectural Management*, Volume 4, No: 1, page 73-87

Oberlender, G.D. and Trost, S.M. (2001). "Predicting accuracy of early cost estimates based on estimate quality". *Journal of construction energy and Mgt.*, ASCE, 127 (3) pp.173-182

Odeyinka, H.A., Kelly, S. and Perera, S. (2009). "An evaluation of the budgetary reliability of bills of quantities in building procurement," *in Proceedings of the Construction and Building Research Conference of the Royal Institution of Chartered Surveyors*. pp. 435–446.

Odeyinka,H., Weatherup, R., Cunningham, G., Larkin, K.,and Mark M., (2010). "Assessing risk impacts on the variability between tender sum and final account," *COBRA Conference, of Royal Institution of Chartered Surveyors*, held at Dauphine Universite, Paris, September 2010.

Omole, A.O. (1999)." Cost Estimating and Management". *The Professional Builders Journal*. vol. 27, January/ July, pp.3-8.

Yusuf, O. H. (2007). "The causes and Effects of Construction Delays on Construction Cost of Housing Projects in Nigeria". *Journal of Financial Management of Property and Construction* , V .2 (3) Pp 31 - 44.

AN ASSESSMENT OF ORGANISATIONAL CULTURE OF CONSTRUCTION ORGANISATIONS IN NIGERIA

Yetunde Olanike Olaleye[1], Yahaya Makarfi Ibrahim[2], Ahmed Doko Ibrahim[3] and Kulomri Jipato Adogbo[4]

[1,2,3,4]*Department of Quantity Surveying, Ahmadu Bello University Zaria*

Understanding of Organisational Culture is fundamental to understanding what goes on in organisations, how to run and improve them. What differentiates successful organisations from others is their organisational culture. This study is aimed at diagnosing the cultural profile of construction organisations in Nigeria. This was carried out using the competing values framework developed by Cameron and Quinn to establish which of the four major culture types (Clan, Adhocracy, Hierarchical or Marketing cultures) is dominant in the Nigerian Construction Industry. Data was collected from contracting organisations registered with the Corporate affairs Commission of Nigeria using a structured questionnaire developed and administered by the researchers. A total number of 200 firms were selected for the study, 97 of them participated. Data collected was analysed using descriptive statistics. The findings of the study revealed that the dominant culture of construction organisations is the hierarchical culture with a mean of 4.01. Organisational leadership is the major characteristics being exhibited by construction organisations. The findings further revealed that is no significant difference in the organisational culture of large and medium construction firms. To be effective, the adoption of some elements of the culture types is necessary, however, the dominant culture has an extensive impact on the character, behaviour and is likely to be a determinant of the success of improvement programs.

Keywords: adhocracy, clan, hierarchical, marketing, organisational culture

INTRODUCTION

The culture of an organisation is a concept that has been the subject of multidisciplinary research since the 20th century (Nurk & Huemann, 2016) an understanding of the culture of an organisation is a basic fundamental issue when examining what happens in an organisation, how to run an organisation and how to improve an organisation (Yacizi, Gritili, Topcu-oraz

[1] yettynike@gmail.com
[2] makarfi@gmail.com
[3] adibrahim2@yahoo.com
[4] kjadogbo@yahoo.com

Olaleye, Y. O., Ibrahim, Y. M., Ibrahim, A. D. and Adogbo, K. J. (2017) An assessment of organisational culture of construction organisations in Nigeria In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 208-218.

& Acar, 2007). The most cited definition of Organisational Culture was by Schein (1992), he defined organisational culture as a pattern of shared basic assumptions that the group learned as it solves its problem of external adaptation and internal integration that has worked well enough to be considered valid and therefore be taught to new members as the correct way to perceive, think and feel in relation to those problems. Several scholars recognize that the culture of organisations have powerful effect on performance and long-term effectiveness of organisations the major distinguishing factor that differentiate successful organisations from non-successful organisations is the culture of the organisations (Zu, Robbin & Fredandall, 2010)

In the late 1990s, a special task group TG23-culture in organisations was established within the International Council for Research and Innovation in Building and Construction (CIB). The TG23 became a working commission on its own and was named working Commission W112 in 2006. One of the most important reasons for specific difficulties related to the construction process identified was the culture of organisations.

The goals of TG23, recently W112 as highlighted by fellows (2011) are:

- To identify and define concepts of culture in the international construction industry and carry out research into the manifestations and effects.
- To discuss and develop appropriate methodologies for the study of culture in organisations
- To determine where appropriate, adopt methodologies for researching culture in the international construction industry

The objectives are in line with the concept of culture applicability to societies and it continues to stimulate new participants from Europe, Asia, Africa, Australia and America (Nekic & Heumann, 2016). Previous researches have looked into the relationship between organisational culture of private universities, banks, multinational cooperation , public and private organisations in Nigeria, this calls for investigation into the characteristics of Organisational culture in the Nigerian Construction Industry, the main reason for the growing importance of Organisational Culture in the construction Industry can be explained by the internalization of the construction market and the fragmented nature of the industry (Oney-Yacizi, Gritili, Topcu-Oraz & Acar, 2007), it is specifically targeted as culture of organisations and not culture in general such as national culture. The capability of handling culture-related issues within the construction process can be seen as a kind of risk management tool that can reduce the risk of dissatisfaction of all parties involved

A consensus has emerged that members of any group for example the construction industry as a group share a collective value and behaviour that influence the activities of the group, this assertion forms the basis of this paper culture of organisations is a crucial factor in the long-term

effectiveness of organisations as it is important to be able to measure and diagnose culture of organisations.

LITERATURE REVIEW

Organisational culture

Organisational culture plays a vital role in improving competitiveness and also in increasing profits and productivity. This has urged top managers in several organisations to explore means of managing and changing the culture of their organisations hence the need for studies on organisational culture Prajogo and McDermott, 2005; Naor et al., 2008; Zu et al., 2010).

Organisational culture can be defined as the continuing and dominant values, behaviours and attitudes in a group of people classified into four views i.e. a mental programming, a learned entity, a strategy and a belief system (Maull 2011). Jaeger (2008) views culture as a set of common ideas shared by members of a group. By practice, such ideas are transformed into the behaviors of the members of an organisation which is built on commonly held attitudes, values and beliefs. organisational culture can be defined as the general pattern of mindsets, beliefs and values members of the organisation share in common, and which shape the behaviours, practices and other artefacts of the organisation which are easily observable (Jaeger, 2008).

Day-to-day behaviour of members in the organisation is governed by a core set of assumptions, understandings, and implicit rules that reflect organisational culture (Baird, Hu & Reeve, 2011). Hence, organisational culture is also broadly considered to reflect the behaviour of members of the organisation (Prajogo and McDermott, 2005; Naor et al., 2008; Zu et al., 2010), and it is the organisation's culture that helps to shape and determine the behaviour of the members and practices within that organisation (Valmohammadi & Roshamir, 2015). Studies on Organisational culture has been carried out by several authors, Nurkic and Heumann(2016) found the dominant OC of Croatian Construction Industry to be the Hierarchical Culture, Lapina et al (2015) established the OC of Riga university to be the Hierarchical culture, the OC of American manufacturing plant is the Clan culture as established by Zu et al (2010), Valmohammadi et al (2015) found the OC of Tehran Pharmaceutical industry to be the Hierarchical and Marketing cultures.

Competing values framework

The competing values framework (CVF) has been used in several studies as a method of analysing Organisational culture, it explores the deep structure of Organisational Culture relating to compliance, motives, leadership, decision making, effectiveness and organisational forms within an organisation, CVF is shown to be theoretically sound in interpreting Organisational Culture and can be operationalized as a psychometrically sound instrument (Gambi et al., 2013; Ivana & Martina, 2016; Lapina, Kairisa, & Aramina, 2015; Ovbagbedia & Ochieng, 2015; Valmohammadi & Roshanzamir, 2015; Zu et al., 2010). This research will adopt the Competing

Values Framework (CVF). The CVF is based on two major dimensions that organized the effectiveness indicators into four main clusters. (shown in Fig.1).

Internal Focus and Integration	Flexibility and Discretion		External Focus and Differentiation
	Culture Type: CLAN Orientation: Collaborative Leader Type: Facilitator, Mentor Team builder Value Drivers: Commitment Communication Development Theory of Effectiveness: Human development and participation produce effectiveness. Quality Strategies: Empowerment, Team building Employee involvement, Human resource development and Open communication	Culture Type: ADHOCRACY Orientation: Creative Leader Type: Innovator Entrepreneur Visionary Value Drivers: Innovative outputs Transformation Agility Theory of Effectiveness: Innovativeness, vision, and new resources produce effectiveness Quality Strategies: Surprise and delight Creating new standards Anticipating needs Continuous improvement Finding creative solutions	
	Culture Type: HIERARCHY Orientation: Controlling Leader Type: Coordinator Monito Organizer Value Drivers: Efficiency Timeliness Consistency and uniformity Theory of Effectiveness: Control and efficiency with capable processe produce effectiveness Quality Strategies: Error detection, Measurement, Process control, Systematic problem solving, Quality tools (fishbone diagrams, Pareto charting, affinity graphing, variance plotting)	Culture Type: MARKET Orientation: Competing Leader Type: Hard driver Competitor Producer Value Drivers: Market share Goal achievement Profitability Theory of Effectiveness: Aggressively competing and customer focus produce effectiveness Quality Strategies: Measuring customer preferences Improving productivity Creating external partnerships Enhancing competitiveness Involving customers and suppliers	
	Stability and Control		

Figure 1.0: The competing values framework (Cameron and Quinn, 2005)

The first dimension emphasizes on flexibility and discretion in the upper quadrant while the lower quadrant emphasizes on stability and control. The second dimension measures the focus of the organisation both internally and externally. A combination of the two dimensions bring about four quadrants as shown in figure 1 above. Each of the four quadrants stands for a distinct set of values that determine an organisations way of doing business. These 4 typologies of organisational culture simultaneously exist theoretically in every organisation as the

a. Clan culture
b. Adhocracy culture
c. Marketing culture
d. Hierarchical culture

Clan culture: Clan culture places emphasis on flexibility and internal orientation Cameron & Quinn, 2005). Organisations with emphasis on this

culture promote the development of human resources, emphasizing openness, participation, cohesiveness and commitment to membership. Such organisations are typified as a friendly place to work where people share a lot (Zu et al, 2015). It is akin to an extended family with best friends at work. Leaders are thought of as mentors, coaches, and, perhaps, even as parent figures. The organisation is held together by loyalty, tradition, and collaboration. Commitment is high. The organisation emphasizes the long-term benefits of individual development with high cohesion and morale being important. Success is defined in terms of internal climate and concern for people. The organisation places a premium on teamwork, participation, and consensus (Valmohamadi & Roshamir,2015).

Adhocracy culture: Cameron and Quinn (2005) described adhocracy culture as one that emphasizes flexibility but with more focus on the external environment. The orientation is towards growth, creativity stimulation, resource acquisition, innovation, and continual adaptation to the external environment (Ivana & Matina, 2016). Organisation with adhocracy culture is characterized as a dynamic, entrepreneurial, and creative workplace. People stick their necks out and take risks. Effective leadership is visionary, innovative, and risk-oriented. The binding force that holds the organisation together is commitment to experimentation and innovation (Zu et al, 2010). The emphasis is on being at the leading edge of new knowledge, products, and/or services. Readiness for change and meeting new challenges are important. The organisation's long-term emphasis is on rapid growth and acquiring new resources.

Marketing culture: According Cameron and Quinn (2005), the marketing culture is also focused on the external environment but is control-oriented. It emphasizes productivity, performance, goal achievement, and one of the primary motivating factors is competition. Such organisation is a results-oriented workplace. Leaders are hard-driving producers, directors, and competitors. They are tough and demanding (Baird et al, 2011). The binding force that holds the organisation together is an emphasis on winning. The long-term concern is on competitive actions and achieving stretch goals and targets. Success is defined in terms of market share and penetration. Outpacing the competition, escalating share price, and market leadership dominate the success criteria.

Hierarchical culture: According Cameron and Quinn (2005), the hierarchical culture is both control and internal oriented. It emphasizes rules and regulations, and standardization to achieve control and stability. Such organisation is characterized as a formalized and structured place to work. Procedures and well-defined processes govern what people do. Effective leaders are good coordinators, organizers, and efficiency experts. Maintaining a smooth-running organisation is important. The long-term concerns of the organisation are stability, predictability, and efficiency. Formal rules and policies hold the organisation together. The CVF has been used in a number of empirical studies to explore organisational culture and the effect of the culture types on various operational management studies

such as performance measurement (Baird et a, 2011: Total Quality Management, Gambi et al, 2013, Supply chain integration Zu et al, 2010).

Research questions

This paper addresses the following research questions:

a. What is the organisational culture profile of construction organisation in Nigeria?
b. To what degree do construction organisation emphasise each culture type?

RESEARCH DESIGN / METHODS

Evaluation of the Organisational culture of Construction organisations in Nigeria was considered a necessary foundation for this study. Based on the review previously presented, the Competing Values Frame work and the Organisational culture assessment instrument developed by Cameron and Quinn (2005) will be adopted for this study. The framework has been adopted by several studies in diagnosing the culture of organisations Prajogo & McDermott, 2005: Zu et al, 2010; Valmohammadi & Roshamir, 2015).

The organisational culture assessment instrument has six key dimensions

a. Dominant characteristics
b. Organisational leadership
c. Management of Employees
d. Organisational Glue
e. Strategic Emphasis
f. Criteria for success.

These dimensions offer four alternative statements. Each of the four statements represent each of the four major culture types (Clan, Adhocracy, Marketing & Hierarchical). Theoretically, these four culture types can be used to describe the pattern for organisational culture.

The research employed the Survey design using a structured questionnaire administered to construction firms in the Federal Capital Territory in Nigeria. A total number of 200 firms were selected for the study, 97 of them participated giving a response rate of 49%. The response rate is higher than those obtained from similar studies (Oney-Yacizi et al, 2007; Baird et al, 2011; Roldan et al, 2012) The firms were selected by judgmental sampling procedure. The judgement criteria used for the selection was emphasis on medium and large firms registered with the corporate Affairs commission (CAC). They were selected because they are more likely to have departments. The federal ministry of works classified large based on annual turnover as organisations that have an annual turnover of N10 billion as stated in a verifiable tax clearance certificate for three preceding years while medium organisations are those that have an annual turnover of N5

billion as stated in a verifiable tax clearance certificate for three preceding years. Heads of Departments were selected to respond on behalf of each organisation.

To identify the cultural dimensions of the firms the respondents were asked to rate the culture of their organisations based on statements from the Organisational Culture Assessment Instrument on a five point likert scale. A scale of 1 -5 was assigned with the highest score of 5 being assigned to strongly agree. The overall cultural profile of organisations was derived by computing the mean scores of all respondents. Coefficient of reliability (Cronbach alpha) was computed for each of the different culture types (Clan 0.804, Adhocracy 0.744, Marketing, 0.768 and Hierarchical 0.793).

ANALYSIS AND RESULTS

Table 1. Descriptive Statistics of the culture types

	Clan	Adhocracy	Marketing	Hierarchical
Dominant Characteristics	3.37	3.63	4.41	4.31
Organisational Leadership	3.86	4.02	4.07	4.23
Management of Employees	3.39	4.06	3.96	4.02
Organisational Glue	4.02	4.00	3.82	4.14
Strategic Emphasis	3.81	4.10	3.86	4.04
Criteria for Success	4.08	3.99	3.95	3.88
	3.76	3.97	4.01	4.10

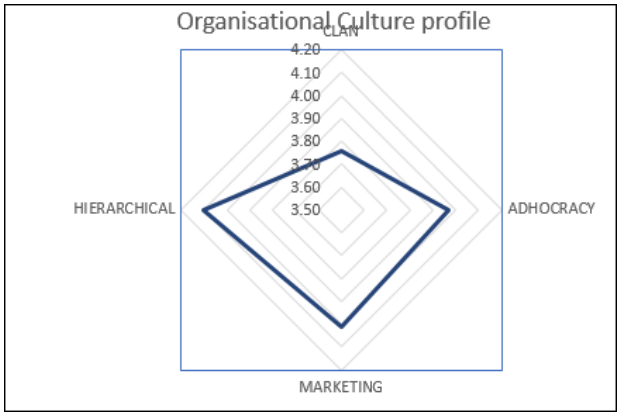


Figure 2: Organisational Culture profile of construction organisation in Nigeria

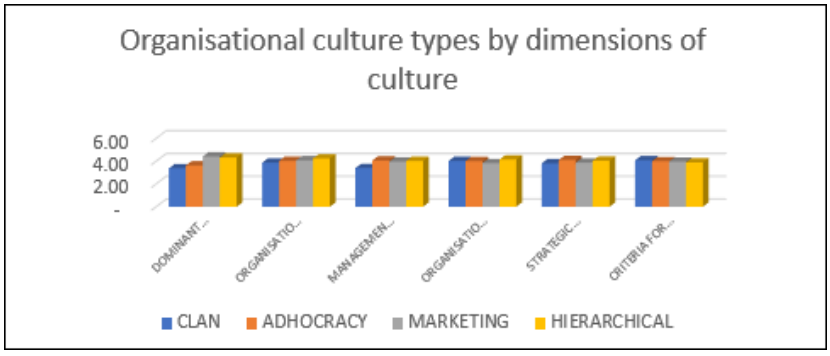


Figure 3 Organisational culture types by dimensions of culture

Analysis of variance
ANOVA test was performed to examine organisational culture differences by size of firms (Medium and Large firms)

	Sum of Squares	Df	Mean square	F	Sig.
Between Groups	.286	5	.057	.232	.948
Within group	62.040	252	.246		
Total	62.356	257			

The analysis of variance was used to facilitate a comparison between firm sizes (Medium and Large construction firms). The result of the ANOVA test conducted indicated a significant value of 0.948. this value is far larger than 0.05 alpha value. This showed that there is no significant differences between organisational culture of the firms studies. The cultures have the same effect and importance.

DISCUSSION AND CONCLUSION

Organisational culture profile by type of culture
The core of this research is derived from the Competing Values Framework, the average mean scores of the responses are shown in Table 1 indicating the dominant culture type of Construction organisations. The cultural profile of each organisation was obtained by averaging the respondents rating for each culture type across the six dimensions.

The findings indicate that the current dominant organisational culture of the sample is Hierarchical culture. This is consistent with the findings of Neurik & Huemann (2015) whose findings revealed that the dominant Organisational culture of the Croatian Construction organisations is the Hierarchical culture and the dominant culture of the Turkish construction industry is the clan and Hierarchical cultures (Oney-Yacizi et al, 2007). The scores indicate that people accept a hierarchical order in which everyone has a place and subordinates take instructions from superiors. The next dominant culture is the Marketing culture followed by the Adhocracy and Clan cultures. Contracting organisations are formal organisations in which control and coordination is achieved through formal methods and procedures that is typical of hierarchical culture. The graphical presentation of results in figure 2, displays the organisational culture profile. Both of the prevailing cultures with the highest scores (hierarchical 4.10 and marketing 4.01) are oriented towards centralization which reflects stability and control, while both of the weaker cultures (adhocracy culture with a mean score of 3.97, and the lowest score is the clan culture with a mean of 3.76 are oriented towards decentralization which reflects flexibility and discretion. This indicates that the focus of the organisations in the survey population is a lot more on stability, order, and control, rather than flexibility, discretion, and dynamism.

The organisational focus of the dominant culture (hierarchical) is internal and oriented towards maintenance and improvement of the existing organisation, while that of other (Marketing) is externally focused on

adaptation and interaction with the external environment. This indicates that the organisations in survey population have an internal focus on integration and unity along with an external focus on differentiation, and rivalry. The organisations have harmonious internal characteristics together with a focus on interacting or competing with others outside their boundaries. The score for both hierarchical and marketing cultures in the survey population is quite high, reflecting the dominant role of both types of culture in the sample organisations.

Organisational culture profile by dimensions of culture

There are six underlying dimensions used to measure organisational culture as shown in Figure 3, and the score of all six dimensions is the aggregated to get the mean score of each culture type. Therefore, the overall score for each culture type is made up of a score on six dimensions of organisational culture type. The six dimensions also helps to determine if the measures are accurate representations of the properties of the formal construct definition indicating that internal consistency exists and the measures consistently represent the same latent constructs of organisation culture type. The findings of the research indicate that the findings indicate that organisations in the survey population are predominantly inclined towards the hierarchical and marketing culture types. This means that the general tendency therefore towards control, centralization, stability, and predictable performance outcomes (hierarchical culture); and task focus, goal achievement, efficiency, productivity and profitability (marketing culture).

CONCLUSION AND RECOMMENDATION

This paper presents the findings of a questionnaire survey carried out in construction organisations with a view of establishing the dominant Organisational Culture of construction organisations. The paper acknowledges that the findings of this study shows the dominance of hierarchical culture type, the findings of this study substantiate the idea of the concurrent coexistence more than one culture types in construction organisations based on the closeness of the means of the Organisational Cultures. Such combination of cultures is consistent with the findings of previous studies on the composition of organisational culture (Zu et al, 2010; Nukik et al, 2106). In the context of co-existence of cultures as found in this study, the previous research on organisational culture suggests that organisations are unlikely to reflect only one culture type (Valmohamadi &Roshamir, 2015) and that to be effective, the adoption of some elements of each of the four ideal culture types (clan, adhocracy, marketing and hierarchical) is necessary. Therefore, a favorable mix of characteristics of organisational culture is desired, that not only meets the competing demands of change and stability but also provides enough flexibility to accommodate innovation and growth (Prajogo and McDermott, 2005). Nevertheless, the dominant culture will have an extensive impact on the character, behavior and performance of an organisation and ultimately this

dominant culture is likely to be a major determinant of the success of improvement programme (Prajogo and McDermott (2005).

In this study, the data on organisational culture profile was collected only at the organisational level, but in the case of large and medium construction organisations each department/division or function may have subgroups of culture which are more homogenous within the department/division but are heterogeneous with respect to overall organisational culture because of the varied nature of their function. Future research may investigate this.

REFERENCES

Baird, K., Jia, K. H. & Reeve, R., 2011. The relationship between organisational culture, total quality management practices and operational performance. *International Journal of Operations and production management,* 31(7), pp. 789-814.

Fellows, R. 2011. Researching for culture in construction, a quest for methodological rigor. ARCOM Doctoral Workshop. Culture in Construction.

Gambi, L. N., Gerolamo, M. C. & Carpinetti, L. C., 2013. A Theoretical model of the Relationship between Organisational Culture and Quality Management techniques. *Social and Behavioral Sciences,* 81(1), pp. 334-339.

Hofstede, G., 1980. *Culture's Consequence.* 2nd ed. Thousand Oaks: Sage.

Ivana, N. S. & Martina, H., 2016. Organisational Culture of the crotian Construction Industry. *Total Quality Mangement and buisnes Excellence,* 23(2), pp. 237-260.

Jaeger, M. & Adair, D., 2016. Perception of TQM benefits, practices and obstacles. The case study of project managers and quality management representatives. *TQM Journal,* 28(2), pp. 317-336.

Lapina, I., Kairisa, I. & Aramina, D., 2015. The role of Organisational Culture in the Quality Managment of University. *Social and Behavioral sciences,* 213(1), pp. 770-784.

Naor, M., Goldstein, S. M., Linderman, K. M. & Schroder, R. G., 2008. The role cultures as a driver of Quality Managment and Performance: Infrastructure Versus Core Quality Practices. *Decision Sciences,* 39(4), pp. 671-702.

Oney-Yacizi, E., Gritili, H., Topcu-Oraz, G. & Acar, E., 2007. Organisational Culture: the case of Turkish Construction Industry. *Engineering, Construction and Architectural Management,* 14(6), pp. 519-531.

Ovbagbedia, O. O. & Ochieng, E. G., 2015. Impact of Organisational Culture on Knowledge transfer in Nigerian Heavy Engineering projects. *Management Procurement and Law,* 168(1), pp. 241-247.

Prajogo, D. I. & McDermott, C. M., 2005. The relationship between Total Quality Mangement Practices and Organisational Culture. *Intenational Journal of Operations and Production Managment ,* 31(7), pp. 1101-1122.

Shein , E., 1997. *Organisational Culture and Leadership.* Second ed. San Francisco: Jossey-Bass.

Valmohammadi, C. & Roshanzamir, S., 2015. The guideline for improvement: Relation among Organisational Culture, TQM and performance. *International Journal of Production Eonomics,* 164(1), pp. 167-178.

Zu, X., Robbin, T. L. & Fredendall, L. D., 2010. Mapping the crictical link betweeen Organisational Culture and TQM/Six Sigma Practices. *International Journal of Production Economics,* 123(1), pp. 86-106.

AN ASSESSMENT OF ORGANIZATIONAL CULTURE FOR TOTAL QUALITY MANAGEMENT IMPLEMENTATION IN THE NIGERIAN CONSTRUCTION INDUSTRY

Yetunde Olanike Olaleye[1], Yahaya Makarfi Ibrahim[2], Ahmed Doko Ibrahim[3] and Kulomri Jipato Adogbo[4]

[1,2,3,4]*Department of Quantity Surveying, Ahmadu Bello University Zaria, Nigeria*

Quality and quality systems are topics which have been receiving increasing attention worldwide. Quality management is critically required for a construction company to sustain in current construction market which is highly challenging and competitive. Construction in Nigeria is characterized by lack of adherence to standard and lack of implementation of Quality management practices. The research is aimed at examining the relationship between organisational culture and Total Quality Management., and establishing the culture type(s) that could be strengthened to support TQM practices. The research was carried out by administering structured questionnaires to managers of construction organisations in the Federal Capital territory of Nigeria. A total number of 200 questionnaires were administer and 97 returned giving a response rate of 49%. The research was analysed using descriptive statistics using Pearson correlation coefficient to establish the relationship between organisational culture types and TQM and also by using multiple linear regression to investigate the culture type that could be strengthened to support TQM. The findings of the study revealed that the clan and marketing culture has the strongest relationship with TQM and also has a positive direct effect on TQM. Strengthen the clan culture in organisations will aid TQM implementation. The study recommends that any efforts that can be made to increase the presence of Clan culture and marketing culture prior to commencing the formal implementation of TQM would be highly beneficial

Keywords: organisational culture, quality, total quality management

[1] yettynike@gmail.com
[2] makarfi@gmail.com
[3] adibrahim2@yahoo.com
[4] kjadogbo@yahoo.com

Olaleye, Y. O., Ibrahim, Y. M., Ibrahim, A. D. and Adogbo, K. J. (2017) An assessment of organizational culture for total quality management implementation in the Nigerian construction industry In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 219-229.

INTRODUCTION

Quality and quality management are topics which have been receiving increasing attention worldwide (Naor, Goldstein, Linderman, & Schroder, 2008). The concept of quality has existed for many years, though, its meaning has changed and evolved over time (Reid & Sanders, 2012). Quality management is critically required for a construction company to sustain in current construction market which is highly challenging and competitive. The advent of mass-production changed the quality emphasis completely. No longer were individuals responsible for making whole products. Instead the manufacturing process broke work down into narrow and repetitive tasks (Rasmussen, 2012). It was viewed as a concept that encompasses the entire organisation and not only production process. The meaning of quality dramatically changed in the late 70s that ended the view that quality is about inspection only (Sallies, 2002). In the 80s organisations were losing business to their competitors that were producing lower priced products with considerable higher quality. To survive and compete internationally, companies had to make major changes in their quality programs by hiring consultant and initiating quality training programs for their employees bringing about the emergence of a new concept of quality. The new concept of quality builds quality into the process, identifies and correct the causes of quality problems. The term used for today's new concept of quality is Total Quality Management (TQM) which is proactive, it is designed to build quality into the product and process (Reid & Sanders, 2012). In recent years, more and more organisations are working towards TQM (Jaeger & Adair, 2016). Recent studies in the field of TQM show that there is increasing recognition of the influence of Organisational Culture on the success or failure of TQM implementation (Green, 2012; Haffar et al., 2013; Jimenez-Jimenez, D. Martinez-Costa M, Martinez-Lorente, & Rabeh, 2014; Rad, 2006).

There are compelling reasons why the study of TQM in organisations warrant the study of its organisational culture (Yong & Pheng, 2008). In practice, the benefits of TQM are not easy to achieve (Rad, 2006), furthermore, literature suggests that only 20 to 30% of organisations that have implemented TQM benefit from the implementation, failure of any initiative is not desirable therefore it is important to seek to ascertain the reasons why some TQM initiatives still fail. One of the most cited reason for its failure is Organisational culture (Oney-Yacizi, Gritili, Topcu-Oraz, & Acar, 2007; Prajogo & McDermott, 2005, 2011; Rad, 2006; Zu, Robbins, & Fredenadall, 2010)

LITERATURE REVIEW

Total quality management

Recently in the global economy, many new change and transformational initiatives are developed to increase effectiveness in organisations, TQM is one of those transformational initiatives and one of the most important evolution of management practices (Haffar, Al-Karaghouli, & Ghoniem,

2013). TQM is a philosophy, a management approach that emphasise mutual co-operation, it involves everyone at every level in the organisations (Baird, Jia, & Reeve, 2011), and improvement in all aspects of the organisation (Calabrese & Corbo, 2015). TQM is aimed at achieving customer satisfaction not only in the production of goods and services that meets customers' needs and requirements but also exceeding them through continuous improvement (Prajogo & McDermott, 2011). TQM strives to provide organisations with a template for success through customer satisfaction (Rad, 2005). Globally, organisations are embracing and implementing the practices of TQM (Ooi, Lin, Tan, & Chong, 2011) because it has been recognised as a means to achieve business performance, competitive advantage and continuous success (Jaca & Psomas, 2015). Organisations that are outcome oriented will be expected to focus on improving product and service quality as a means of achieving competitive advantage, such organisations are more likely to implement TQM practices to enhance their quality performance (Anthony, Keung, Knowles, & Gosh, 2002). Construction in Nigeria is characterized by lack of adherence to standard and lack of implementation of Quality management practices (Akinola, Akinderawo, & Olatunji, 2012). In an attempt to improve quality and performance, many companies have focused on TQM. However, in spite of these claimed benefits, a closer examination of literature shows that implementing TQM has not achieved intended results and one of the key barrier is organisational culture (Gambi, M C Gerolamo, & Carpinetti, 2013).

Organisational Culture is a set of shared meanings that make it possible for members of a group to interpret and act upon their environment (Schein, 1997). Organisational culture depends for its existence on a definable organisation, in the sense of a number of people interacting with each other for the purpose of accomplishing same goal in their defined environment (Schein, 1997). It is the collective programming of the mind which distinguishes the members of one organisation from another (Hofstede, 1980). Culture defines the core values, assumptions, interpretations, and approaches that characterize an organisation (Cameron & Quinn, 2006). In an organisation, subunits such as functional department, product groups, hierarchical levels or teams can also reflect their own unique cultures referred to as subculture (Gimenez-Espin, Jiménez-Jiménez, & Martínez-Costa, 2013; Valmohammadi & Roshanzamir, 2015; Willar, Trigunarsyah, & Coffey, 2016). It is thus essential that organisational culture must be in agreement with TQM practices (Cheng & Liu, 2007). Despite the widespread acknowledgement of the important role of organisational culture for TQM implementation, there is a gap in empirical literature examining the association between organisational culture and TQM practices.

Competing values framework

The competing values framework (CVF) has been used in several studies as a method of analysing Organisational culture, it explores the deep structure of Organisational Culture relating to compliance, motives, leasership,

decision making, effectiveness and organisational forms within an organisation. (Gambi et al., 2013; Ivana & Martina, 2016; Lapina, Kairisa, & Aramina, 2015; Ovbagbedia & Ochieng, 2015; Valmohammadi & Roshanzamir, 2015; Zu et al., 2010). This research will adopt the Competing Values Framework (CVF). The CVF is based on two major dimensions that organized the effectiveness indicators into four main clusters. (shown in Fig.1).

Internal Focus and Integration	Flexibility and Discretion		External Focus and Differentiation
	Culture Type: CLAN Orientation: Collaborative Leader Type: Facilitator, Mentor Team builder Value Drivers: Commitment Communication Development Theory of Effectiveness: Human development and participation produce effectiveness. Quality Strategies: Empowerment, Team building Employee involvement, Human resource development and Open communication	Culture Type: ADHOCRACY Orientation: Creative Leader Type: Innovator Entrepreneur Visionary Value Drivers: Innovative outputs Transformation Agility Theory of Effectiveness: Innovativeness, vision, and new resources produce effectiveness Quality Strategies: Surprise and delight Creating new standards Anticipating needs Continuous improvement Finding creative solutions	
	Culture Type: HIERARCHY Orientation: Controlling Leader Type: Coordinator Monitor Organizer Value Drivers: Efficiency Timeliness Consistency and uniformity Theory of Effectiveness: Control and efficiency with capable processes produce effectiveness Quality Strategies: Error detection, Measurement, Process control, Systematic problem solving, Quality tools (fishbone diagrams, Pareto charting, affinity graphing, variance plotting)	Culture Type: MARKET Orientation: Competing Leader Type: Hard driver Competitor Producer Value Drivers: Market share Goal achievement Profitability Theory of Effectiveness: Aggressively competing and customer focus produce effectiveness Quality Strategies: Measuring customer preferences Improving productivity Creating external partnerships Enhancing competitiveness Involving customers and suppliers	
	Stability and Control		

Figure 1.0: The competing values framework (Cameron and Quinn, 2005)

Research questions

a. What is the relationship between Organisational culture and TQM practices?

b. What culture type(s) can be strengthened to support TQM implementation?

RESEARCH DESIGN AND METHODS

This paper reviewed literature that suggests that researchers have looked into the relationship that exists between TQM and Organisational Culture and considers the fact that Organisational Culture precedes TQM implementation. The study considered theories and collect data hence the deductive approach will be the most suitable. Identifying the relationship between Organisational Culture and TQM will add an important level of understanding that can help in facilitating TQM success and determine the type of Organisational culture that will support TQM. The data collection

process points towards the deductive approach therefore the survey is appropriate for the research process. The survey design allows collection of quantitative data which can be analysed using descriptive and inferential statistics. The survey method has been applied in research examining aspects of TQM (Akinola et al., 2012; Black & Porter, 1996; Gunning & McCallion, 2007; Jimenez-Jimenez et al., 2014), Organisational Culture (Ivana & Martina, 2016; Oney-Yacizi et al., 2007; Tidor, Gelmereanu, Baru, & Morar, 2012; Wu, 2015) and relationship between Organisational Culture and TQM (Haffar et al., 2013; Prajogo & McDermott, 2005; Rad, 2006; Valmohammadi & Roshanzamir, 2015; Zu et al., 2010)

The quantitative method is used when collecting numeric data through experimentation or survey strategy. According to Matveev (2002) quantitative methods can provide a high level of measurement precision, statistical power, and high levels of reliability of data. In order to utilize the statistical power of the quantitative method the data was analysed using statistical (quantitative) analysis procedure. This study seeks to establish relationship between different variables (organisational culture and TQM) and this will be achieved by a quantitative approach that will enable the research to formulate the relationship and infer meaning, direction and establish relationship between Organisational Culture and TQM.

This study focused on construction organisations registered with the corporate affairs commission (CAC) of Nigeria with business addresses in the Federal Capital Territory. The target respondents of this survey are Construction Organisations in the Federal Capital Territory Abuja, this is due to the fact that Abuja has a large number of Construction and Consulting organisations. Firms not expressly practicing Total Quality Management were included because they may not be specifically familiar with TQM but may be practicing the principles routinely without knowing it. It means that their response will be practical rather than theoretical knowledge. This research will use the judgmental sampling method which is a method that determines which sections, strata or clusters of the population will be sampled. A total of 200 questionnaires were distributed and 97 were returned giving a 49% response rate.

The survey instrument (questionnaire) was developed based on literature review, the identified variables will be used to construct appropriate measures. The respondents were asked to indicate the perceived level of agreement to which culture type applies to their organisation. Likert scale will be used for each item measured. To achieve the objectives of this research, it is necessary to collect information on the type of organisational culture, and the significant TQM practices that exist in the Nigerian construction organisations. The questionnaire was divided into three sections to provide empirical evidence to answer the research questions. The first section of the questionnaire will constitute questions on personal information of the respondents. The second section of the survey instrument will examine TQM concepts and practices. To identify the practices, extensive literature review will be carried out to derive a set of common practices filtered from a list of practices. Respondents will be asked to

indicate their agreement or disagreement on the existence of the identified TQM practices in their organisations. The six TQM categories were measured using the criteria for performance excellence of the Malcom Baldridge National Quality Award (MBNQA). Likert scale will be used to calculate the mean of the practices on a scale of 1 to 5 with 5 being Strongly Agree and 1 Strongly disagree.

The third section of the questionnaire will identify the dominant culture in the organisations and its characteristics. Specifically, the six key dimensions of organisational culture (Dominant Characteristics, Organisational Leadership, Management of Employees, Organisational Glue, Strategic Emphasis, and Criteria for Success) will be measured using the Competing Value Framework (CVF). The CVF is used for assessing and profiling the dominant cultures in organisations because it helps individuals to identify the underlying cultural factors that exist in their organisations.

ANALYSIS AND RESULTS

Correlation Analysis

Correlation is a statistical measure that indicates the extent to which two or more variables fluctuate together, is a measure of the linear dependence between two variables X and Y. It has a value between +1 and −1 inclusive, where 1 is total positive linear correlation, 0 is no linear correlation, and −1 is total negative linear correlation. A positive correlation indicates the extent to which those variables increase or decrease in parallel; a negative correlation indicates the extent to which one variable increases as the other decreases.

Table 1: Correlation Analysis

	TQM PRACTICES		
	N	Pearson Correlation	Sig. (2-tailed)
CLAN CULTURE	43	0.514	0.000
ADHOCRACY CULTURE	43	0.196	0.208
MARKETING CULTURE	43	0.442	0.003
HIERARCHICAL CULTURE	43	0.358	0.018

The correlation test result conducted above indicated that TQM practice has a significant relationship with clan culture. (Sig = 0.000). A Pearson correlation of 0.514 shows that there is a positive relationship between TQM practice and clan culture. An improvement in the clan culture in the construction organization will have a direct improvement in the TQM practice.

The next culture that has a positive relation with TQM practice is the marketing culture. Marketing culture is seen to have a correlation coefficient of 0.442 which indicated an averagely weak relation, with a significant value of 0.003 telling us that indeed a relationship exist between TQM practice and marketing culture. Hence, an advancement in marketing culture will lead to an improvement in the TQM practice.

The correlation test also spotted the fact that there exists a positive relationship between TQM practice and hierarchical culture, a significant value of 0.018 proved so. In this case, the relationship between them is a weak relationship (r = 0.358), hence a change in hierarchical culture will lead to negligible same directional change in TQM practice.

Adhocracy culture has no relationship with TQM practice. According to the correlation result, the significant value indicated a value of 0.208, this is greater than 5% or 0.05, and hence no relationship exists between adhocracy culture and TQM practice.

Table 2: Regression Analysis

Coefficients[a] Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	2.105	.531		3.963	.000
CLAN	.370	.120	.404	3.078	.004
ADHOCRACY	-.245	.153	-.427	-1.599	.118
MARKETING	.183	.085	.431	2.144	.039
HIERACHICAL	.152	.164	.283	.926	.360

a. Dependent Variable: TQM

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.645[a]	.416	.355	.28775

a. Predictors: (Constant), Hierarchical, Clan, Marketing, Adhocracy

The regression analysis conducted above produced the TQM model given below

$$\boldsymbol{Y = 2.105 + 0.370X_1 - 0.245X_2 + 0.183X_3 + 0.152X_4}$$

Where,

Y = TQM

X_1 = Clan culture

X_2 = Adhocracy culture

X_3 = Marketing culture

X_4 = Hierarchical culture

The Clan culture (X_1) indicated a regression coefficient of 0.370 with a significant value of 0.004, as such, clan culture could be said to have an impact on the TQM of the construction organization.

The X_2 which represents the adhocracy culture has a regression coefficient of -0.245 with a significant value of 0.118 which is greater than 5% (0.05), thus we conclude that adhocracy culture has no relative impact on the TQM of the construction firm.

The marketing culture (X_3) proved significant at 0.039 which is less than 5% (0.05), also with a regression coefficient of 0.183. this thus shows that the marketing culture has impact on the TQM of the construction firms

The last Culture which is the hierarchical culture (X_4) has a regression coefficient of 0.182 and a significant value of 0.360, which is far higher than

the significant threshold of 0.05. Hence, it can be concluded that hierarchical culture also has influence on the TQM of the construction firm.

The regression result has shown that the clan culture and the marketing culture are the only culture that has significant influence on the TQM of the construction organization.

The clan culture has a regression coefficient of 0.360 which is higher than the marketing culture with a coefficient of 0.182. Hence, strengthening the clan culture will provide more support for the TQM of the construction firm. Literature such as Cameron and Quinn (2005) recognize the advantage of multiple culture types as one single culture type is not the best approach for organisational effectiveness. A mix of the four-culture type is strongly recommended.

DISCUSSION OF RESULTS

The basis of this study is that Organisational Culture precedes and has a significant impact of TQM implementation. The findings indicate that Organisational Culture can have a positive effect on TQM implementation. 2 out of the 4 culture types have shown to have the ability to have such effect. The strongest relationship between Organisational Culture and TQM exist between the clan culture and TQM. Efforts should be geared towards enhancing the presence of Clan Culture as this will be highly beneficial. The co-existence of all the four cultural types within the survey population has confirmed the need to incorporate the balance four culture types. Identifying the dominant culture will facilitate the management of cultural inconsistencies which is a major issue in TQM implementation and the main challenge of organisations that implement it.

The findings substantiate the importance of progressively building a cultural environment that will improve TQM implementation in order to support the comprehensive implementation of various TQM practices and hence increase the possibility of success with quality management initiatives. The different practices are driven by and reflect multiple dimensions of organisational culture (Prajogo and McDermott, 2005). the advantage of different culture types indicates that an emphasis on one single culture type is not the best approach for overall organisational effectiveness. The results of this study suggest that in order to seek maximum benefits from implementing multiple TQM practices, it is important to develop not only flexibility and people-oriented culture values (clan and adhocracy) but also control and external oriented values (marketing and hierarchical culture).

CONCLUSION AND RECOMMENDATION

Organizational culture is recognized as critical for TQM implementation, this research examined the relationship between Organisational Culture and Total Quality Management practices. The results show the positive direct effects of the clan culture on TQM. Managers should be aware of the

cultural values emphasized in their organization because of their influences on the TQM practices. Previous studies on TQM implementation reveal two related aspects. Firstly, that TQM is often not implemented properly and secondly that when properly implemented TQM undeniably improves performance. To this end, this study has provided an empirically grounded framework that can be used alongside other pertinent advice as a tool for helping practitioners to implement TQM effectively. The findings suggest that any efforts that can be made to increase the presence of Clan culture and marketing culture prior to commencing the formal implementation of TQM would be highly beneficial. Alternatively, the findings indicate that such efforts would be highly beneficial as part of the ongoing implementation, or as part of a rejuvenation of TQM efforts should a loss of momentum occur during TQM implementation as has been reported in the literature as a common occurrence as implementation progresses and matures. The study applied the cross-sectional design, collecting data at a single point in time. Future researchers are encouraged to consider longitudinal designs which can establish the effect of culture TQM practices over a period of time.

REFERENCES

Akinola, J. A., Akinderawo, O. F., & Olatunji, F. O. (2012). Impact of TQM on Nigerian Construction Firms. Paper presented at the West Africa Built Environment Research (WABER) Conference, Abuja.

Anthony, J., Keung, K., Knowles, G., & Gosh, S. (2002). Critical Success factors of TQM implementation in Hong Kong industries. international Journal of Quality and Reliability Management, 19(5), 551-566.

Baird, K., Jia, K. H., & Reeve, R. (2011). The relationship between organisational culture, total quality management practices and operational performance. International journal of operations and production management, 31(7), 789-814.

Black, S. A., & Porter, L. J. (1996). "Identification of the Critical Factors of TQM*". Decision Sciences, 27(1), 1-21.

Calabrese, A., & Corbo, M. (2015). Design and blueprint for TQM implementation in service organisations. Total quality management, 26(7), 719-732.

Cameron, K. S., & Quinn, R. E. (2006). Diagnosing and Changing Organisational Culture. San Fransisco.: Jossey-Bass.

Cheng, C., & Liu, A. (2007). The relationship of Organisational culture and the implementation of TQM in construction firms. Surveying and built Environment., 18(1), 7-16.

Gambi, L. N., M C Gerolamo, & Carpinetti, L. C. R. (2013). A theoretical Model of the Relationship between Organisational Culture and Quality Management Techniques. Procedia. Social and Behavioural Sciences, 81(1), 334-339.

Gimenez-Espin, Jiménez-Jiménez, D., & Martínez-Costa, M. (2013). Organizational culture for total quality management. Total Quality Management & Business Excellence, 24(5-6).

Green, T. J. (2012). TQM and organisational culture: How do they link? Total Quality Management & Business Excellence, 23(2), 141-157.

Haffar, M., Al-Karaghouli, W., & Ghoniem, A. (2013). The Mediating Effect of individual Readiness for change in the relationship between organisational culture and TQM. Total quality management, 24(6), 693-706.

Hofstede, G. (1980). Culture's Consequences. Thousand Oaks: Sage.

Jaca, C., & Psomas, E. (2015). Total Quality Management Practices and performance outcomes in Spanish Service Companies. Total Quality Management and business excellence, 26(9), 958-970.

Jaeger, M., & Adair, D. (2016). Perception of TQM benefits, practices and obstacles. The case study of project managers and quality management representatives in Kuwait. The TQM journal, 28(2), 317-336.

Jimenez-Jimenez, D. Martinez-Costa M, Martinez-Lorente, A. R., & Rabeh, H. A. D. (2014). Total Quality Management performance in Multinational Companies. A learning Perspective. The TQM journal, 27(3), 328-340.

Matveev, A. V. (2002). The Advantages of employing quantitative and qualitative methods in intercultural research: practical implications from the study of the perceptions of intercultural communication competence by American and Russian managers. Bulletin of Russian communication, 59-76.

Naor, M., Goldstein, S. M., Linderman, K. W., & Schroder, R. G. (2008). The role of culture as driver of Quality Management and Performance: Infrastructure Versus Core Quality Practices. Decision Sciences, 39(4), 671-702.

Oney-Yacizi, E., Gritili, H., Topcu-Oraz, G., & Acar, E. (2007). Organisational Culture: the case of Turkish Construction Industry. Engineering. Construction and Architectural Management, 14(6), 519-531.

Ooi, K., Lin, B., Tan, B., & Chong, A. Y. (2011). Are TQM practices supporting customer satisfaction and service quality? Journal of services, Marketing, 25(6), 410-419.

Prajogo, D. I., & McDermott, C. M. (2005). The relationship between Total Quality Management practices and Organisational Culture. International journal of operations and production management, 25(11), 1101-1122.

Prajogo, D. I., & McDermott, C. M. (2011). The relationship between multidimensional organisational culture and performance. International journal of operations and production management, 31(7), 712-735.

Rad, A. M. M. (2006). The impact of Organisational culture on the successful implementation of Total Quality Management. The TQM Magazine, 18(6), 606-625.

Rasmussen, R. (2012). Total Quality Management. The way I see it. SMT, 1(1), 10-21.

Reid, R. D., & Sanders, N. R. (2012). Operations Management an Integrated approach (Fourth ed.). United State of America: John Weiley and Sons.

Sallies, E. (2002). Total Quality Management in Education (First ed.). USA: Stylus Publishing Inc.

Schein, E. (1997). Organisational Culture and Leadership (Second Edition ed.). San Franscisco: Jossey-Bass.

Valmohammadi, C., & Roshanzamir, S. (2015). The Guideline of improvement: Relations among Organisational Culture, TQM and Performance. international Journal of Production Economic, 164(1), 167-178.

Zu, X., Robbins, T. L., & Fredenadall, L. D. (2010). Mapping the Critical Links between Organisational Culture and TQM/Six Sigma Practices. international Journal of Production Economic, 123(1), 86-106.

AN EVALUATION OF INDOOR THERMAL CONDITIONS OF RESIDENTIAL BUILDINGS WITH DIFFERENT FABRIC FINISHES AT OKIGWE, NIGERIA

Marcellinus Uwadiegwu Okafor[1]
[1]*Department of Architecture, Imo State University, Owerri, Nigeria*

Building forms and materials differ in type and quantity with climates, cultures and traditions. In the search for ways to reduce internal heat gain and moisture content in residential buildings, this paper investigated indoor air temperature and relative humidity values of residential buildings at Okigwe, Nigeria, with the aim of determining differences between indoor thermal conditions of residential buildings with different fabric finishes. Observations and field measurement research design methods were adopted. Data were obtained through primary and secondary sources. Primary data were from observations of physical characteristics of the buildings selected through stratified sampling: 'plastered painted' and 'not plastered not painted' strata and field measurement through hourly and simultaneous monitoring of indoor environmental variables of air temperature and relative humidity from 1 November 2015 to 31 October 2016 (366 days), using Tinytag Explorer 4.9 model data loggers. The secondary data on outdoor temperature and relative humidity were got from the nearest Meteorological Station at the Imo International Cargo Airport. The mean annual outdoor temperature and relative humidity values were 29.00C and 69.9% respectively. The annual mean and standard deviation of indoor air temperature and relative humidity values of 'plastered painted' and 'not plastered not painted' buildings were (M = 29.30C, SD = 1.587; M = 69.1%, SD = 18.53) and (M = 29.00C, SD = 1.818; M = 66.8%, SD = 17.45) respectively. The z and t tests conducted at $\alpha = .05$, between mean daily indoor air temperature and relative humidity values of 'plastered painted' and 'not plastered not painted' residential buildings showed significant differences: air temperature ($z = 2.0465$, $p = 0.0204$) and relative humidity ($z = 1.7380$, $p = 0.0411$). There was no significant difference between outdoor and indoor values. The paper, therefore, recommends that efforts should be geared towards improving the materials and composition of the building fabrics to enable modification of the external environment internally for thermally comfortable environment.

Keywords: air temperature, building fabric, finish, indoor thermal conditions, Okigwe-Nigeria, relative humidity

[1] arcdrmuokafor@gmail.com

Okafor, M. U. (2017). **An evaluation of indoor thermal conditions of residential buildings with different fabric finishes at Okigwe, Nigeria** *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 230-242.

INTRODUCTION

The building fabric is a major interface that relates external and internal environments and its forms and materials likewise, determine the relationship between the outdoor temperature and solar radiation conditions, and the indoor temperatures in naturally ventilated or non-air-conditioned buildings (Givoni, 1998; Shaghayegh & Shea, 2013). Further, fabrics of air-conditioned buildings influence the quantity of energy required to maintain the indoor temperature within the comfort limits as stipulated in the thermostat setting (Givoni, 1998). In other words, Haase and Amato (2006) aptly captured the essence of the building fabric because of the critical roles they play in architectural aesthetics and expressions, structural soundness and climate control. Buildings are primarily meant to protect mankind from the inclement climatic and weather conditions and hostile forces of nature, they also exist to provide safe and healthy shelters as people spend most of their times and activities within them (Baker, 1996; Roaf, et al., 2009; Nicol, et al., 2012). Alnaser, Flanagan and Alnaser, W (2008) observed that the increasing costs of energy, scarcer and more expensive, and more extreme changes in the global climate, have challenged the architect to design thermally comfortable buildings that are accessible, secure, healthy and productive while reducing its effects on the environment.

Previous studies have reported on the relationships between the over-growing population of Nigeria; demands for more buildings, infrastructural development, and their effects on climate change, thus making it exigent to delve into thermally efficient ways of designing and constructing buildings especially as they are meant to consume enormous quantities of energy to maintain thermal comfort (Efeoma & Uduku, 2016; Adaji, et al., 2016; Africa Progress Panel, 2015; Akadiri, 2016). It has been established that fabric forms and materials comprising roofs, walls, floors and fenestration influence the relationship between outdoor temperatures, solar radiation conditions and indoor thermal environment (Shaghayegh & Shea, 2013; Lawal & Ojo, 2011). Further, Koenigsberger, et al., (1974) supported the assertion that treatment and selection of materials for building fabrics finishes influence internal thermal behaviours and help in reducing heat loads.

Despite global concerns shown in the propagation of strategies for the reduction of energy consumption for maximum indoor thermal comfort, there is still lack of coordinated holistic approach or standard regulations in Nigeria, defining the nature, type, treatment, and selection of materials for finishes of building fabric and their influence on internal thermal environment. Attempts made so far were based on professional lore of the architects and environmental planners; customs and traditions, and socio-cultural needs of promoters of the building industry. Many studies have analysed thermal environments with emphasis on thermal comfort perception of occupants both adaptively and under steady state conditions, without much attention given to the examination of materials that are used

in the composition of the buildings, since they provide the platforms for occupants to express their feelings.

For acceptable indoor thermal conditions of residential buildings in warm-humid climate to be achieved; reduction of daytime solar heat gain, avoidance of heat storage which increases discomfort at nights and moisture content control have been advocated (Evans, 1980). The overarching climatic concerns in the warm-humid climate are elevated temperatures and relative humidity. The mean annual temperature is 26.4^0C with 27.6^0C, 25.0^0C and 2.6^0C as maximum, minimum and range respectively. The annual precipitation is over 2000mm with dry and rainy seasons. Meze-Hausken (2000) reported that elevated indoor temperatures and relative humidity can lead to mortality, forced migration and low productivity due to its harshness.

The understanding of thermal characteristic behaviours of fabric finishes of buildings, especially in a developing and populous nation like Nigeria, will positively influence minimum consumption of energy and its load requirements for maximum comfort. This paper therefore, is aimed at investigating the differences between thermal conditions of indoor air temperature and relative humidity values of residential buildings with varying fabric finishes at Okigwe, Nigeria, with a view of providing criteria for energy load reduction strategies

LITERATURE REVIEW

The quest to achieve thermally acceptable indoor environments in warm-humid climate has always been laid on ways of minimising heat gains indoors and maximising evaporative cooling of the occupants (Lawal & Ojo, 2011). To ensure acceptable thermal environment, choice of site; provision of naturally ventilated spaces; shading from solar radiation, use of lightweight materials for the fabric and waterproofing have been advocated by researchers as means of maintaining indoor thermal comfort in warm-humid climate (Heerwagen, 2004; Lawal & Ojo, 2011). However, this paper is concerned with discussion on the thermal characteristics of materials for building fabric finishes, hence its theoretical knowledge base is taken from theories of heat transfer and storage.

Fabric thermal properties

The thermal properties of the building fabric materials determine the level of its modification of indoor temperatures over a wide range of external conditions (Evans, 1980; Givoni, 1998). The properties of materials that constitute the building fabric components are evaluated in terms of their absorptivity, conductivity and thermal capacity as well as: air-to-air transmittance (U-value), solar gain factor, time lag and admittance. Heat is gained or lost in the building through conduction, convection, evaporation and radiation. Givoni (1998) and Heerwagen, (2004) stated that heat is transferred through building materials and assemblies whenever, a beam of incident solar radiant heat energy strikes the surface of the building, the heat is either reflected (reflectivity) away or absorbed (absorptivity) or

transmitted (emissivity) by the surface of the body. Building fabric materials have high reflectivity tendencies when their surfaces are more dense and smooth. In terms of absorptivity, darker colours and high thermal mass materials are more absorptive than lighter colours and low thermal mass materials. For emissivity, rough surfaces emit heat better than highly polished surfaces (Heerwagen, 2004; Lawal & Ojo, 2011; Shaghayegh & Shea, 2013; Allen, 2005).

However, Givoni (1998) identified thermal resistance R (or its reciprocal, the U-value) and heat capacity as the two fundamental thermal properties that control the heat flow in buildings. Lawal and Ojo (2011) stated that materials of building fabric allow exchange of heat from one side to the other at different rates, depending on the type, thickness, space, vapour barrier, temperature and surface texture of the materials. It went further to define the range of U-values for roof and walls constructed of sandcrete block, which is a physical mixture of sand, cement and water in varying proportions. The U-value for the roof ranges from 0.08 – 3.22 $W/M^2\ ^0C$ and walls 0.75 – 6.53 $W/M^2\ ^0C$ depending on the properties of the materials used.

From the Second Law of Thermodynamics, which describes the actions of thermal (heat) energy transfer, by stating that heat will flow from a system with a higher temperature to surrounding that have a lower temperature. Since building fabric is the major receptor of the sun's radiation, it will maintain higher temperature during the day and lower temperature during the nights. During the nights, when the intensity of the solar radiation has reduced, heat flow will be reversed from interior to exterior. This movement of heat is of interest to architects in the design of comfortable buildings, because if equilibrium is not maintained between the exchange of heat during the night-time and daytime, occupants of the building must take actions necessary to make their buildings comfortable

In other related studies, Koenigsberger, et al., (1974) emphasized that the treatment and selection of materials for the building fabric influence its thermal behaviour and help in the reduction of heat loads. Hermawan (2015) in a study of thermal difference between wooden houses and brick houses in Indonesia, a warm and tropical climate, found that occupants felt thermally different because of differences in the composition of wall fabric materials. Nematchuoa, et al., (2015) reported a clear difference in indoor ambience between plaster and marble coated buildings in a study of the effect of wall construction materials over indoor air quality in humid and hot climate. However, Koranteng, et al., (2015) in a study at Kumasi, Ghana, concluded that material differences do not have any significant effect on indoor comfort but rather orientation of buildings.

In summary, the ability of building fabric materials to absorb, emit, and reflect incident thermal energies determine the level of comfort experienced internally as the temperature of the human body and interiors must be maintained within a narrow range to avoid discomfort. Similarly, a combination of environmental and personal factors comprising air temperature, humidity, mean radiant temperature, air velocity, clothing,

and metabolic levels are fundamental issues that influence the discursive field of thermal comfort. Air temperature plays key role as it determines the occupants' sensation within spaces and relative humidity which measures the quantity of moisture in the atmosphere assesses the evaporative cooling capacities of the spaces. Thus, the key variables involved in determining the indoor thermal conditions of the fabric finishes were indoor and outdoor air temperatures and relative humidity. From empirical studies reviewed above, it was established that differences in wall materials, coatings and orientation contribute to providing indoor thermally comfortable environment.

PROBLEM STATEMENT AND RESEARCH QUESTION

The choice of materials for the fabrics of residential buildings in Okigwe, Nigeria, were based on professional lore of architects, customs and traditions, socio-cultural and economic dispositions of promoters of the building industry. It is established that modification relationships exist between fabric forms and materials, the outdoor temperature and solar radiation conditions, and the indoor temperatures. However, there is dearth of empirical analyses on the effects of different fabric finishes type in relation to indoor and outdoor temperature and relative humidity in Okigwe, Nigeria. This paper therefore, empirically evaluated the thermal conditions of residential buildings with different fabric finishes at Okigwe, Nigeria, with a view of providing criteria for energy load reduction strategies.

Specifically, the study measured the values of indoor temperature and relative humidity of 'plastered painted' and 'not plastered not painted' residential buildings. The outdoor values of temperature and relative humidity were also obtained and compared to the indoor values to establish if significant differences exist amongst them. The approach chosen toward the realisation of the study objectives was to seek answers to these under listed questions and test the significance of the results obtained using the formulated hypotheses.

- In what ways do the thermal design characteristics of 'plastered painted' differ from 'not plastered not painted' residential buildings at Okigwe, Nigeria?
- To what extent do the indoor thermal conditions (air temperature and relative humidity) of 'plastered painted' and 'not plastered not painted' residential buildings vary at Okigwe, Nigeria?
- To what extent do the outdoor and indoor thermal conditions differ between 'plastered painted' and 'not plastered not painted' residential buildings at Okigwe, Nigeria?
- The hypotheses formulated were:
- $H_0 1$: Indoor thermal conditions (air temperature and relative humidity) were not significantly different between 'plastered painted'

and 'not plastered not painted' residential buildings at Okigwe, Nigeria.

- $H_0$2: Outdoor and indoor thermal conditions were not significantly different between 'plastered painted' and 'not plastered not painted' residential buildings at Okigwe, Nigeria.

RESEARCH DESIGN AND METHODS

This paper reports part of a parent study that compared indoor thermal comfort conditions of traditional and contemporary buildings in the dry season at Okigwe, Nigeria. The aim of the parent study was to establish design criteria for thermally comfortable environment. The specific objectives of the parent study were investigation of thermal design characteristics and occupants' thermal perception; and measurement indoor air temperature and relative humidity. Further, comparisons were made between occupants' thermal sensations and indoor air temperature and relative humidity values of both building types.

The research design for this study was survey. The survey was carried out by observing the characteristics of the sampled building types. Data for the field measurement were got through hourly and simultaneous monitoring of indoor environmental variables of air temperature and relative humidity for 366 days (1 November 2015 – 31 October 2016), using Tinytag Explorer 4.9 data loggers set to record the values on hourly rate. In addition, secondary data on outdoor temperature and relative humidity were got from the nearest Meteorological Station at the Imo International Cargo Airport.

THE STUDY AREA

Okigwe is a town in the warm-humid climate of Nigeria. It lies between Latitudes 5° 30' and 5° 57' North of the Equator and Longitudes 7° 04' and 7° 26' East of the Greenwich Meridian. The town experiences two main seasons: the dry season is accompanied by a dust-laden wind from the Sahara Desert, known as Harmattan, which is brought by the Tropical Continental (cT) air mass, while the rainy season is heavily influenced by the Tropical Maritime (mT) from the Atlantic Ocean. The mean annual temperature is 26.4^{0}C with 27.6^{0}C, 25.0^{0}C and 2.6^{0}C as maximum, minimum and range respectively. The annual precipitation is over 2000mm.

STUDY POPULATION AND SAMPLING

From the pilot study conducted, a stratified sampling technique was adopted based on the prevalent building fabric finishes types in the study area, hence, the residential buildings were stratified into two: 'plastered painted' (PP) and 'not plastered not painted' (NPNP), and one building was randomly selected from each of the stratum for the field measurement.

DATA COLLECTION

Observation

Data collected were: type of buildings, geographical positions, materials for roof coverings, walls, wall finishes and floors. Additional data were gathered with respect to types of ceiling, materials and type of doors and windows provided in the sampled buildings.

Field measurement

Indoor environmental variables of air temperature and relative humidity were monitored simultaneously on hourly basis for 366 days (1 November 2015 to 31 October 2016) using Tinytag Explorer 4.9 Germini Data Loggers (air temperature range of -25^{0}C to +85^{0}C). They were mounted at a height of 1200mm above the finished floor level to record the hourly air temperature and relative humidity values.

ANALYSIS AND RESULTS

Characteristics of the building types

From Table 1, both building types had same characteristics except for ceiling, floor and window types and materials. The buildings were bungalows with corrugated metal roofing sheets on wooden roof truss system. The walling materials were made of sandcrete blocks. The floors and ceiling sheets were made of cement/sand screed and asbestos sheets respectively. The doors were made of wood whereas, windows were made of adjustable glass louvres and wood casement types. The finishes materials for one of the building's fabric (PP) building type was cement/sand plastering rendered with coats of lightly coloured emulsion paints and the other building type (NPNP) had no cement/sand plastering and paint coating.

Indoor and outdoor Eenvironmental variables

The annual indoor and outdoor values of means, maxima, minima, and standard deviations determined from the monthly mean values of air temperatures and relative humidity within the study period were presented in Table 2

Indoor air temperature and relative humidity values

The indoor annual mean, maximum and minimum air temperature values for PP building type were 29.3^{0}C, 32.3^{0}C and 26.9^{0}C respectively. Similarly, NPNP building type had 29.0^{0}C, 33.7^{0}C and 25.5^{0}C as its equivalent. The range and standard deviation for NPNP building type were 8.2^{0}C and 1.8^{0}C; whereas 5.4^{0}C and 1.6^{0}C for PP building type. The indoor mean relative humidity value for PP building type was 67% and it varied from 57.1 – 76%. In the NPNP building type, the annual mean value of relative humidity was determined to be 68.9%. During the period of the measurement, the highest and lowest values obtained for the relative humidity were 81.2% and 55.3% respectively. The standard deviation of the relative humidity values for both PP and NPNP building types were 18.9% and 25.9% respectively.

Table 1: Characteristics of the Building Types

Characteristics	PP (Bungalow)	NPNP (Bungalow)
Latitude/Longitude	5^0 44' 48" N/7^0 11' 36" E	5^0 48' 52" N/7^0 18' 41" E
Roof materials	Corrugated metal roofing sheets on wooden truss	Corrugated metal roofing sheets on wooden truss
Base Wall materials	Sandcrete block wall	Sandcrete block wall
Finishes materials	Plastered, Painted	Not plastered, not painted
Floor materials	Cement/Sand screed	Nil (bare)
Ceiling	Asbestos sheets	Nil
Windows/Doors	Louvre /Wood	Wood/Wood
Picture		

Source: Fieldwork (2016)

Table 2: Statistical results for indoor and outdoor air temperatures and relative humidity in PP and NPNP buildings

Parameter	Annual (Nov 2015 – Sept 2016)				
	Mean	Max imuim	Minimum	Standard Deviation	Range
Indoor air temperature (^{0}C) of PP	29.3	32.3	26.9	1.6	5.4
Indoor air temperature (^{0}C) of NPNP	29.0	33.7	25.5	1.8	8.2
Indoor relative Humidity (%) of PP	67.0	76.0	57.1	17.5	18.9
Indoor relative Humidity (%) of NPNP	68.9	81.2	55.3	18.5	25.9c
Outdoor temperature (^{0}C)	29.0	30.7	28.4	1.9	2.3
Outdoor relative Humidity (%)	69.9	75.4	65.8	14.6	9.6

Source: Fieldwork (2016)

Outdoor temperature and relative humidity values

The outdoor annual mean, maxima and minima values of temperature and relative humidity obtained as secondary data from the Meteorological Station at the Imo International Cargo Airport were also recorded and presented in Table 2. The annual mean values for temperature and relative humidity were 29.0^{0}C and 69.9% respectively. The maxima values were 30.7^{0}C and 75.4%, while the minima values were 28.4^{0}C and 68.8%.

Differences between indoor monthly mean air temperature and relative humidity values of PP and NPNP building Ttypes

The variations between the monthly mean values of indoor air temperature and relative humidity of PP and NPNP building types were depicted in Fig 1 and 2. Likewise, comparisons were made between monthly mean values

of the outdoor and indoor air temperature and relative humidity of both building types as shown in Fig 3 and 4.

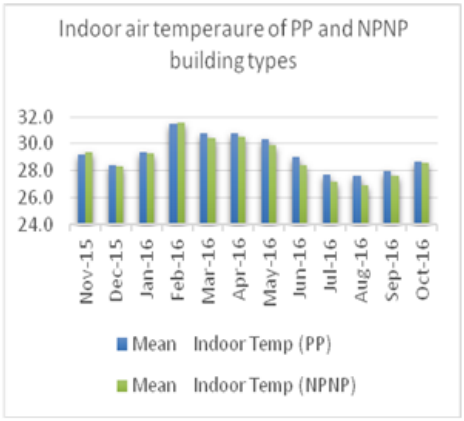


Fig 1: Air temperature (^{0}C) of PP and NPNP

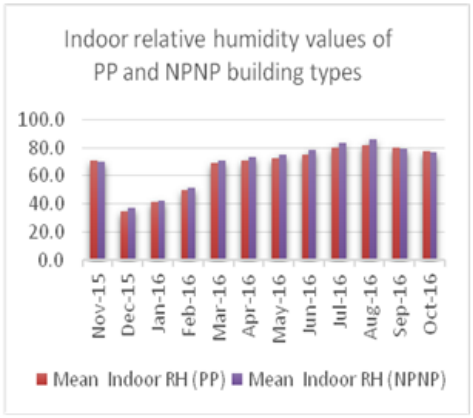


Fig 2: Relative Humidity (RH) of PP and NPNP

Differences between indoor and outdoor monthly mean air temperature and relative humidity values of PP and NPNP building types

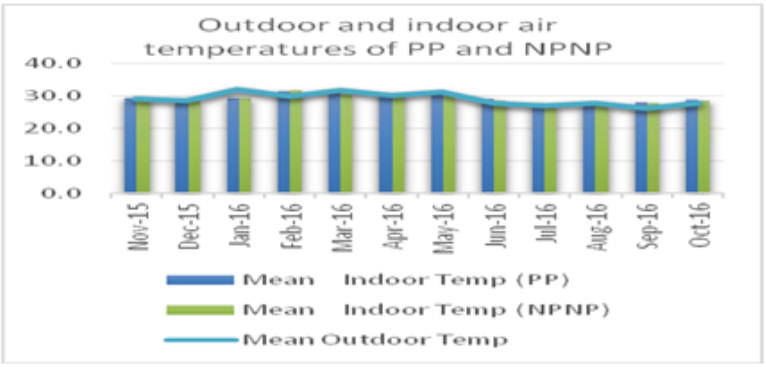


Fig 3: Outdoor and Indoor temp. of PP and NPNP

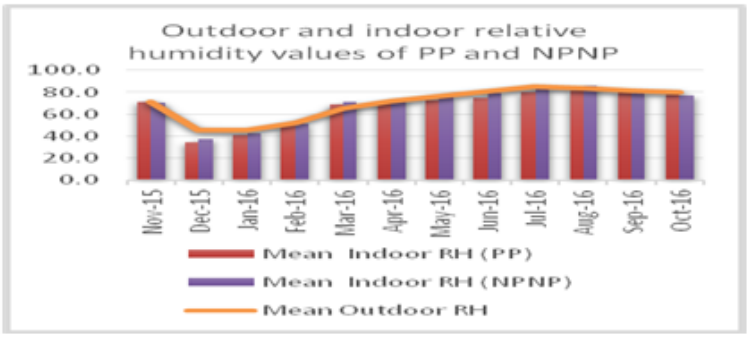


Fig 4:Outdoor and indoor RH of PP and NPNP

Test of hypotheses

$H_0$1: The z-test results conducted to test significance of differences between the daily mean values of indoor air temperature and relative humidity of PP and NPNP building types were as shown in Table 3.

Table 3: z-tests for indoor air temperature (^{0}c) and relative humidity values of PP and NPNP building types

Building Type		Mean	Known Variance	Hypothesized Mean Difference	z	P value
PP	Indoor Air Temperature (^{0}C)	29.3	2.52	0	2.046	0.0204
NPNP		29.0	3.31			
PP	Relative Humidity (%)	67.0	304.54	0	1.738	0.0411
NPNP		68.9	343.36			

Source: Fieldwork (2016)

The daily mean values of indoor air temperature (29.3^{0}C) of PP and (29.0^{0}C) of NPNP building types significantly differed, (**z** = 2.046, ***p*** = 0.0204). Equally, daily mean values of indoor relative humidity between PP (67.0%) and NPNP (68.9%) building types significantly differed (**z** = 1.738, ***p*** = 0.0411).

$H_0$2: The t-test was adopted to test significant differences between indoor and outdoor monthly mean values of (i) air temperature of PP building type (ii) air temperature of NPNP building type (iii) relative humidity of PP building type (iv) relative humidity of NPNP building type. The results as reported in Table 4 showed that no significant differences existed between the indoor and outdoor monthly mean air temperature values of PP and NPNP building types and relative humidity values of NPNP building type. However, there was significant difference between indoor monthly mean relative humidity values (**M** = 67%, **SD** = 17.5%) of PP and outdoor monthly mean relative humidity values (**M** = 69.9%, **SD** = 14.6%), ***t*** (11) = -2.74, ***p*** = .0192.

Table 3: z-Tests for Indoor Air Temperature (0C) and Relative Humidity Values of PP and NPNP Building types

Indoor and Outdoor Mear Monthly values	M	SD	df	r	t-stat	p-value	Remark
^{0}C of PP building type	29.3	1.6	11	0.75	0.78	0.4472	Not Significant
^{0}C of NPNP building type	29.0	1.8	11	0.74	0.02	0.9822	Not Significant
RH of PP building type	67.0	17.5	11	0.98	-2.74	0.0192	Significant
RH of NPNP building type	68.9	18.5	11	0.98	-0.9731	0.3514	Not Significant

Source: Fieldwork (2016)

DISCUSSION

Reduction of high internal temperatures and control of moisture contents in buildings remain a task that must be accomplished for the achievement of indoor thermal comfort of buildings in warm-humid climate. The materials for building fabric finishes of PP and NPNP building types as in Table 1, showed differences in window types, floor finishes, and ceiling sheet materials. There were observed variances in the wall materials: PP building type was finished with coats of emulsion paints on cement/sand rendered surfaces, while NPNP building type was bare as constructed without any

form of embellishment. The ceiling in NPNP building type was not covered and generally, ceiling sheets provide extra insulation for interiors by reducing the transfer of solar radiation h eat. Both PP and NPNP building types had similar roof covering materials -corrugated iron roofing sheets. Since these building fabric finishes are the interface between external and internal building environment and have direct contact with solar radiation; the determination of the amount of heat absorbed, transmitted and reflected through them constitute the overriding challenge of this study.

The annual mean indoor air temperature values of 29.3^0C and 29.0^0C determined for PP and NPNP building types respectively had a minimal difference of 0.3^0C and variation over the period of study indicated clearly that building fabric finishes acted differently in the emission, absorption and reflection of incident thermal energy upon them. The annual mean indoor relative humidity values calculated for NPNP building type was higher than PP building type by 1.9%.

The significance of the results obtained from statistical analyses confirmed the differences between indoor thermal comfort conditions of PP and NPNP building types. Thus, building fabric finishes of residential buildings at Okigwe, Nigeria, produced different indoor thermal comfort conditions. This aligns with the findings of Hermawan (2015), and Nematchuoa, et al., (2015). When compared to the outdoor temperature and relative humidity values, there existed no significant difference between them, except for the relative humidity values of NPNP building type. The annual indoor air temperature values of PP (29.3^0C) and NPNP (29.0^0C) building types when compared to the annual outdoor air temperature value of 29.0^0C showed no significant difference, thus establishing that the building fabric of PP and NPNP residential building types in Okigwe, Nigeria, did not modify the external outdoor temperature internally. The finding partly corroborates that of Koranteng, et al., (2015) which found that orientation of buildings significantly affected indoor thermal comfort of buildings and not the building materials.

RECOMMENDATIONS AND CONCLUSION

The analyses and data from this study revealed valuable information on the thermal behaviour of building fabric finishes materials. It established significant differences between indoor values of air temperature and relative humidity of PP and NPNP building types. There were no significant differences between outdoor and indoor air temperature and relative humidity values of PP and NPNP building types in the study area, Okigwe, Nigeria

In as much as significant difference exists between the thermal conditions of PP and NPNP building types, there was no significant difference between indoor and outdoor thermal conditions due to the fabric materials of the residential buildings in Okigwe, Nigeria. This entails that the fabric materials of residential buildings in Okigwe, Nigeria, do not modify the external environment, hence the idea of reducing internal heat gains and

moisture control is lost with the type and nature of the fabrics of the residential buildings. The thermo-physical properties of these building fabric finish materials: air-to-air transmittance (U-value), solar gain factor, time lag and admittance need to be further investigated. It is recommended that architects, environmental planners, property developers, building industry promoters, and students alike should be conscious of the deficiencies of the fabric materials of residential buildings in Okigwe, Nigeria, in modifying the external environment. It is necessary to improve the materials and composition of the building fabric finishes enabling differences between internal and external environment to occur for thermally comfortable environment.

ACKNOWLEDGEMENTS

I am sincerely grateful to my doctoral thesis supervisors: Associate Professor Odim Onuoha Odim and Professor Abiodun Olotuah for the inspiration, I derived from their wealth of experience and knowledge during my Ph.D. studies at the Chukwuemeka Odumegwu Ojukwu University, Anambra State, Nigeria.

REFERENCES

Adaji, M. U., Watkins, R. & Adler, G., 2016. *Thermal Comfort of Occupants during the Dry and Rainy Seasons in Abuja, Nigeria.* Cumberland, Windsor, UK, Network for Comfort and Energy Use in Buildings.

Africa Progress Panel, 2015. *Africa Progress Report 2015: Power People Planet-Seizing Africa's Energy and Climate Opportunities.* s.l., Africa Progress Panel (APR).

Akadiri, P. O., 2016. Evaluating the Performance of Bioclimatic Design Building in Nigeria. *Civil and Environmemtal Research,* 8(5), pp. 60-66.

Allen, E., 2005. *How buildings work: The natural order of architecture.* 3rd ed. New York: Oxford.

Alnaser, N. W., Flanagan, R. & Alnaser, W. E., 2008. Model for calculating the sustainable building index (SBI) in the Kingdom of Bahrain. *Journal of Energy and Buildings,* Volume 40, pp. 2037-2043.

Baker, G. H., 1996. *Design strategies in architecture: An approach to the analysis of form.* London: Routledge.

Efeoma, M. & Uduku, O., 2016. *Longitudinal Survey of Adaptive Thermal Comfort of Office Workers in the Hot-Humid Climatic Zone of Enugu, Nigeria.* Cumberland, Windsor, UK, Network for Comfort and Energy Use in Buildings.

Evans, M., 1980. *Housing, Climate and Comfort.* New York: Halsted Press.

Givoni, B., 1998. *Climate considerations in building and urban design.* New York: John Wiley & Sons .

Haase, M. & Amato, A., 2006. Performance Evaluation of Three Different Facade Models for Sustainable Office Buildings. *Journal of Green Building ,* 1(4), pp. 89-103.

Heerwagen, D., 2004. *Passive and Active Environmental Controls: Informing the Schematic Designing of Buildings.* New York: McGraw-Hill.

Hermawan, Prianto, E. & Setyowati, E., 2015. The Difference of Thermal Performance between Houses with Wooden Walls and Exposed Brick Walls in Tropical Coasts. *Procedia Environmental Sciences,* pp. 168-174.

Koenigsberger, O. H., Ingersoll, T. G., Alan, M. & Szokolay, S. V., 1974. *Manual of Tropical Housing and Building.* London: Longman Group Limited.

Koranteng, C., Essel, C. & Amos-abanyie, S., 2015. The Effect of Different Wall Materials at Different Orientations on Indoor Thermal Comfort in Residential Buildings in Kumasi, Ghana. *Research Journal of Engineering and Technology,* 1(1), pp. 9-18.

Lawal, A. F. & Ojo, O. J., 2011. Assessment of thermal performance of residential buildings in Ibadan Land, Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences ,* 2(4), pp. 581-586.

Meze-Hausken, E., 2000. Migation caused by climate change: How vulnerable are people in dryland areas?. *Mitigation Adaptation Strategy in Global Change,* Volume 5, pp. 379-406.

Nematchuoa, K. M., Tchinda, R. & Orosa, J. A., 2015. Effect of Wall Construction Materials over Indoor Air Quality in Humid and Hot Climate. *Journal of Building Engineering,* pp. 16-23.

Nicol, F., Humphreys, M. A. & Roaf, S., 2012. *Adaptive thermal comfort: Principles and practice.* Oxon: Routledge.

Roaf, S., Crichton, D. & Nicol, F., 2009. *Adapting buildings and cities for climate change: A 21st century survival guide.* Oxford: Elsevier Press.

Shaghayegh, M. & Shea, A., 2013. Performance evaluation of modern building thermal envelpoe designs in the semi-arid continental climate of Tehran. *Buildings,* pp. 674-688.

AN INTERNATIONAL EXPERTS' OPINION ON THE OBJECTIVES OF STAKEHOLDER MANAGEMENT IN CONSTRUCTION PROJECTS

Goodenough D[1]. Oppong, Albert P. C. Chan[2], Ernest E. Ameyaw[3] and D. Owusu-Manu[4]

[1,2]*The Hong Kong Polytechnic University, Department of Building and Real Estate, Hung Hom, Kowloon, Hong Kong*

[3]*Kingston University, Penrhyn Road, Kingston upon Thames, London, UK*

[4]*Kwame Nkrumah University of Science and Technology, Department of Building and Real Estate, Kumasi, Ghana.*

One paramount issue in construction project management is the acknowledgement and management of the multitude of stakeholders who are related to projects. This is due to the fact that stakeholder management (SM) is a determinant of the success or failure of construction project delivery. Over the years, SM has performed poorly in construction projects, which could have resulted from the lack of comprehensive SM performance management tool. Even though SM objectives form the basis of such a tool for its management purpose, there is lack of corresponding empirical study. The study aims at evaluating the important objectives that project managers (PMs) consider in managing construction stakeholders. On this premise, an international survey was conducted on experts (academics and practitioners) around the world to elicit their opinions on the objectives for managing construction stakeholders. Through purposive sampling technique based on predefined qualification criteria, the experts were identified from related publications; the local chapters of Project Management Institute (PMI); regional and country affiliates of International Project Management Association (IPMA); and the yahoo platform of Co-operative Network for Building Researchers (CNBR). Upon analysis of 67 duly completed responses by the experts, 13 objectives are found to be very important in managing construction stakeholders. Amongst them, "satisfy the needs, interests and objectives of stakeholders" was ranked highest. The findings are useful as they inform PMs on the relevance of the stakeholders in projects and how project success is more likely to be achieved by meeting the important SM objectives. Hence, projects could be more successful if the stakeholders are placed on the same pedestal as cost, time and quality requirements. Moreover, stakeholder and organizational satisfaction depends heavily on the fulfilment of the important SM objectives in project delivery. Future research should focus on establishing the relationships between the objectives, critical success factors and key performance indicators, which will be useful in managing

[1] goodenough.de.oppong@connect.polyu.hk

[2] albert.chan@polyu.edu.hk

[3] ernestameyaw1@gmail.com

[4] d.owusumanu@gmail.com

Oppong, G. D., Chan, A. P. C., Ameyaw, E. E. and Owusu-Manu, D. (2017). **An international experts' opinion on the objectives of stakeholder management in construction projects** *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 243-259.

(evaluating, benchmarking, monitoring and improving) SM performance in the industry.

Keywords: construction projects, stakeholders, stakeholder management, objectives, project management

INTRODUCTION

One paramount issue of construction project management is the acknowledgement and management of the multitude of stakeholders who are captured in the project environment. This is due to the fact that SM greatly determines the success or failure of construction project delivery. The problems that associate with improper management of construction stakeholders include poor scope and work definition, poor quality and quantity of project resource assignment, communication difficulties amongst participants, variations in work scope, and unforeseen regulatory changes (Yang et al., 2009). The aggregating consequences are the usual time and cost overruns that are common phenomenon in the industry. On the other hand, stakeholder oriented governance of projects has been found to correlate positively with successful project delivery (Joslin and Muller, 2016). This is the reason why stakeholder satisfaction has been consistently acknowledged in literature as crucial indicator of project success (e.g. Davies, 2016).

In the construction industry, diverse individuals are identified as stakeholders who are often associated with projects. These stakeholders are recognized in projects subject to how they are affected by or can affect the project implementation, and/or by their vested interests in the project (Littau et al., 2010). The stakeholders identified with construction projects include clients/developers, project leaders, financiers, designers, suppliers, contractors and subcontractors, end users, project community groups, general public, governmental national, regional and local authorities, mass media, environmentalists, concerned and special interest groups, traditional authorities/chieftaincy structures, and traditional worshipers and deities (Manowong and Ogunlana, 2010; Olander, 2003; Moura and Teixeira, 2010; Ezeabasili et al., 2015). These stakeholders are vested with diverse interests and pursue conflicting expectations in projects (Chan and Oppong, upcoming). The implication is that some stakeholders may be in support of project whiles others may oppose it. Stakeholders often make use of their power to control resources and vested interests to influence project delivery in accordance with their needs and expectations (Olander and Landin, 2005; 2008). If the PMs fail to acknowledge, analyse and manage the stakeholders appropriately, the project is more likely to fail. Hence, it is very necessary for the PMs to identify and properly manage the stakeholders and also evaluate the extent of influence exerted on the project (Manowong and Ogunlana, 2010).

Over the years, the construction industry has underperformed in terms of the management of its project stakeholders when compared to other industries like manufacturing (Loosemore, 2006). The reasons include the high level of project complexity and uncertainty, and multiplicity of project stakeholders. As stated by Ward and Chapman (2008), the stakeholder-associated uncertainties in construction project environment include who the important stakeholders are, how they are going to affect the project across the lifecycle, what their motives are in the project, and the implications of the interrelationships amongst the stakeholders. This therefore stresses on the importance of stakeholders in construction project delivery. Even though there are studies that examined the satisfaction of one group of stakeholders or the other (e.g. Lehtiranta et al., 2012; Masrom et al., 2013; Rashvand and Majid, 2014; Leung et al., 2004; Yang and Shen, 2015; El-Sawalhi and Hammad, 2015; Li et al., 2013; Li et al., 2016), there has been the lack of a comprehensive tool to manage (evaluate, benchmark, monitor and improve) SM performance in construction projects (Oppong et al., 2017). In order to solve this problem, Oppong et al. (2017) developed a dynamic SM performance management model through the consolidation of literature. The model asserts that construction SM performance could be effectively managed where objectives are set, strategies are established for realization, and the actual outcome (stakeholder and organizational satisfaction) is measurable through performance indicators.

Whiles there is lack of empirical research, it is believed that there may be important objectives of construction SM which have not been previously established. This could be an explanation for the poor performance of SM in construction projects across the past decades (Loosemore, 2006). Through an international survey on construction practitioners and academics, this study is aimed at evaluating the important objectives that project managers (PMs) consider in managing construction stakeholders. “Objectives” is defined by the *Online Business Dictionary* as the “basic tools that underlie all planning and strategic activities”. Moreover, they constitute the basis on which policies are formulated and performance is evaluated. The definition is applied in this context because it is believed that together with other attributes such as critical success factors and key performance indicators, SM performance could be objectively, practically and reliably managed where there is a sound basis for managing construction stakeholders (Oppong et al., 2017; Toor and Ogunlana, 2008; Yeung et al., 2012). Hence, this study seeks to answer the question “what important objectives do PMs consider in managing construction stakeholders?”

In the next sections, literature is reviewed, the methodology of the study is discussed, and then the results are presented. Afterwards, the conclusions and implications are also discussed.

LITERATURE REVIEW

Stakeholder theory

The stakeholder concept dates far back as 1963 where Igor Ansoff and Robert Stewart of Stanford Research Institute (SRI) defined stakeholders to be "entities without whose support the organization will cease existence". This definition is regarded as broad and has seen many rebuttals across the past couple of decades. In 1984, Professor R. Edward Freeman published a landmark book entitled "Strategic management: A stakeholder approach", which reignited SM research. He defined stakeholders in a more narrow way as "any group or individual who can affect or is affected by the achievement of the firm's objectives". It has been argued that "affecting or being affected" is not the only criteria to make an individual or a group stakeholder(s) of projects (Littau et al., 2010). Hence, Olander (2007) claimed that a point should be made for individuals and entities having a stake in the outcome of the project; where the stake could be an interest, a right or ownership in project. In summary, the definitions of "stakeholders" identified in literature reflect three main themes: (1) could affect or be affected by project, (2) having a stake/interest in project, or (3) both of the above (Littau et al., 2010).

In this study, stakeholders are defined as "any individual or entities that affect or can be affected by, have significant stake (interest, right, ownership, knowledge, influence, or contribution) in, or are generally indispensable to the accomplishment and survival of, the construction project". This definition therefore legitimizes some other stakeholders including the media and local religious groups/deities (Olander and Landin, 2005; Ezeabasili et al., 2015) that even though are crucial in project delivery (with moral stakes), have been sidelined in previous studies because they lack actual stakes in the project. Elias et al. (2002) produced a literature map of stakeholder theory development across the years. They stated that in between the SRI seminal work in 1963 and the Freeman's 1984 re-ignition, the stakeholder theory diversified into four main areas: corporate planning, corporate social responsibility, systems theory, and organization theory. After 1984 as well, the theory diversified into descriptive, normative and instrumental perspectives. From 1997, the concept of dynamics in stakeholder environment became popularized (Mitchell et al., 1997; Roley, 1997). Beyond, more stakeholder theories and empirical studies have been undertaken.

Stakeholder management objectives

As stated by Mitchell et al. (1997) and Freeman (1984), the fundamental purpose of SM is to consider the differing perspectives of stakeholders, improve the communications existing amongst the stakeholders, and clarify their associated needs. Dialoguing platforms that allows stakeholders to be equally informed and also make their own contributions democratically to project development increases learning and value sharing (Innes and Booher, 2004). Yang and Shen (2015) also stated that the SM process is designed to solve problem, minimize project risks, and facilitate projects to

progress smoothly and promptly. Asides, SM is to help gain stakeholder acceptance and buy-in in project implementation, so the PMs require top management support to achieve project goals (Karlsen et al. 2008; Jergeas et al., 2000; El-Sawalhi and Hammad, 2015). El-Sawalhi and Hammad (2015) realized that the general public showed high level of acceptance and support towards infrastructure projects in the Gaza Strip. This is because the projects were designed to be labour-intensive instead of capital-intensive, and helped to reduce the unemployment rates. Meanwhile, Li et al. (2013) opined that public participation process provides a favourable occasion to resolve and compromise project conflicts, analyse and prioritize stakeholder needs, and optimize the mutual satisfaction.

Aaltonen et al. (2008) articulated an empathic view that the key issue in SM is to effectively manage the interrelationships between projects and related stakeholders, so that the stakeholders are motivated to exhibit behaviour that satisfy the clients' requirements and objectives. In a dam construction project, Mahato and Ogunlana (2011) realized that the project team adopted public participation to improve stakeholder sense of belongingness and support of project; compensation and resettlement program to sustain and improve livelihood; and monitoring and reporting program to create positive stakeholder perception and trust in project. There is increasing awareness and advocacy for the incorporation of stakeholder engagement in project decision making to ably identify specific needs and requirements of stakeholders, improve the performance of projects, and enhance corporate social responsibility towards the stakeholders (Vos and Achterkamp, 2006; Greenwood, 2007). As stated by Garmendia and Stagl (2010), the goal of public engagement is to infuse stakeholder value into decision-making process of projects, resolve stakeholder conflicts, build project-stakeholder relationships that are trustworthy, and fulfil the needs, interests and objectives of all stakeholders represented in the process. Leung et al. (2013) also suggested that project team members and other powerful stakeholders should endeavour to make substantial contribution in the engagement process in order to understand public views and successfully deliver projects to the satisfaction of stakeholders. Li et al. (2012) opined that public engagement is promoted and implemented worldwide to improve two-way communication, enhance the long-term viability of projects, and improve benefits that accrue to the communities. This will also ensure that the decision-making process is open, transparent, and accountable.

Karlsen et al. (2008) stated that PMs have to implement proactive SM to minimize stakeholder actions that may negatively affect projects. Through literature review, Mathur et al. (2008) conceptualized stakeholder engagement from three perspectives. From the strategic management viewpoint, they stressed that stakeholder engagement is aimed at capturing knowledge, improving project ownership by end users, minimizing conflicts, encouraging innovation, and expediting spin-off partnerships. Also, from the ethical perspective, SM focuses on enhancing inclusive and local decision-making, promoting equity amongst stakeholders, and building social capital. Finally, social learning perspective creates an opportunity for

awareness and value creation, influences attitude and affects behaviours (Mathur et al., 2008). Rowlinson and Cheung (2008) acknowledged how indispensable stakeholders are in projects and stated that project objectives could not be easily achieved unless the stakeholders are rationally empowered to effectively participate in the management of project.

According to Olander and Landin (2008), project and its stakeholders must be managed such that negative impacts are minimized and the accruing mutual benefits are also maximized where possible. They argued on the premise that whiles stakeholders pursue the attainment of some benefits, they also protest strongly to fend off suspected or experienced negative project impacts. Moreover, Olander and Landin (2008) advocated for an open and trustworthy communication with stakeholders. In an earlier study, Olander and Landin (2005) realized that poor communication at the early project stages could engender conflicts and controversy with respect to size, location and design of facility. On the contrary, proper two-way communication with the stakeholders ensures the mitigation of conflicts and controversies, and hence, maintaining the desired level of project implementation (Olander and Landin, 2008). Cleland (1988) informed that SM process is designed to curtail stakeholder activities that could potentially impact project, and persuade the stakeholders to support project purposes. SM success assumes that PM would consider the influence of project decisions on the stakeholders across project duration. Subsequently, the SM process guarantees credible and timely information about capabilities of stakeholders and the options readily available for them (Cleland, 1988). This enables PMs to take decisions that will optimize the value and satisfaction that stakeholders realize in projects. El-Gohary et al. (2006) asserts that stakeholder engagement programme is determined to communicate with stakeholders, and clarify stakeholder concerns, and infuse them into project design to achieve joint solutions. Furthermore, public engagement is implemented to resolve conflicting issues, satisfy needs, improve project deliverables, and foster social cohesion (Leung et al., 2012; Irvin and Stansbury, 2004). Even though public engagement has gained grounds especially in developed countries, there are still problems with regards to its implementation. For instance, governments are very cautious not to give the citizenry more power. The fear is that citizenry becoming over-active may result in conflict and disorder (Shai and Yai, 2011).

It is realized that even though a number of SM objectives with varying coverage and emphasis exist in literature, they have not been well synthesized and empirically evaluated so that PM could apply successfully in projects. Consequently, construction SM has been practiced in a random and ineffective manner (Yang and Shen, 2015). Hence it is of necessity to empirically evaluate and establish the important objectives that PMs should consider in managing project stakeholders.

Interested readers may refer detailed review of construction SM objectives in Oppong et al. (2017).

RESEARCH METHODOLOGY

Prior literature and pre-testing

This study forms part of a broader research into the attributes of SM performance in construction projects by drawing on international experiences. The initial step in this study was to consolidate a list of factors which are referred here as the objectives of SM in construction projects or related projects. A lot of factors were initially identified in literature from contexts such as purposes, reasons, motives, objectives, aims or goals for managing project stakeholders. After the critical review, 18 objectives were consolidated through content analysis by using the open coding method (please see Table 1). The list of factors (forming part of other performance attributes) were then emailed to 5 international project (stakeholder) management experts based on related publications. They were required to review the structure, comprehensibility, clarity and tenses, and also comment on the duration for completion. Even though no changes were suggested to the set of 18 objectives, some of the comments critically made was in the section on the profile of respondents. The experts confirmed that the draft was good for the survey given that the minor suggestions were incorporated.

Table 1: Objectives of SM in construction projects (Summary from Oppong et al., 2017)

S/N	Objectives of SM	Source
1	Achieve collaborative and integrated project solution	[1] [2] [3] [4] [5] [6] [7] [8
2	Enhance local decision making	[2]
3	Increase stakeholders' sense of belongingness and ownership of project	[2] [9]
4	Satisfy the needs, interests and objectives of stakeholders	[4] [8] [10] [11]
5	Encourage innovation in project development	[2]
6	Increase awareness, change attitude and affect behaviour of stakeholders	[2]
7	Build social capital, and promote social learning and cohesion	[2]
8	Facilitate projects to move forward in a timely and effective manne	[7] [12]
9	Ensure openness, transparency, and accountability of the decision-making process	[13]
10	Curtail stakeholder activities that might adversely affect project	[14]
11	Resolve and minimize conflict and controversy between diverse stakeholder interests	[2] [4] [5] [12]
12	Maximize mutual benefits and minimize negative impacts of projec	[5] [7] [12] [13]
13	Obtain good stakeholder perception, acceptance and support of project purpose	[9] [11] [14] [15] [16]
14	Build robust, trustworthy and communicative project relationship with stakeholders	[1] [4] [6] [10] [11] [12] [17]
15	Facilitate spin-off partnerships with stakeholders	[2]
16	Enhance corporate social responsibility towards stakeholders	[9] [18]
17	Improve the long-term viability of project towards stakeholders	[13]
18	Promote equity amongst stakeholders	[2]

Note: 1 = El-Gohary et al. (2006), 2 = Mathur et al. (2008), 3 = Vos & Achterkamp (2006), 4 = Garmendia & Stagl (2010), 5 = Li et al. (2013), 6 = Mitchell et al. (1997), 7 = Yang & Shen (2015), 8 = Irvin & Stansbury (2004), 9 = Mahato & Ogunlana (2011), 10 = Freeman (1984), 11 = Manowong & Ogunlana (2010), 12 = Olander & Landin (2008), 13 = Li et al. (2012), 14 = Cleland (1988), 15 = El-Sawalhi & Hammad (2015), 16 = Jergeas et al. (2000), 17 = Aaltonen et al. (2008), and 18 = Greenwood (2007).

International expert survey

Subsequently, an empirical questionnaire survey was conducted on targeted academic and industry experts worldwide. The experts were required to rate on a 5-point scale the extent to which they consider the factors as important objectives in SM process based on experience. Purposive sampling method was engaged in identifying the experts. The experts were required to meet any two of the four pre-established criteria, viz; knowledge and in-depth understanding of the SM concept, current/recent practical experience in construction SM, extensive involvement in construction project management generally, and participated in related conferences or published related journal/conference papers. These criteria were adapted from similar studies so it is believed that appropriate experts participated in the survey (e.g. Yeung et al., 2007).

Table 2: Profile of experts

Demographic variables	Number of experts	Demographic variables	Number of experts
Nature of knowledge/Experience		Level of Related Experience	
Academia/research	50	1-5 years	15
Industry	17	6-10 years	16
Total	67	11-15 years	14
Nature of Project		16-20 years	9
Building	38	Above 20 years	13
Civil works	18	Total	67
Both	11	World Regions	
Total	67	Africa	17
Sector of Client of Project		Americas	14
Public	36	Asia	10
Private	25	Middle East	7
Both	6	Australia and Oceania	3
Total	67	Europe	16
Nature of Organization		Total	67
Client organization	4		
Consultant organization	8		
Contractor organization	5		
Academic/research institution	50		
Total	67		

The experts were drawn from four main platforms; authors of related publications; the local chapters of Project Management Institute (PMI); regional and country affiliates of International Project Management Association (IPMA); and the yahoo platform of Co-operative Network for Building Researchers (CNBR). Emails were sent personally to over 200 targeted authors identified from the publications, and also sent to the CNBR

platform. Emails were also sent to the presidents or correspondents in IPMA affiliates and PMI chapters globally requesting the questionnaire to be sent to the members or published on their common platforms. The respondents were given the flexible option of filling the questionnaire online through "Survey Monkey" link or by duly completing the attached Word version and returning by email. It was requested in the questionnaire for the respondents to forward to other qualified and willing experts to complete. Hence, it is not possible to capture the exact size of the sample.

The respondents were given a two-week period to complete the survey upon receipt. Since the target respondents were issued the questionnaires at different times, email reminders were sent to the respondents directly and to the presidents or correspondents of the platforms after a month of starting the survey. The entire survey started from mid-November 2016 and ended mid-January 2017. After the process, only 76 responses were received. Some of the responses were not duly filled or appropriate for the study, so they were removed. Small sample sizes are the usual undesired realities of most international email/web-survey based research due to the low response rates (e.g. Ameyaw and Chan, 2015). The contribution from academia and industry, with mixed world regional background of the experts, and types of projects adds to the reliability of the responses. In the Table 2, the detailed demographic profile of the respondents are shown.

Analytical methods

The IBM SPSS 20 software was used to perform reliability analysis, agreement and consistency of response, and ranking of the factors. These were achieved with techniques including Cronbach's alpha, Kendall's coefficient of concordance (W), and the mean significance analysis. A Cronbach's alpha value more than 0.70 is considered acceptable, indicating the reliability and internal consistency of the dataset (Nunnally, 1978). A (W) value close to +1 indicate a strong agreement on the ratings of the experts. A 0.05 significance level (W) with a null hypothesis that "there is no significant agreement among experts on the rankings" was set. Due to the limitation of the (W) to only 7 attributes (N), Siegal and Castellan (1988) suggested that the chi-square (X^2) test value should instead be used as a near approximation where the (N) is greater than 7. Hence, if the (X^2) value computed is more than the tabulated value (critical value of X^2), then the rejection of null hypothesis is justified.

The mean significance analysis is engaged to evaluate the relative importance of the objectives of construction SM. The assumption underlying this analysis is that the responses are regarded to follow a normal distribution pattern with 95% of data lying within the ambit of two standard deviations (2σ) of the mean (μ) i.e. within (μ-2σ, μ+2σ) (Zhang, 2006). All responses that lie outside this range are removed and the mean significance index (μ_1) is recomputed for each objective and serves as the basis for ranking.

RESULTS AND DISCUSSION

Reliability and Validity of data

The Cronbach's (α) value for the 18 objectives is 0.905, which makes the scale suitable for further analysis (Nunnally, 1978). The implication is that the data collection instrument is reliable and the responses of experts are uniform.

Agreement and Consistency of Responses

The *W* value resulting from the computation is 0.191 with a significant test value of 0.000. Because the number of elements (*N*) is more than 7, the chi-square (χ^2) is rather used as close approximation (Siegel and Castellan, 1988). With a confidence interval of 95%, the computed (χ^2) value (217.208) is greater than the tabulated critical (χ^2) value (43.224) at a degree of freedom of 17. The implication is that the null hypothesis is to be rejected as there is a significant agreement amongst the ratings of the experts on the SM objectives. Moreover, it shows that the data is also valid for further analysis.

Ranking of the Stakeholder Management Objectives

The mean significance index values of the 18 objectives are shown in the Table 3. The standard deviation (σ) values, and mean significance index values prior to and after the elimination of responses outside the specified range (μ_1 and μ_2 respectively) are also shown in the same Table. The criteria adapted in labelling the level of importance of the objectives are defined as: $\mu_2 \leq 1.49$ (least important), $1.50 \leq \mu_2 \leq 2.49$ (fairly important), $2.50 \leq \mu_2 \leq 3.49$ (important), $3.50 \leq \mu_2 \leq 4.49$ (very important), and $\mu_2 \geq 4.50$ (most important). It is noted that the mean significance index values range from 3.07 to 4.37. Out of this distribution, 13 objectives came up as very important with μ_2 ranging from 3.52 to 4.37. These objectives are key and should be greatly considered by PMs in order to achieve high performance in construction SM. Also, 5 objectives with μ_2 values from 3.07 to 3.42 are labelled as important.

The satisfaction of stakeholders' needs, interests and objectives ranks highest amongst all the objectives in managing construction stakeholders. This is to be expected because stakeholder satisfaction has risen from oblivion to become an important criterion in accessing the success of construction projects in recent years (Oppong, et al., 2017, Davis, 2016). Leung et al. (2004) sees participant satisfaction as the most crucial determinant of construction project success and specifically stated it to be "affective state reached by the individual through attainment of certain goals (success) which gives rise to rewards" (pp. 329-330).

Stakeholders feeling satisfied demonstrates that the PMs have given much attention and consideration to them and hence, critical for project success (Garmendia and Stagl, 2010; Irvin and Stansbury, 2004). Moreover, the project organization may also feel satisfied when the stakeholders are satisfied (Oppong, et al., 2017). The next most important objective is the facilitation of projects to move forward effectively and adhere to time. Until

stakeholder buy-in is gained, it becomes difficult to execute projects accordingly (Jergeas et al., 2000). Most of the times, the stakeholders who are unsatisfied or feel affected may interrupt projects in formal or informal ways such as litigations, petition or picketing. Hence, PMs must ensure that the stakeholders are well coordinated and managed so that projects could be delivered smoothly to meet targets.

Construction stakeholders are also managed to achieve collaborative and integrative solutions, and also resolve conflict and controversy in project delivery (El-Gohary et al., 2006; Vos and Achterkamp, 2006; Mathur et al., 2008; Olander and Landin, 2008). Due to the divergent interests and viewpoints of different stakeholders (which should not be discounted), the PMs are to ensure that stakeholders' concerns are considered and mutually compromised so that the best solutions are generated (Yang and Shen, 2015).

In public projects especially, the stakeholders may be interested in how transparent and open that the projects are procured and implemented. This is usually realized through the public participation setting where the decision-making process is centred on two-way communication process (Li et al., 2016). Subsequently, the project endeavours would become accountable to the public who are expecting value for the money investment. Asides, SM is to build a good and effective relationship with the stakeholders, and also enhance the stakeholders' sense of belongingness and ownership of project. Li et al. (2012; 2016) therefore asserted that the project organization should continuously engage the stakeholders throughout the project lifecycle in order to ensure that the interrelationships are well coordinated. Moreover, Garmendia and Stagl (2010) opined that the stakeholder engagement process produces trustworthy project relationships, resolves conflicts, and incorporates stakeholder values and needs. The relationship between project and its stakeholders should be robust, honest and trustworthy so that there is a smooth two-way communication with the stakeholders. In line with Olander and Landin (2008), project acceptance and support, which is a requisite to success, could be attained where the PMs build and maintain a trustworthy relationship and also communicate well the positive and negative impacts of projects with the stakeholders. Moreover, when the stakeholders feel that they are important and their needs are considered in the project, they will be willing to provide the necessary support for project implementation (Mahato and Ogunlana, 2011; Mathur et al., 2008).

The delivery of construction projects always come at costs and benefits. The cost may include the environmental impacts to be borne, traffic diversion that could lead to longer travel times, relocation of neighbouring people and activities, and health and safety problems. On the other hand, the benefits may include employment generation, improvement of neighbourhood quality, economic growth, tourism attractiveness, and corporate social benefits. The role of the PM is to attain balance by minimizing the costs and maximizing the mutual benefits accruing to the stakeholders (Olander and Landin, 2008). In controversial and conflict prone projects especially, the

stakeholders may use diverse mechanisms to get needs met in projects. Whiles some stakeholders may use formal platforms like meetings, letters or litigation to make known needs or resolve conflicts, others may ride on crude approaches such as picketing, vandalizing or media attacks for same.

Table 3: Mean Index values of the Objectives for Managing Construction Stakeholders

Objectives of stakeholder management	Number of responses					Total	Mean Sig. Index (μ_1)	Std. Dev. (σ)	μ_1-2σ	μ_1+2σ	Mean Sig. Index (μ_2)	Rank	Importance
	1	2	3	4	5								
Satisfy the needs, interests and objectives of stakeholder	0	2	6	29	30	67	4.30	0.76	2.78	5.82	4.37	1	Very Imp.
Facilitate projects to move forward in a timely and effective manner	1	4	14	22	26	67	4.01	0.99	2.03	6.00	4.19	2	Very Imp.
Achieve collaborative and integrated project solution	0	3	13	28	23	67	4.06	0.85	2.36	5.76	4.16	4	Very Imp.
Resolve and minimize conflic and controversy between diverse stakeholder interests	2	2	12	29	22	67	4.00	0.95	2.09	5.91	4.16	4	Very Imp.
Ensure openness, transparency, and accountability of the decision making process	0	6	14	27	20	67	3.91	0.93	2.04	5.78	4.10	5	Very Imp.
Build robust, trustworthy an communicative project relationship with stakeholders	0	3	15	29	20	67	3.99	0.84	2.30	5.67	4.08	6	Very Imp.
Enhance stakeholders' sense of belongingness and ownership of project	0	4	18	25	20	67	3.91	0.90	2.11	5.71	4.03	7	Very Imp.
Maximize mutual benefits and minimize negative impacts of project	1	5	14	27	20	67	3.90	0.97	1.95	5.84	3.94	8	Very Imp.
Obtain good stakeholder perception, acceptance and support of project purpose	2	2	19	27	17	67	3.82	0.95	1.92	5.73	3.91	9	Very Imp.
Curtail stakeholder activities that might adversely affect project	3	5	17	27	15	67	3.69	1.05	1.59	5.78	3.81	10	Very Imp.
Create awareness, change attitude and affect behaviour of stakeholders	0	10	21	26	10	67	3.54	0.93	1.68	5.39	3.54	12	Very Imp.
Improve the long-term viability of project to stakeholders	2	10	19	27	9	67	3.46	1.00	1.45	5.47	3.54	12	Very Imp.
Enhance local decision making	0	10	24	21	12	67	3.52	0.96	1.60	5.44	3.52	13	Very Imp.
Enhance corporate social responsibility towards stakeholders	5	11	23	19	9	67	3.24	1.12	1.01	5.47	3.42	14	Important
Facilitate long-term spin-off partnerships with stakeholders	4	12	26	16	9	67	3.21	1.08	1.05	5.37	3.35	15	Important
Build social capital, and promote social learning and cohesion	1	16	22	21	7	67	3.25	0.99	1.27	5.23	3.29	16	Important
Encourage innovation in project development	1	14	29	16	7	67	3.21	0.95	1.32	5.10	3.24	17	Important
Promote equity amongst stakeholders	3	18	24	15	7	67	3.07	1.05	0.98	5.17	3.07	18	Important

Total number of responses (N) = 67

The consequences include time and cost overruns, and the halting of projects in the extreme case. PMs therefore commit to managing stakeholders to

mitigate stakeholder activities that could have impact on projects (Cleland, 1988). PMs are always interested in encouraging stakeholders to support project purpose. As such, they may engage all available means to change attitude and affect behaviour of stakeholders towards projects (Mathur et al., 2008). Hence, some adverse project stakeholders could become supportive overtime (Cleland, 1988). This is possible where the stakeholders continuously get acquainted with project knowledge (Mathur et al., 2008). Posterity cannot possibly be neglected in developmental discourses in present times. Moreover, construction projects are expected to deliver value to users over entire lifecycle. This is feasible if diverse stakeholder interests and needs are captured in final deliverables and are sustainable over project lifecycle (Li et al., 2012). It is very important for projects to meet indigenous peoples' requirements. Stakeholders often desire keenly that developmental projects reveal their local identity and pride (Olander and Landin, 2008). Hence, involving stakeholders in local decision making is key to reach social acceptance and use of deliverables (Mathur et al., 2008).

Asides, the least ranked objectives for managing construction stakeholders include: facilitate long-term spin-off partnerships with stakeholders; build social capital, and promote social learning and cohesion; encourage innovation in project development; and promote equity amongst stakeholders. The reasons may include the fact that only a handful of construction process last long (e.g. decades). Hence, most PMs may prefer building active short-term relationships than long-term partnerships with the stakeholders. Also, every new construction project may bring on board quite unique stakeholders. Shai and Yai (2011) further argued that most governments are worried that an over-active citizenry could result in conflict and disorder. Consequently, public participation platforms are only a formality for governments to present their intents in a regulated manner instead of rigorously engaging the invited stakeholders to influence premeditated decisions. Hence, such settings do not necessarily lead to significant increase in social capital, social learning or equity amongst the stakeholders, especially in developing countries. Despite the low ranking, these objectives are considered to be important in construction SM process. As such, PMs should equally give due attention to them especially where project is mega, complex, long-term, and involves a lot of stakeholders and uncertainties. It becomes apparent that project success could be attained when these key objectives are pursued by PMs in the delivery of construction projects.

RESEARCH LIMITATION

The limitation of the generalizability of the findings of this study include the fact that the responses are small to reflect the perception of all experts globally. Also, more of the responses came from academia and might not necessarily represent the industry as well. Hence, more investigation in different countries that counter well these limitations could proof impactful for academia and industry in construction SM.

CONCLUSION

The research presented the evaluation of 18 factors which are considered objectives for managing construction stakeholders by using a questionnaire survey on international experts. The findings are very useful because the 13 very important objectives are a prerequisite for effectively delivering contemporary construction projects which are usually complex, and abound with uncertainties and stakeholders. Without the project teams reaching such objectives, project failure becomes inevitable. This perhaps explains the reason for the poor performance of construction SM over the decades as these objectives were not generally accomplished. This could also underlie the project failure rates in the construction industry. The results emphasize the indispensability of stakeholders in construction projects and how PMs should properly coordinate with them to ensure success. Stakeholders have become very important in construction projects and should be placed on the same pedestal as cost, time and quality requirement. Consequently, attaining these objectives in project delivery could guarantee that both the stakeholders and the project organization are mutually satisfied and could translate into overall project success. The implication for industry include the corporate effort to accomplish at least the very important objectives that will ensure that construction project delivery is improved. The implication for academia include the fact that there is a good foundation to conduct much deeper investigation into such objectives relative to the type and setting (different backgrounds due to culture and location) of project. Moreover, the interrelationships between the important objectives, critical success factors and key performance indicators should be established through future research to ensure that SM performance is well managed (evaluated, benchmarked, monitored and improved) in construction projects.

ACKNOWLEDGEMENT

The authors express gratitude to the Department of Building and Real Estate of the Hong Kong Polytechnic University for funding this study. Also, all experts who contributed to this research are greatly appreciated.

REFERENCES

Aaltonen, K., Jaakko, K., & Tuomas, O. (2008). Stakeholder salience in global projects. *International Journal of Project Management*, *26*(5), 509-516.

Ameyaw, E. E., & Chan, A. P. (2015). Risk ranking and analysis in PPP water supply infrastructure projects: An international survey of industry experts. *Facilities*, *33*(7/8), 428-453.

Chan, A. P. C. & Oppong, G. D. (upcoming). Managing the expectations of external stakeholders in construction projects. *Engineering Construction and Architectural Management*.

Cleland, D. I. (1988). Project stakeholder management. In: Cleland, D. I., & King, W. R. (Eds.). *Project management handbook* (2nd Edition). New York: John Wiley and Sons, pp. 275-301.

Davis, K. (2016). A method to measure success dimensions relating to individual stakeholder groups. *International Journal of Project Management*, 34(3), 480-493.

El-Gohary, N. M., Osman, H., & El-Diraby, T. E. (2006). Stakeholder management for public private partnerships. *International Journal of Project Management*, *24*(7), 595-604.

Elias, A. A., Cavana, R. Y., & Jackson, L. S. (2002). Stakeholder analysis for R&D project management. *R&D Management*, *32*(4), 301-310.

El-Sawalhi, N. I., & Hammad, S. (2015). Factors affecting stakeholder management in construction projects in the Gaza Strip. *International Journal of Construction Management*, *15*(2), 157-169.

Ezeabasili, A. C. C., U-Dominic, C. M., & Okoro, B. U. (2015). Contemtious issues on poor stakeholder management in some major road construction projects in Anambra State, Nigeria. *Civil and Environmental Research*, 7(2), 120-129.

Freeman, R. (1984). *Strategic management: a stakeholder approach,* Boston, Massachusetts, US: Pitman.

Garmendia, E., & Stagl, S. (2010). Public participation for sustainability and social learning: Concepts and lessons from three case studies in Europe. *Ecological economics*, *69*(8), 1712-1722.

Greenwood, M. (2007). Stakeholder engagement: Beyond the myth of corporate responsibility. *Journal of Business Ethics*, 74(4), 315-327.

Innes, J. E. & Booher, D. E. (2004). Reframing public participation: Strategies for the 21st century. *Planning Theory and Practice, 5*(4), 419-436.

Irvin, R. A., & Stansbury, J. (2004). Citizen participation in decision making: Is it worth the effort? *Public Administration Review*, 64(1), 55-65.

Jergeas, G. F., Williamson, E., Skulmoski, G. J., & Thomas, J. L. (2000). Stakeholder management on construction projects. *AACE International Transactions*, *PM.12,* AACE International, Morgantown, WV, 12.1-12.6.

Joslin, R., & Müller, R. (2016). The relationship between project governance and project success. *International Journal of Project Management*, *34*(4), 613-626.

Karlsen, J. T, Græe, K., & Massaoud, J. M. (2008). Building trust in project-stakeholder relationships. *Baltic Journal of Management*, *3*(1), 7-22.

Lehtiranta, L., Kärnä, S., Junnonen, J. M., & Julin, P. (2012). The role of multi-firm satisfaction in construction project success. *Construction Management and Economics*, *30*(6), 463-475.

Leung, M. Y., Ng, S. T., & Cheung, S. O. (2004). Measuring construction project participant satisfaction. *Construction Management and Economics*, *22*(3), 319-331.

Leung, M. Y., Yu, J. Y., Wang, L., and Zhou, W. T. (2012). *Improvement of public engagement performance for planning and development projects via a value management approach*. Hong Kong Institute of Surveyors (Planning and Development Division) and City University of Hong Kong, Hong Kong.

Leung, M. Y., Yu, J., & Liang, Q. (2013). Improving public engagement in construction development projects from a stakeholder's perspective. *Journal of Construction Engineering and Management*, *139*(11), 04013019.

Li, T. H., Ng, S. T., & Skitmore, M. (2012). Public participation in infrastructure and construction projects in China: From an EIA-based to a whole-cycle process. *Habitat International*, *36*(1), 47-56.

Li, T. H., Ng, S. T., & Skitmore, M. (2013). Evaluating stakeholder satisfaction during public participation in major infrastructure and construction projects: A fuzzy approach. *Automation in construction*, *29*, 123-135.

Li, T. H., Ng, S. T., & Skitmore, M. (2016). Modeling multi-stakeholder multi-objective decisions during public participation in major infrastructure and construction projects: a decision rule approach. *Journal of Construction Engineering and Management*, *142*(3), 04015087.

Littau, P., Jujagiri, N. J., & Adlbrecht, G. (2010). 25 years of stakeholder theory in project management literature (1984–2009). *Project Management Journal*, 41(4), 17-29.

Loosemore, M. (2006). Managing project risks. In: Pryke, S. and Smyth, H. (Eds.). *The Management of Complex Projects: A Relationship Approach*. UK: Blackwell.

Mahato, B. K, & Ogunlana, S. O. (2011). Conflict dynamics in a dam construction project: a case study. *Built Environment Project and Asset Management*, 1(2), 176-194.

Manowong, E., & Ogunlana, S. (2010). Strategies and tactics for managing construction stakeholders. In: *Construction Stakeholder Management,* Blackwell, New York, NY, 121-137.

Masrom, M. A., Skitmore, M., & Bridge, A. (2013). Determinants of contractor satisfaction. *Construction Management and Economics*, *31*(7), 761-779.

Mathur, V. N., Price, A. D., & Austin, S. (2008). Conceptualizing stakeholder engagement in the context of sustainability and its assessment. *Construction Management and Economics*, 26(6), 601-609.

Mitchell, R. K., Agle, B. R., Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Academy of Management Review, 22*(4), 853-886.

Moura, H. M. P., & Teixeira, J. M. C. (2010). Managing stakeholders conflicts. In: *Construction Stakeholder Management,* Blackwell, New York, NY, 286-316.

Nunnally, J. C. (1978). *Psychometric theory (2nd Edition)*. New York: McGraw-Hill.

Olander, S. (2003). *External Stakeholder Management in the Construction Process*, Licentiate dissertation, Department of Building and Architecture, Lund Institute of Technology, Lund, Sweden.

Olander, S. (2007). Stakeholder impact analysis in construction project management. *Construction Management and Economics*, *25*(3), 277-287.

Olander, S., & Landin, A. (2005). Evaluation of stakeholder influence in the implementation of construction projects. *International Journal of Project Management*, 23(4), 321-328.

Olander, S., & Landin, A. (2008). A comparative study of factors affecting the external stakeholder management process. *Construction Management and Economics*, 26(6), 553-561.

Oppong, G. D., Chan, A. P., & Dansoh, A. (2017). A review of stakeholder management performance attributes in construction projects. *International Journal of Project Management*, *35*(6), 1037-1051.

Rashvand, P., & Zaimi Abd Majid, M. (2014). Critical criteria on client and customer satisfaction for the issue of performance measurement. *Journal of Management in Engineering*, *30*(1), 10-18.

Rowley, T. J. (1997). Moving beyond dyadic ties: A network theory of stakeholder influences. *Academy of management Review*, *22*(4), 887-910.

Rowlinson, S., & Cheung, Y. K. F. (2008). Stakeholder management through empowerment: modelling project success. *Construction Management and Economics*, *26*(6), 611-623.

Shan, C., & Yai, T. (2011). Public involvement requirements for infrastructure planning in China. *Habitat International*, *35*(1), 158-166.

Siegal, S. & Castellan, N. J. (1988). *Nonparametric statistics for behavioral sciences (2nd Edition)*. New York: McGraw-Hill.

Toor, S-u-R. & Ogunlana, S. O. (2008). Critical COMs of success in large-scale construction projects: Evidence from Thailand construction industry. *International Journal of Project Management*, 26(4), 420-430.

Vos, J. F., & Achterkamp, M. C. (2006). Stakeholder identification in innovation projects: Going beyond classification. *European Journal of Innovation Management*, 9(2), 161-178.

Ward, S., & Chapman, C. (2008). Stakeholders and uncertainty management in projects. *Construction Management and Economics*, 26(6), 563-577.

Yang, J., Shen, Q., & Ho, M. (2009). An overview of previous studies in stakeholder management and its implications for the construction industry. *Journal of Facilities Management*, *7*(2), 159-175.

Yang, R. J., & Shen, G. Q. (2015). Framework for stakeholder management in construction projects. *Journal of Management in Engineering*, *31*(4), 04014064.

Yeung, J. F., Chan, A. P., & Chan, D. W. (2012). Fuzzy set theory approach for measuring the performance of relationship-based construction projects in Australia. *Journal of Management in Engineering*, *28*(2), 181-192.

Yeung, J. F., Chan, A. P., Chan, D. W., & Li, L. K. (2007). Development of a partnering performance index (PPI) for construction projects in Hong Kong: a Delphi study. *Construction Management and Economics*, *25*(12), 1219-1237.

Zhang, X. (2006). Public clients' best value perspectives of public private partnerships in infrastructure development. *Journal of Construction Engineering and Management*, *132*(2), 107-114.

AN INVESTIGATION INTO THE EFFICIENCY OF CLASSIFICATION OF CONSTRUCTION FIRMS IN GHANA

Alex K. Eyiah[1]
[1]*Built Environment Department, Pentecost University College, Sowutuom, Accra, Ghana*

The construction industry is one of the highly-regulated industries. There are reported cases of negative impact of regulatory policies on the performance of contractors both in developed and developing countries. The classification of construction firms is an attempt to regulates which contractor can do which type of work at any given period. The study investigates whether the rules and procedures outlined in the guidelines for classification of constriction firms in Ghana are being adhered to when issuing certificate to contractors. The guidelines for classification and registration of contractors by the Ministry of Works and Housing is examined. A questionnaire is designed with a view to generating information on contractors relating to classification exercise. The questionnaires were targeted at fifty construction firms based in five district assemblies in the central region. A response rate of 60 percent was achieved. The findings suggest that the classification system is inefficient. Many contractors are categorized under financial classes but they do not possess the prescribed number of equipment and personnel as stated in the guidelines for classification. The system has the potential of preventing very able professionals from entering the industry if they are unable to meet the high requirement standards. It is also an avenue for corrupt practices as contractor would do anything to ensure the smooth operation of the businesses.

Keywords: classification, construction firms, developing countries, Ghana, regulations

INTRODUCTION

The construction industry plays an important role in the socio-economic development of a country. A vibrant construction industry, that mobilizes local resources in the development and maintenance of physical infrastructure, is an important means to accelerate economic growth. In Ghana, the industry is critical to the country's economic health, both by virtue of its size and as a driver of growth. By 2006, the industry was the fastest-growing sector in the economy, with a growth rate of 8% against the

[1] dreyiah@yahoo.com

Eyiah, A. K. (2017). **An investigation into the efficiency of classification of construction firms in Ghana** *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 260-270.

national average of 6% (MOE, 2010). The sector's share of GDP increased from 5% in 1975 to 9% in 2000 and then to 15% by 2007 (Sutton and Kpentey, 2012). Provisional estimates for 2015 showed the industry sector recording the highest growth, with construction being the largest activity within the industry sector with a growth of 30.6 percent and a share of 14.8 percent of nominal GDP (GSS, 2016).

The role played by construction firms in the development process cannot be underemphasised. However, their participation in the industry has been affected by several challenges including regulation of the industry (Anaman and Osei-Amponsah, 2007; Darko and Lowe, 2016). Regulation challenges are not peculiar to the construction industry but tends to be exacerbated due to the complexity of the industry. Anaman and Osei-Amponsah (2007) observe that as a results of regulation construction firms find themselves interfacing with national, regional and district bureaucracies at all levels of a project: to obtain building permits, to have work inspected and to have the completed project certified 'good for possession'.

In Ghana, after registering with Registrar General, construction firms who wish to undertake public projects are required to register with the Ministries of Works and Housing and the Roads and Highway for categorization into the type of work they wish to undertake and then financial grading. There are concerns as to whether the registration exercise is yielding its intended purpose. For example, at the launch of the maiden National Building and Civil Contractors' Excellence Award, the Association of Building and Civil Engineering Contractors of Ghana (ABCECG) called for a review of the registration process to weed out non-performing contractors (GNA, 2011). The Chairman of the Technical Committee of the Association notes that shortfalls of the exercise had resulted in the proliferation of all sorts of incompetent contractors in the industry (GHA, 2011). On the other hand, the exercise stands to prevent competent contractors from entering the industry if they are unable to meets the requirement standards set for categorization and grading. There is the need to balance the positive and negative effects of the classification system so contractors are not hindered from contributing to the development of the industry.

There is very little body of knowledge on the subject matter. The result from a google search for empirical studies on the subject was not encouraging. This paper is an attempt to bridge this gap. It is expected that findings would serve as a basis for other developing counties to investigate the best possible way to encourage contractors to participate in the construction industries. The aim is to explore the efficiency of classification of construction firms in Ghana. The objective is to examine the guidelines for contractor classification and identify whether the rule and procedures outlined in the guidelines are well applied. The following question should guide the investigation: What criterial is adopted in contractor classification? Are contractors appropriately classified per the established rules and procedures? The remainder of the paper contains: regulation and

the construction industry, contractor classification system, research methodology, analysis and discussion of findings and conclusions.

LITERATURE REVIEW

Business regulation is defined as rules and legal system relating to contracts, employment and intellectual property rights within which firms operate (Smith, 2000). Governments regulate business formation and operation in the form of licenses, registration and permits. ADB (2001) identifies business licenses under two categories: (a) general business license; government permission is needed for business activities in the market (b) specific business license; regulation of business activities in fields where it is claimed a specific public interest requiring safeguards concerns arising from specific sectoral, process or product-related activities. Generally, the purpose of registration is to create a basic information structure, which helps provide up-to-date information on the business population for public policy-making and administrative purposes. Here, businesses are registered with a view to creating a basic information structure.

One school of thought has is that regulation is driven by the needs of businesses (Stigler, 1971). Thus, they are acquired, designed and operated primarily for businesses to increase profit and protect against competition. Another suggests that regulation is in response to broad social movement or crises situation and act to protect the public (Wilson, 1994). Proponents are of the view that regulation carry great benefits but that the rules may be poorly implemented. Critics, however, argue that regulation are cumbersome, confusing, expensive, inefficient, and ultimately, counter-productive, because they affect the very businesses and industries they were established to protect. Excessive regulation is said to affect economic performance and development in that it makes it too costly for firms to engage in the formal economy, causing them not to invest or to move to the informal economy. Branstetter et.al (2010) offer evidence that simpler business registration helps create formal firms. In examining the impact of a reform program, they find that reducing the time and cost of registration increased the number of start-ups by 17% and created about 7 new jobs a month per 100,000 county inhabitants in eligible industries. Dreher and Gassebner (2013) used panel data for 43 economies to test that excessive entry regulation can be detrimental to entrepreneurship and a source of corruption. They find that high numbers of procedures and high minimum capital requirements impede firm entry. Furthermore, high levels of regulation go hand in hand with corruption. They found that corruption is used to "grease the wheels," reducing the burdensome impact of regulations.

Proponents of lesser regulation in the construction industry are of the view that excessive regulation could hinder the type of flexibility, competition and innovation that the industry needs (Creusen, 1999). Massimo et al (2008) notes that regulation may prevent construction firms from penetrating certain market. It notes that the main question surrounding

these measures relates to whether they are more burdensome than necessary to achieve their objectives. There is evidence to suggest that regulatory policies relating to technical requirement, permits, registration of contractors and professionals, wages and remunerations, classification of contractors and foreign equity limitation have impacted negatively on the performance of contractors and the industry in general (GATS, 2000; House of Commons, 2003; Ministry of Foreign Affairs of Japan, 1996; Creusen, 1999; ACEC, 2000; BCCA, 2001). Creusen (1996) reported that, in Dutch housing industry, quality and safety requirements had resulted in high administrative costs for contractors and difficulties for new firms who wanted to venture into the industry. In the USA, it was found that costs of undertaken government projects were higher than those of private sector as a result of regulatory policies associated with the latter (The American Consulting Engineers Council (ACEC, 2000). In Ethiopia, licenses issues had compelled contractors to purchase expensive equipment and were burdened with the huge sums of money involved in engaging technical expertise (Building blocks of Ethiopian construction). In Tanzania, almost half of contactors survey were operating informally because they could not afford the cost involved in formalizing their businesses (Mlinga and Lema, 1999).

Guidelines for Classification of Contractors in Ghana

Classification of construction firms is common in many countries. Generally, the purpose of registration is to ensure companies are experienced and qualified to meet the criteria for the category in which they wish to be classified. The criteria for classification covers: experience (executed projects for specified period of time); technical (number of specified staff with a pre-determined number of years' experience; assets and capital value; and others (complete an application form, supply various document relating to the conditions in certain formats, audited accounts etc).

In Ghana, the exercise is undertaken by the two ministries responsible for construction: The Ministry of Works and Housing (MWH) and the Ministry of Roads and Highways (MRH). The system and processes for classification are very similar with the two ministries. For convenience, this paper focuses on the exercise by the MWH. The process starts with purchasing an application form from MWH, which comes with a "guideline for classification and registration of contractors. Purchase can only be made with a copy of company registration obtained from the Registrar General's Department. The guideline indicates that: the purpose of the classification register is solely for the use of government ministries, departments, agencies and corporations, national, regional, metropolitan, municipal and district tender boards and other institutions which require the service of building and civil Contractors for the execution of projects. The aim, according to the guideline, is the proper grading of contractors into categories and financial classes.

Table 1: Summary of Contractors Minimum Personnel Requirement

PERSONNEL	"D" GENERAL BUILDING WORKS FINANCIAL CLASS				"K" CIVIL WORKS FINANCIAL CLASS			
	I	II	III	IV	I	II	III	IV
Architect	2	1	-	-	2	1	-	-
Civil Engineer	2	2	-	-	2	2	-	-
Quantity Surveyor	2	1	-	-	2	1	-	-
Surveyor	2	2	1	-	2	2	1	-
Accountant	1	1	-	-	1	1	-	-
Purchasing Officer	2	1	1	-	2	1	1	-
Book-Keeper	4	2	1	1	4	2	1	1
Works Superintendent	10	6	2	-	10	6	2	-
General Works Forman	8	5	2	1	8	5	2	1
Carpentry Forman	8	5	2	1	8	5	2	1
Mason Forman	8	5	2	1	8	5	2	1
Painter Foreman	8	5	1	1	8	5	1	1
Steel Bending Forman	6	4	1	1	6	4	1	1

Source: Guidelines for the Classification and Registration of Contractors in the General Building and General Civil Works.

Table 2: Excerpt of Contractors' Minimum Equipment Requirement

EQUIPMENT	"D" GENERAL BUILDING WORKS FINANCIAL CLASS				"K" CIVIL WORKS FINANCIAL CLASS			
	I	II	III	IV	I	II	III	IV
Dozer 140hp	1	-	-	-	1	-	-	-
Mixer Concrete - 10CYH	2	-	-		2			
Concrete Mixer – 0.5HP	2	2	1	1	2	2	1	1
Pumps Water – 90,000 L/Hour	1	1	1	-	1	1	1	-
Pumps Water – 450,000 L/Hour	1	1	-	-	1	1	-	-
Tanker Water Towed 1500L	1	1	-	-	1	1	-	-
Truck Tipper-5/m^3 (Hiring i.e. Class 3)	5	3	1	-	5	3	1	
Truck Flat Bed	3	2	1	-	3	2	1	-
Truck Pick-Up (Hiring i.e. Class 4)	5	3	1	1	5	3	1	1
Excavator	1	1	-	-	1	1	-	-
Tower Crane / Hoist	1	-	-	-	1	-	-	-
Scaffold	2	1	-	-	2	1	-	-

Source: Adapted from Guidelines for the Classification and registration of Contractors in the General Building and General Civil Works.

Companies aspiring to be classified into class 1 and 2 should have registered with the Register General's Department as a Limited Liability Company. Applications should include membership certificate of the Association of Building and Civil Contractors of Ghana (ABCCG). Applicants are required

to provide, among others, supporting documentation such as purchase receipt for immovable equipment, police registration form for vehicles, current CVs of key personnel; award letters of contracts executed in the past five years, indenture /lease documents and site plan for landed property. The application form is a ten-page document indicating the appropriate parts the contractors should fill.

Contractors are then grouped into categories D and K depending on the type of work they wish to undertake. They are further grouped into classes 1, 2, 3 and 4 depending on their operation financial ceiling. Tables 1 and 2 illustrates a summary of the minimum personnel and equipment required for financial classification.

RESEARCH METHODOLOGY

A copy of the guidelines for classification and registration of contractors was purchased from the Ministry of Works and Housing. The procedure for the classification exercise is discussed earlier in the previous sections. The requirement for classification includes: contractors were to be members of the contractors' association; the legal forms of firms to be classified into class 2 and class 1 should be limited liabilities companies; contractors are to have a minimum number of equipment to be considered for any financial class; contractors were to have a minimum number of trades foremen and works supervisors; contractors should have a minimum number of professional. The questionnaire was designed to help solicit information from contractors on these requirements. Contractors were requested to indicate the legal form of their businesses, financial class, and membership status with the contractors' association. They were also requested to indicate from a table the type and number of equipment they have and the number of key personnel as specified in the guidelines for classification.

For convenience, building contractors operating in the central region and doing work for municipal and district assemblies were considered. There is not a recognized list of contractors operating in the central region from which one could establish the total number of contractors and their classification. Bearing in mind the objectives of this paper, a sample size of 50 contractors was considered appropriate. Five assemblies, out of the seventeen in the region, were selected for the survey. Contractors patronize these offices to facilitate the execution and administration of project awarded them. Ten sets of questionnaires were deposited at each of the selected assemblies at the offices of the coordinating director, finance officer and the works departments. These personnel were to encourage contractors who visited them to respond to the questionnaires. 35 questionnaires were received but 30 were properly answered so were used for purpose of analysis.

DATA ANALYSIS AND DISCUSSION

The main purpose of the analysis is to establish whether contractors had fulfilled the requirement stated in the guidelines for classification taken into consideration their current financial class. Frequency tables and cross tabulation analysis was performed in an attempt to address the aim and answer the research questions. Nine contractors, representing 30 percent, were in financial class, eighteen contractors, representing 60 percent, were in financial class 2 and 3 contractors, representing 10 per cent were in financial class 3. No class 4 contractor was captured in the survey. Majority of the respondent (approximately 67 per cent) indicated that it took between 1-3 months to receive certificate of classifications. 30 percent indicated that It took less than one month for them to receive their certificates. The majority of the respondents (77 percent) indicated that they had ever been upgraded. Only 13 percent indicate that they have ever been downgraded. Fourteen approximately (47 percent) indicated that their businesses were sole proprietorship while 53 per cent were limited liability companies. Further analysis (table 3) revealed that approximately 14 percent of the sole proprietors were in class 1 while approximately 72 percent were in class 2. The finding contradicts the condition that class 1 and class 2 contractors are to be limited liability companies. Furthermore, contrary to the conditions set out in the guideline, none of the respondents was a member of the contractor's association.

Table 3. Financial class vs legal form of business

			Legal Form of Contractors		
			Sole Proprietorship	Limited Liability Company	Total
Financial Class	Class 1	Count	2	7	9
		% within Financial Class	22.2%	77.8%	100.0%
		% within Legal Status.	14.3%	43.8%	30.0%
	Class 2	Count	10	8	18
		% within Financial Class	55.6%	44.4%	100.0%
		% within Legal Status.	71.4%	50.0%	60.0%
	Class 3	Count	2	1	3
		% within Financial Class	66.7%	33.3%	100.0%
		% within Legal Status.	14.3%	6.3%	10.0%
Total		Count	14	16	30
		% within Financial Class	46.7%	53.3%	100.0%
		% within Legal Status.	100.0%	100.0%	100.0%

Source: Field Data

Table 4 Financial class vs personnel and equipment holding

Class/Number		Personnel	None	1 No	2 No	3 No.	Equipment	None	1 No.	2 No.	3 No.	4 No.	5 No.
Class 1	8	Architects	8	-	-	-	Dozer 140hp	8	-	-	-	-	-
Class 2	18		18	-	-	-		17	1	-	-	-	-
Class 3	3		3	-	-	-		3	-	-	-	-	-
Class 4	-		-	-	-	-		-	0	-	-	-	-
Total	**29**		**29**	**0**	**0**	**0**		**28**	**1**	**0**	**0**	**0**	**0**
Class 1	8	Civil Engineers	6	2	-	-	Mixer Concrete (10CYH)	-	6	2	-	-	-
Class 2	18		14	4	-	-		2	13	3	-	-	-
Class 3	3		3	-	-	-		-	3	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**23**	**6**	**0**	**0**		**2**	**22**	**5**	**0**	**0**	**0**
Class 1	8	Quantity Surveyor	3	5	-	-	Concrete Mixer (0.5hp)	-	6	2	-	-	-
Class 2	18		11	7	-	-		1	16	1	-	-	-
Class 3	3		3	-	-	-		2	1	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**17**	**12**	**0**	**0**		**3**	**23**	**3**	**0**	**0**	**0**
Class 1	8	Surveyor	8	-	-	-	Pumps Water (90,000 L/Hour)	2	6	-	-	-	-
Class 2	18		18	-	-	-		8	10	-	-	-	-
Class 3	3		3	-	-	-		2	1	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**29**	**0**	**0**	**0**		**12**	**17**	**0**	**0**	**0**	**0**
Class 1	8	Accountant	-	8	-	-	Pumps Water (45000L/Hour)	6	2	-	-	-	-
Class 2	18		3	15	-	-		15	3	-	-	-	-
Class 3	3		1	2	-	-		3	-	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**4**	**25**	**0**	**0**		**24**	**5**	**0**	**0**	**0**	**0**
Class 1	8	Purchasing Officer	3	5	-	-	Tanker Water Towed (1500L)	7	-	1	-	-	-
Class 2	18		7	11	-	-		17	1	-	-	-	-
Class 3	3		3	-	-	-		3	-	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**13**	**16**	**0**	**0**		**27**	**1**	**1**	**0**	**0**	**0**
Class 1	8	Book-Keeper	8	-	-	-	Truck Tipper 5/m³	-	-	2	2	2	2
Class 2	18		14	4	-	-		1	4	5	7	-	1
Class 3	3		3	-	-	-		2	-	1	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**25**	**4**	**0**	**0**		**3**	**4**	**8**	**9**	**2**	**3**
Class 1	8	Works Superintendent	1	7	-	-	Truck Flat Bed	-	4	4	-	-	-
Class 2	18		7	11	-	-		2	12	4	-	-	-
Class 3	3		2	1	-	-		-	3	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**10**	**19**	**0**	**0**		**2**	**19**	**8**	**0**	**0**	**0**
Class 1	8	General Works Forman	-	5	3	-	Truck Pick-Up	2	3	1	2	-	-
Class 2	18		-	12	6	-		7	7	3	1	-	-
Class 3	3		-	2	1	-		1	2	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**0**	**19**	**10**	**0**		**10**	**12**	**4**	**3**	**0**	**0**
Class 1	8	Carpentry Forman	-	3	5	-	Excavator	8	-	-	-	-	-
Class 2	18		1	9	7	1		17	1	-	-	-	-
Class 3	3		1	1	1	-		3	-	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**2**	**13**	**13**	**1**		**28**	**1**	**0**	**0**	**0**	**0**
Class 1	8	Mason Forman	-	3	4	1	Tower Crane/ Hoist	8	-	-	-	-	-
Class 2	18		1	7	7	3		17	1	-	-	-	-
Class 3	3		-	2	1	-		3	-	-	-	-	-
Class 4	-		-	-	-	-		-	-	-	-	-	-
Total	**29**		**1**	**12**	**12**	**4**		**28**	**1**	**0**	**0**	**0**	**0**
Class 1	8	Painter Forman	2	5	1	-							
Class 2	18		6	9	3	-							
Class 3	3		1	2	-	-							
Class 4	-		-	-	-	-							
Total	**29**		**9**	**16**	**4**	**0**							
Class 1	8	Steel Bending Forman	2	5	1	-							
Class 2	18		7	9	2	-							
Class 3	3		3	-	-	-							
Class 4	-		-	-	-	-							
Total	**29**		**12**	**14**	**3**	**0**							

Source: Field Data

This research has revealed that contractors in the respective financial classes did not have the required number of personnel and equipment as specified in the guidelines. For example, in table 1, a D1 contractor should have a minimum of 2 architects, 2 civil Engineers, 2 quantity surveys and 2 surveyors, 10 works superintendents and total of 30 foremen. From table 2, they should have among others a bulldozer, a crane and an excavator. It can be noticed from table 4 that none of the respondents in class 1 met these conditions. A similar pattern can be identified in all the other categories and financial classes. At best, it is only class 3 respondents that come close to satisfying the requirement set out in the guidelines.

From industrial experience and observation, it must be acknowledged that, there are many contractors, particularly in class 1 and class 2, that possess personnel and equipment far in excess of the minimum requirement set out in the guidelines of classification. Notwithstanding, in practice, most of the requirement might not be needed by contractor for the type of projects they undertake. For example, the architect role would be irrelevant in the organizational structure of a construction firm. Meanwhile the cost involved in engaging such a professional could be unbearable. Similarly, purchasing a crane or for a bulldozer would place a huge financial burden on a contractor especially when there is not continuous flow of projects to execute. Today, the plant and equipment hiring market is highly adequate to serve contractors who want to rent.

Indeed, the system has the potential of discouraging emerging entrepreneurs who have graduated from the universities, with the necessary managerial and technical know-how joining the industry. Information provided in the guidelines suggest the only criteria for assessing contractors is the information the latter have provided. There is also no system of monitoring the performance of contractors after they have received their certificates. In this regard, the opportunity for malpractices and corruption is highly expected. To carry out their business as usual, contractors would always find ways of obtaining the kind of classification they want and ensure they obtain renewal certificates even if they are not performing.

CONCLUSION

A vibrant construction industry, that mobilizes local resources in the development and maintenance of physical infrastructure, is an important means to accelerate economic growth. Construction firms play an important role in the development process. Meanwhile their effective participation has been affected by several challenges including regulation of the construction industry. Classification of construction firms can be classified under regulations

In Ghana, the main aim of contractors' classification is to aid government ministries and agency in procuring the most suited contractor to undertake public works. The exercise seeks to classify contractors based on their capabilities: mainly personnel and equipment holdings. The most capable

contractors are grouped under financial class 1 and the least, financial class 4. This paper sort to investigate whether rules and procedure outline for classifying contractors were being followed. The findings suggest the classification system is inefficient. There is evidence to suggest that procedures and rules as stated in the guidelines to not properly followed. Majority of the contractors surveyed are categorized under a particular financial classis but do not possess the requirements as stated in the guidelines for classification. Other conditions, such as being a member of the contractors' association before one could be classified, are also flouted. There is the potential for malpractices and corruption as contractor would do anything possible to ensure the survival of the businesses.

The findings of this study may be useful in guiding policy makers in Ghana and other developing countries in the quest to find more suitable local contractor to participate in the development process. In Ghana, perhaps, the starting point could be subjecting the classification system to a necessity test with a view to finding a better way of making local contractors more capable. In this way, we would be finding answers to questions such as are the aims of the classification system is being achieved? are we achieving an benefits from the classification system? What are the current challenges of the classification system? Which agents are in the best position to handle the classification exercise? and what measures could make the classification exercise more beneficial?

REFERENCES

ACEC (2000) Impact of federal government contracting requirements on design and construction, American Consulting Engineers Council.

ADB (2001) 'Improving the regulatory framework for SMEs: streaming business formulisation procedures and facilitating One-Stop-Service', Policy Discussion Paper, No. 7, Asian Development Bank.

Anaman K. and Osei-Amponsah, C. (2007) 'Analysis of the causality links between the growth of the Construction industry and the growth of the macro-economy in Ghana', Construction Management and Economics, 25:9, 951-961

Atkins, W.S. (1994) Strategies for the European construction sector: a programme for change, final report of the strategic study on the construction sector, European Commission.

Branstetter, L., F. Lima, L. Taylor and A. Venancio (2010), "Do Entry Regulations Deter Entrepreneurship and Job Creation? Evidence from Recent Reforms in Portugal", NBER Working Paper 16473.

BCCA (2001) 'The regulatory burden on the British Columbia construction industry: a tangle of red tape, www.bccassn.com/reports/A Tangle of Red Tape.pdf

BRTF (2000a) Helping small firms cope with regulation, Better Regulation Task Force, The Cabinet Office, London.

BRTF (2000b) Principles of good regulation, Better Regulation Task Force, The Cabinet Office, London.

Building blocks of Ethiopian construction industry, www.telecom.net.et/~usemb-et/wwwhec.07htm

Creusen, H. (1999) Housing construction: between competition and regulation

Darko E and Lowe A. (2016) Ghana's Construction Sector and Youth Employment, Working Paper, Oversees Development Institute, www.odi.org

Dreher and Gassebner (2013), Greasing the Wheels? The Impact of Regulation and Corruption, Public Choice, Vol.155, Issue 3-4, p413-432

GATS (2000) Construction and related engineering services, summary of proposal from WTO members, General Agreement on Trade in Services.

GNA (2011) Contractors call for review of registration process, GhanaWeb, Article 218956, www.ghanaweb.com

GSS (2016) Revised 2015 Annual Gross Domestic Product, Ghana Statistical Service, Economic Statistics Directorate

House of Commons Hansard Debate for 31 January 2003, www.parliament.the-stationery-office.co.uk/pa/cm200203/cr

Institute of Statistical, Social and Economic Research (2015) The State of the Ghanaian Economy Report 2014, University of Ghana, Legon, Ghana.

Massimo G., Anna J. and Frédéric G. (2008) Experts Meeting on Construction Services, Trade and Regulation: The Case of Construction Services, OECD Directorate

Ministry of Foreign Affairs of Japan (1996) Emergency priority programmes for reducing housing construction cost, www.mofa.go.jp/region/n-america/us/economy

Ministry of Education (2010) 'Assessment report of the construction industry skills demand and supply in Ghana'. Accra: COTVET

Ministry of Works and Housing, Guidelines for the Registration and Classification of Contractors.

OECD (2000) The OECD reference management services multi-country business survey: benchmarking regulatory and administrative business environments in SMEs.

Smith, H.L. (2000) 'Regulatory policies and innovation', School of Geography and the Environment, University of Oxford.

Stigler, G.J. (1971) 'The theory of economic regulation', Bell Journal of Economics and Management Science, Vol. 2, No. 2. pp.3-21.

Sutton, J. and Kpentey, B. (2012) 'An enterprise map of Ghana'. London: International Growth Centre.

Weidenbaum, M. (1976) 'Reforming government regulation of businesses', Journal of Hillsdale College, Vol. 5, No. 6.

Wilson, J.Q. (1974) 'The Politics of Regulation', in Social Responsibility and the Business Predicament, McKie, J. (ed.) Brookings Institute: Washington DC, pp.135-168

ANALYSIS OF GREEN BUILDING STRATEGIES FOR HOT-DRY CLIMATIC CONDITIONS IN NORTH-WESTERN CITIES IN NIGERIA; LESSONS FROM BOTSWANA, BURKINA FASO & SOUTH AFRICA

A. A. Yakub[1], A.O. Salawu[2], S. D. Gimba[3], A. Ahmad[4] and A. Jolaoye[5]

[1,2,3,4,5] *College of Environmental Studies, Hussaini Adamu Federal Polytechnic, Kazaure, Jigawa State, Nigeria*

Inadequacies in the Nigerian housing sector pose a great challenge and have propelled the present government to embark on mass housing development alongside most of the low-income earners who would not be able to afford the public housing thus indulging in acquiring land and constructing their desired houses. These activities have significant negative environmental impacts. To address this problem, green/sustainable housing is advocated as these have less toxic materials and in most cases, promote use of local materials to suit climatic conditions. Borrowing a leaf from the Botswana, Burkina Faso and South African experience, the research examined green building strategies for these areas taking into consideration the locally available materials that could be used, its prospects and implementation difficulties. Structured Questionnaires were distributed to 150 purposively selected property developers and tenants in the selected metropolitan cities with 125 retrieved. Adopting the Likert scale ranking and the descriptive method for the purpose of analysis, the collated data were analyzed and the study found out that if local materials such as timber, compressed earth block, earth plastering and stones are adopted in housing construction, the housing shortages will be greatly reduced and the effect on construction on the environment would also be reduced. Thus, while canvassing for the improvement and adoption of local building materials for effective housing, it is recommended that public awareness should be created.

[1] aayakubam@gmail.com
[2] fatsalbode@gmail.com
[3] gimbasd@gmail.com
[4] abubakarahmad88@yahoo.com
[5] hakeemjolaoye@gmail.com

Yakub, A. A., Salawu, A. O., Gimba, S. D., Ahmad, A. and Jolaoye, A. (2017). **Analysis of green building strategies for hot-dry climatic conditions in north-western cities in nigeria; lessons from Botswana, Burkina Faso & South Africa** *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 271-286.

Keywords: green building, indigenous materials, Nigeria, sustainable development

INTRODUCTION

Studies reveal that the building sector, which consume more than one third of the world's energy, are the single major or largest contributor to global warming (World Green Building Council Report, 2009), which implies that the building sector uses more energy than other sectors. This complements Watson and Balkens's (2008) study also found out that the construction and operation of buildings require more energy than any other human activity. Thus, the International Energy Agency (IEA) estimated in 2006 that buildings used 40% of primary energy consumed globally, accounting for roughly a quarter of the world greenhouse gas emissions.

The building sector emitted more than the industrial or transportation sectors with 36 percent of total emission attributed to it in 1998 (Battles, Burns and Energy Information Administration 'EIA', 2000). Earlier studies had shown that the growth rate of emissions is higher in developing countries as Wiel et al (1998) concluded that the CO_2 emissions from buildings grew by 1.7 percent per annum between 1980 and 1990, with rates of growth noted to be four times greater in developing countries. Likewise, Levine, Price and Martin (1996) justified Wiels' finding as they concluded that these annual growths in CO_2 emissions from buildings varied widely by regions; 0.9% of such emissions comes from industrialized countries, 0.7% from Eastern Europe/former Soviet Union and 5.9% from developing countries like ours.

While in the United States, buildings are responsible for 72% of electricity consumption, 39% of energy use, 35% of carbon dioxide emissions, 40% of raw material usage, 30% waste output and 14% potable water consumption (USGBC, 2009). Africa, on the other hand, is said to be the hottest continent as well as the world's largest consumer of biomass energy which largely results from negative environmental effects caused by buildings, as building construction has been said to account for nearly half of all the greenhouse gas emissions and energy consumed owing largely to the energy used (carbon emission) in the production and transportation of materials to building construction sites, and energy used to operate these buildings including waste generated through reconstruction processes where demolition waste would fill and pollute landfills (EPA, 2004 estimated that the construction, renovation, and demolition of buildings, generates 136 million tons of debris per year), these results in extreme weather conditions being experienced, increase in rainfall, flooding, building collapses, increased thermal discomfort in buildings, water shortages and draught, increase in cost of building construction and operation amongst others. Thus, the need to go GREEN as Lee and Yik (2004) puts it that buildings are the dominant energy consumers in modern cities but their consumption

can be largely cut back through improving efficiency, which is an effective means to lessen greenhouse gas emissions and slow down depletion of non-renewable energy sources.

Therefore, Monica (2007) opined that building is 'green' when it reduces exposure to noxious materials, conserves non-renewable energy and scarce materials, minimises the life-cycle ecological impact of energy and materials and uses renewable energy and sustainable materials. While Strawman (2007) said 'green building' incorporates a series of practices in the design and construction of buildings and their associated landscapes that serve to minimize adverse impacts to the environment and to building occupants with a goal to having buildings that will be environmentally friendly from its design to the end of its useful life.

The movement for the adoption of Green Building is often advocated by developers, investors and real estate brokers alongside the government in the quest to finding lasting solution to the environmental and health impact of building activities as Green Building often has the advantages of reducing gas emissions; improving business productivity of their tenants; and benefit occupants to a degree that may exceed the underlying asset's value.

Thus, for West Africa, Nigeria and north-western Nigeria in particular, Green Building is not a matter of choice or luxury but a necessity for the environmentally conscious industry stakeholders that consists the real estate professionals, owners, developers, government officials and even the end-users for the fact that we need a unified effort with measurable means to tackle threats to the environment. When the benefits of Green Building are measured against the status quo, they should be the logical choice as one of the most effective solutions to many environmental concerns as the growing environmental issues will continue to create global problems which can only be eliminated with local effort.

Lukachko and Lstiburek (2008) opined that most green building concepts focuses on the following three areas;

1. Energy efficiency; such as designing buildings to minimize undesirable solar gains during hot seasons while maximizing desirable solar gains cold seasons in order to achieve optimal use of energy conservation measures through passive solar orientation; maximize the use of natural day lighting which significantly reduces artificial lighting energy use and use of on-site small-scale wind/solar based energy generation.
2. Water conservation; maintaining the existing natural flows and features of the land; minimize the use of potable water by using low-flow plumbing fixtures and toilets and waterless urinals; harvest, retain, process and recycle rainwater using methods that closely emulate natural systems and make use of the existing natural water cycle and minimize the unnecessary and inefficient use of potable water by constructing wells and

3. Improving Environmental Quality; select materials to minimize adverse impacts on the environment such as the use of building materials, finishes and furnishings which do not harbour, generate or release contaminants (Hansen, 2004); explore materials that explore the use of bio-based materials and finishes such as agriboard (sheathing and or insulation board made from agricultural waste and byproducts, including wheat, soy, and other materials); improve solar orientation, indoor air quality and natural ventilation, thermal comfort, and natural daylighting into interior spaces as Wikipedia's encyclopaedia opined that lightening has direct effects on the human health such as stress, headaches, fatigue and decrease in sexual functioning and at the long run has greater increasingly effect on people as they age and select materials that can be recycled thus exploring the policy of "waste equals food" where most of the construction waste is recycled and used for future product rather than being land filled

Therefore, this study focuses on selecting materials to minimize adverse impacts on the environment in hot-dry climatic conditions of the north-western parts of the nation which was done by finding out the level of awareness of the Green Building concept within the case study area; the constraints in its implementation; the benefits/prospects of its implementation and the available strategies for its implementation.

THE STUDY AREA

The study area covers the metropolitan cities of Kaduna, Kano and Katsina which are cities located within the north-western part of Nigeria. The cities are commercial in nature, as Kaduna is the successor of the old northern region of Nigeria as it was the base of the then northern region during the colonial era, thus popularly known as 'garin gwamna' in Hausa meaning 'the city of the governor' as that was the only governor ruling over the entire northern region. The city had 760,084 inhabitants as at 2006.

Kano is also an ancient city which is presently the commercial nerve of the entire northern region popularly referred to as the centre of commerce. It is a focal point for regional, national and international commercial activities in the northern region. The metropolitan Kano, consisting of Kano municipal, Fagge, Dala, Gwale, Tarauni and Nassarawa local governments, has a population figure of over 2 million residents. The 2006 population puts it as 2,163,225. Katsina on the other hand is a city, a local government area and the capital of Katsina State with a population of 459,022 as per the 2006 census figures. These three metropolitan cities have a high concentration of industrial and commercial concerns.

GREEN BUILDING AND THE NEED FOR ITS ADOPTION IN NORTHERN PARTS OF NIGERIA

Green Building is a building which is environmentally friendly and socially and economically viable from design to the end of its useful life, thus a holistic approach to building construction which is a part of the larger concept of sustainable development as it enhances the environment against the negative side effect of construction activities. Furthermore, the concept is an all-inclusive concept that converts all liabilities of materials, water and energy waste, and pollution emissions into economic opportunities through the realization of environmentally sound, healthier and cost effective project. No wonder Karolides (2002) described it as a clear answer to health, economic and environmental challenges. Thus, a phenomenon closely related to the concept of sustainable development which is seen as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987).

Thus, a building is said to be 'green' when it reduces exposure to noxious materials, conserves non-renewable energy and scarce materials, minimises the life-cycle ecological impact of energy and materials and uses renewable energy and sustainable materials (Monica, 2007). Many researchers have looked into the benefits of 'going green' such as Russo and Fourt (1987), Hart (1995), Leaman (1999), Heerwagen (2000), Robinson (2005), CoreNet (2008) and RICS (2010). They concluded that the benefits of Green Buildings are enormous. Thus, its adoption is a viable option in north-western Nigeria most especially with its attendant implications as follows:

Saves energy: Gregory (2006) opined that Green Building use 30% less energy when compared to conventional buildings, thus with the inefficient power generation and supply in northern Nigeria, green building is inevitable because of the inability of successive government to guarantee the supply of adequate electricity. Thus, most industrial and commercial concerns currently rely on generating sets to power production and commercial endeavours which results in high cost of production thus making locally produced goods more expensive than their imported counterparts resulting into high propensity and preference for imported goods at the expense of the economy.

Conserve natural resources and generally reduce operating costs; Robinson (2005) opined that with the adoption of green buildings, operating costs of businesses are drastically reduced with its attendant effect on increased productivity. This results from the use of natural resources such as the use of sunlight as sources for cooling, heating and other services. Likewise, several studies have revealed that building materials generally constitute a large proportion of total capital investment in constructions which at times takes over 80% of total value of construction.

Improve air and water quality, reduce solid waste and enhance and protect ecosystems; thus high rate of *environmental pollution* attributable to materials used in construction including emissions from generators within

the sub-region; the choice of building materials adopted such as the Corrugated Iron Sheets (CIS) for roofing, over reliance on generators by households and industrial cum commercial users etc. results into a high rate of environmental pollution which has a repercussionary health related hazards and also contributes significantly to the dreaded global warming.

Thus, the need for environmental protection measures to ensure reduction of operational energy in construction through harnessing the thermal insulation, energy saving of green buildings, and green roof's ozone pollution reduction capacities which will reduce negative environmental impact. Moreover, Green buildings' waste management ensures resources and energy efficiency as extensive use of recycled materials help conserve, restore, and preserve the eco-system.

REVIEW OF LITERATURE

Experience from sister countries

Botswana

With a scattered population of only 2 million in an area of about 600,000km², Botswana was one of the poorest countries in the world during its independence in 1966, but with the discovery of diamonds, the country has become one of the most rapidly developing countries in the world.

In the past two decades, there have been discussions about the rising cost of building schools and hospitals as most building materials were imported from neighbouring countries. Even though Botswana have a long tradition of building in earth as it has the ideal climate for building using earth which is abundant, accessible, and inexpensive and also requires simple techniques (ideal for self-help / do-it-yourself) and require low energy input for their production and utilization and which offer natural insulation properties (Lyamuya and Alam, 2013). Thus, the need to revisit traditional building construction as described in the following paragraph.

Rammed Earth

The rammed earth process begins with soil selection. Soil used to make rammed earth must have an appropriate ratio of sand, gravel, and clay to give cohesion, stability, and strength to the wall. Commonly, soil used in the construction of rammed earth building is taken directly from the site, moistened, and compacted with little thought as to its precise composition. Traditional builders also found many ways to adapt their material to local conditions by inserting branches (to act as reinforcement), water, blood, or lime to prevent cracking / reduce shrinkage or to increase cohesion and durability. Rammed earth is done to comply with building codes where experts have determined the appropriate amounts of gravel, sand, silt, clay, moisture and stabilizing agent necessary to build structures. Although, there are different opinions regarding the best formula for making rammed earth structures, but generally Rael's (2009) is more acceptable where he opined that the mixture should include; Clay 15-18%; Silt 32%; Sand 30%; and Aggregates 23%. The formwork used in the construction of rammed earth structures is generally constructed of wood, portable and light enough

to be managed by one person and it is designed to resist the outward forces created by the compaction of the soil. Although, in the contemporary practice, the use of steel-lined slip forms for formworks are replacing the wooden type.

Adobe (hand-made sun-dried bricks)
Traditionally, most earth constructions in Botswana have revolved around adobe (handmade sun dried bricks) and stacked earth. The ingredients which includes Clay 14-15%; Silt 22-32%; Sand 61-62%; Gravel 2-7% (Rael: 2009) including straw and water are mixed and shaped into a brick which is then baked in the sun until dry. The soil composition required to create a high-quality brick must have large particle sizes of aggregate and sand which help to create a stronger brick, and silt and clay to bind the various components together. More aggregates means greater strength but the resulting brick is more susceptible to erosion (Lyamuya and Alam, 2013). In addition, a more lasting maintenance free wall can be obtained by plastering with a cement mixture.

Examples of the adobe are the traditional Tswana houses which are commonly found in the eastern hardveld among Tswana speakers.

Burkina Faso
In Burkina Faso, the Compressed Earth Block (CEB) has been in vogue. The CEB has the versatility of a brick but the social, economic, and environmental potential of rammed earth which are adopted in Burkina Faso in various institutional projects such as schools and clinics. The precision of shaping earth in a steel mould results in a standardized product, and its sharp edges and smooth surfaces allow a CEB to be left exposed as a finish material and its production requires very little moisture/water.

CEB does not need to be cured thus can be used immediately out of the machine. Some of the machines, such as those with a hydraulic press, require very little manual labour. The ideal soil for CEB consists of (Rael: 2009) Clay 10-30%; Silt 15-25%; Fine Sand 15-35%; Coarse Sand 15-35%; Fine Gravel 10-70% (Lyamuya and Alam, 2013). The use of compressed earth blocks is ideal for institutional buildings. It requires some investment to acquire the machines, but these can be moved from one site to another.



Source: Lyamuya and Alam, 2013. (Institutional buildings constructed using CEB in Burkina Faso)

South Africa

Green buildings are often measured in terms of their operational impact on the environment thus their ability in improving their surrounding environment such as preserving and restoring habitat that is vital for sustaining life; assuring the healthiest possible environment; representing the most efficient and least disruptive use of land and at the long run becomes a net producer/exporter of resources such as energy and water rather than being a net consumer.

Thus, the Green Building Council of South Africa (GBCSA) defines a green building as a resource-efficient, energy-efficient and environmentally responsible building that reduces its direct and indirect impact on the environment throughout its life, from the beginning of construction, during occupancy, and when it is later demolished. Hassan *et al.* (2002) and Kolev (2009) opined that a green building is designed and constructed in a way that is measurably less harmful than traditional buildings to the environment and to the occupants. In essence, green buildings attempt to solve measurable problems associated with conventional buildings.

Many scholars are of the opinion that the future for green building is more concentrated in South Africa compared to other parts of the world as it is one of the only countries with a high reported level of green activity in the residential marketplace (McGraw-Hill Construction notes). Thus, South Africa is considered as the fastest growing sustainable building country in the world that produces environmentally friendly buildings. Stuart-Findlay (N.A) opined that the drive for companies to operate green building in South Africa is for the financial incentives as businesses strive to operate more efficiently in a climate of sharp increases in operating expenses such as electricity and water. And as these costs rise, businesses are looking for ways to contain their total cost of occupation.

Windapo (2014) in his study of Green Building Drivers in the South African Construction Industry concluded that without a sound business or economic case, such as downstream financial benefits due to reduced operating costs and higher rental income, and without government regulations to support the construction of green buildings, very few clients would develop green buildings for the sole purpose of environmental sustainability. Thus, recommended that the South African government implement legislative measures and building regulations in support of green building design and construction.

The Green Building Council of South Africa (GBCSA)

The mission of the Green Building Council of South Africa (GBCSA) is to promote development and encourage green building practices through market-based solutions thus the development of the Green Star SA rating tool which is the green building rating system in South Africa that established green building standards and provides clear guidelines on what constitutes a green building and has therefore provided the industry with an initial framework for financing, developing and investing in sustainable buildings (Windapo, 2014).

The South African government adopted a National Framework for Green Building in South Africa (NFGBSA) as its official green building in November 2011 with the aim of developing green building regulations and standards. And according to research undertaken by McGraw Hill (2013) 51% of all firms in South Africa are expected to be building at high levels of green activity and as at 2013, a total of 36 buildings had received a Green Star rating through the Green Building Council of South Africa (GBCSA).

According to the Construction Industry Development Board- CIDB (2013), the South African Government is dedicated to reducing greenhouse gas emissions through a variety of mechanisms such as green building. Thus, the South African government and non-government entities are taking steps toward a green construction industry aiming to reduce its greenhouse gas emissions by 34% by 2020 and 42% by 2025.

The six-star Green Star South Africa rating
The 'Green Star South Africa rating' is used in rating of green compliant buildings and it is a category considered in line with international best practice and as such the first government building in South Africa to achieve the prestigious is located in the City of Tshwane. It is a 30,654 square metre building which houses the Department of Environmental Affairs building in Pretoria which has its roof covered with solar panels and rain harvesting system, catapulting the building to its green credentials.

Another of such properties includes the Cape Town's No. 1 Silo which is an 18,723 square metre commercial office space situated at the V&A Waterfront. The silo achieved the six star rating for its water efficient fittings and fixtures, a system which monitors energy and water use, lighting used when required and a storm water retention-enabled roof.

Furthermore, is the Midrand's 458 square metre Vodafone site solution innovation centre situated at the Vodacom campus is known for renewable energy use ability, water sustainability and other appropriate material and technology used in the building's design.

The five-star Green Star South Africa rating
The five-green star rating has been awarded to, among others, Standard Bank's head office in Rosebank, DSTV City in Randburg during its construction stage and Group Five's head office within the Waterfall commercial business park.

The five-star Green Star South Africa rating

The four-green star rating has been awarded to Sandton's Alexander Forbes; Nedbank's head office; Alice Lane Building-1 and Worley Parsons building at Melrose Boulevard among others.

METHODOLOGY

The subject of study in this work are the real estate professionals that would include; Real estate developers, builders, quantity surveyors, estate surveyors, facility managers, architects, urban planners and the end users inclusive within the metropolitan cities selected, thus these will constitute

the respondents for the purpose of questionnaire administration within the study area.

Data was collected primarily through the questionnaire survey, which is a form of quantitative technique, where the research developed the questionnaire design and survey model alongside interviews that were conducted with these professionals in the built environment. Semi-structured interview was also conducted, a form of qualitative technique, where the questions were open-ended which lasted over a period of 1 hour to 1 hour 30 minutes.

The Questionnaires were distributed to 50 purposively selected property professionals and 100 tenants in the selected cities out of which 125 questionnaires were dully completed and retrieved. This group were conveniently selected on the basis of who was willing to respond, thus at the end the descriptive method of analysis was adopted to analyse data so gathered from the survey through the use of the SPSS to provide a comprehensive analysis of the research problem.

The proportion method is a statistical means of representing the significance of a variable relative to all other variables under consideration. Statistically, it is represented by the total score of the variable divided by the overall sum of scores of all variables being considered and it is usually expressed in percentage. Proportion is useful in depicting at a glance, variables which are very significant and those which are not significant. The technique is very apt when the task involves ranking of variables in order of significance (Ojo, 2005).

FINDINGS

Potential of local building material in the north-western region

From the Survey of one hundred and fifty (150) respondents in the study area, where a total of 125 responses were retrieved, it shows that the abundant deposits of clay, laterite, stone, lime, agro-industrial waste etc., in their natural state complements the call for the use of local materials for building construction purposes. Thus, a descriptive analysis of their responses is captured on Likert table regarding some major aspects of building as follows.

From the recommended materials selected thus adoptable in green building, their qualities were considered, out of the seven selected qualities; durability, reusability, recyclability and biodegrability was ranked highest with 386 points. This quality cuts across economic and users' health which is centrally paramount to the end users in the study area. Furthermore, environmental health, proximity of materials and resources efficiency was all ranked significant with point 235, 246, and 232, respectively. An absence of fairly significant and insignificance in the rating implies that all the qualities of natural materials adoptable for green building are highly adored.

Table 1: recommended traditional/indigenous materials to be incorporated for the construction of green building in the north-western part of Nigeria

REASONS	Level of Influence VS 4	S 3	FS 2	NS 1	NR 0	Total No. of Respondents	Total Points	Rating
Earth clay	69	28	18	2	8	125	398	Very Sig.
Timber/Wood	67	31	10	4	13	125	385	Very Sig.
Straw bales	56	19	15	5	30	125	316	Significant
Stone	62	33	8	17	5	125	380	Very Sig.
Rice/Wheat husk	47	25	18	20	15	125	319	Significant
Stalk of sorghum	39	27	18	23	18	125	296	Significant
Grass	50	23	15	9	28	125	308	Significant
Recycled Plastic	33	36	22	18	16	125	302	Significant
Ferrock	35	30	22	18	20	125	292	Significant
Fly ash	23	40	23	25	14	125	283	Significant
Sawdust	62	23	15	13	12	125	360	Significant

Source: Field survey, 2017

Likely reasons for not embracing green building in Nigeria

Investigation was made into the likely reasons why many people desist from embracing green building concept as an alternative to contemporary method. It was observed that lack of interest was rated highest by the respondents with 405 points earning. Lack of awareness, undue influence of modernity and lack of enabling environment were all rated significant with varying degree of points while on the other hand economic situation earned 114 points and was rated as an insignificant reason for people's negligence of traditional building materials.

Table 2: Quality of materials recommended for green building in Nigeria

Qualities	Level of Influence VS 4	S 3	FS 2	NS 1	NR 0	Total No. of Respondent	Total Points	Rating
Healthy for the natural environment	35	45	20	20	5	125	335	Significant
Healthy for the interior environment	30	32	28	20	15	125	292	Significant
Help minimizing building energy use	45	27	13	30	10	125	317	Significant
Have low - embodied energy	9	10	50	40	16	125	206	Fairly Sig.
Durable, reusable, recyclable, and biodegradable.	64	28	18	10	5	125	386	Very Sig.
Locally obtained or sourced.	30	50	33	10	2	125	346	Significant
Resource efficient and will not compromise the health of (the environment /occupant.	51	24	20	16	14	125	332	Significant

Source: Field survey, 2017

Table 3: Advantages ascribed to green building

Advantage	Level of Influence VS 4	S 3	FS 2	NS 1	NR 0	Total No. of Respondents	Total Points	Rating
Health preserving & environmentally friendly	61	46	6	7	5	125	389	Very Sig.
Cost efficiency	72	28	12	13	0	125	385	Very Sig.
Sustainability	50	32	17	15	11	125	311	Significant

Source: Field survey, 2017

Table 4: Level of significance attached to the benefits of Green Building practice if employed in Nigeria

BENEFITS	Level of Influence VS 4	S 3	FS 2	NS 1	NR 0	Total No. of Respondents	Total Points	Rating
Economic/Financial benefits	52	27	23	7	16	125	342	Significant
Health/Social benefits	32	17	24	40	12	125	267	Significant
Environmental benefits/preserving natura resources	40	4	1	0	3	125	437	Very significant

Source: Field survey, 2017

From the table above, it was explicitly deducted that some varying level of significance were given to the complex benefits accrued to green building practice. Three of these benefits were accordingly rated by the respondent's notion. Environmental and natural resource preservation was ranked very significant with 437. None of the respondents opined that the benefit was insignificant. Health and social benefit was highly ranked with 267 points. Economic and financial benefits was also significantly ranked with 342 points.

Key to decision making

Approximately 125 persons responded out of the 150 implemented questionnaires, thus;

Total Points (assuming all respondents had chosen a specific option);

Very significant (VS) = 4 points x 125 respondents = 500 points i.e. 376-500

Significant (S) = 3 points x 125 respondents = 375 points i.e. 251-375

Fairly significant (FS) = 2 points x 125 respondents = 250 points i.e. 126-250

Not significant (NS) = 1 points x 125 respondents = 125 points i.e. 1-125

No response (NR) = 0 points x 125 respondents = 0 points

DISCUSSION

From the response on Table 1, three of the materials were rated to be very significant with Earth clay rated highest followed by Stone and then Wood. All other traditional materials were rated as being significant in the construction process where they opined that straw bales can be used to create a home's walls inside of a frame, replacing other building materials such as concrete, wood, gypsum, plaster, fibre glass or stone as they naturally provide very high levels of insulation for a hot or cold climate, and are not only affordable but sustainable.

Bamboo is such a promising building material for modern buildings because of its combination of tensile strength, light weight and fast growing renewable nature. Used for framing buildings and shelters, bamboo can replace expensive and heavy imported materials and provide an alternative to concrete it can also be adopted in Rammed Earth construction which is a technology that has been used by human civilization for years and has the ability to last long.

While Recycled Plastic is a new building phenomenon which includes ground up recycled plastics and trash, which not only reduces greenhouse gas emissions, but reduces weight and provides a new use for landfill clogging plastic waste. Ferrock on the other hand uses recycled materials including steel dust from the steel industry to create a concrete like building material that is even stronger than concrete. This unique material actually absorbs and traps carbon dioxide as part of its drying and hardening process making it actually carbon neutral and less carbon dioxide intensive than traditional concrete.

Saw dust can be adopted in making Timbercrete which is an interesting building material made of saw dust and concrete mixed together, since it is lighter than concrete it reduces transportation emissions and reuses a waste product which replaces some of the energy intensive components of traditional concrete which can be formed into traditional shapes such as blocks, bricks and pavers. Fly ash is a by-product of burning coal. This can be adopted in Ashcrete which is a concrete alternative that uses fly ash instead of traditional cement.

On table 3 the accrued advantages of adopting green building concept were tabled, thus the advantages were rated on a Likert scale as presented in the table. Users' health preservation and cost effectiveness were rated very significant with 389 and 385 points respectively. Sustainability of building earned 311 points and was also rated significant. The corollary of the analysis is that all the quarried advantages fell into the positive side of the scale which translates into high prosperity for the practice.

Also, out of all the benefits slotted for the practice of green building, reduction in operating cost was rated most with a whooping point of 401. This was followed by reduction in capital cost, reduction in liability risk and evolution of new business opportunity. It was absorbingly realized that none of the foreseeable benefits was insignificant while health and productivity

gain, attraction and retaining of employee and market benefit all have fair significant. The accumulation of these benefits presents a fortress of attracting strength for people's embracement of the practice.

From the foregoing, it is evident that Nigeria stands to take advantage of hindsight benefit by the knowledge in the foregoing accounts of the strategies for green building developments in its sister countries such as South Africa, Botswana and Burkina Faso such as the prevalence of local materials such as clay, silt, thatch wood, bamboo, husks etc. as evident in the empirical data in this study supports the viability of green building initiatives in Nigeria. Likewise, the Green Star Ranking of South Africa for example is instructive to the development of a sound policy framework needed to regulate the practice in Nigeria.

CONCLUSION AND RECOMMENDATIONS

The primary concern of green buildings is to protect our planet with the aim of creating a better and healthier environment for people. The result indicates that green buildings have a positive prospect as they were rated to have high benefits although with undue influence of modernity alongside relatively low level of knowledge by the built-environment stakeholders as they are not fully familiar with most green-building concept rather more familiar with conventional materials thus an indication of insufficient experience in green-building materials and concept.

Following this, it is thus recommended that local materials such as compressed earth block as is the vogue in Burkina Faso; handmade sun-dried bricks clamoured for in Botswana (commonly available in rural parts of Nigeria); stones and wood should be adopted in housing construction to reduce housing shortages and the effect of construction on the environment.

Additionally, public awareness should be created and as such built environment professionals should acquire more experience in green-building concepts, moreover such concepts should be embedded in the built environment curriculum especially with the current global climate changes. Likewise, the Green Star Rating system should also be borrowed from South Africa so as to encourage green construction.

ACKNOWLEDGMENTS

The author would like to acknowledge, with thanks, the assistance of the following students who helped in conducting the survey, thus served as research assistants: Leonar Tobechi Obioma, Mayowa Oyaniran, Chika Nwandu Agim and Yahaya Ibrahim Gambo

REFERENCES

Brundtland, G., (1987). "Our Common Future: World Commission on Environment and Development". Oxford: Oxford University Press.

CIDB. (2011). "Best Practice Guide from Best Practice: Project Assessment Scheme" Construction Industry Development Board: Pretoria, South Africa. Available online: http://www.cidb.org.za/.

CoreNet (2008). "Global Trends in Sustainable Real Estate: An Occupier's Perspective" Available from: www.nzgbc.org.nz/main/resources/documents/sustainableRealEstate

Department of Surveys and Mapping (DSM) (2001). "Botswana National Atlas", Gaborone, DSM.

EPA, (2004). "Buildings and the Environment: A Statistical Summary" .U.S. Environmental Protection Agency Green Building Workgroup December 20, 2004.

GBCSA. Available online: http://www.gbcsa.org.za.

Hart, S.L., (1995). A Natural-resource-based view of the firm. "Academy of Management Review", 20 (4), 996-1014.

Hassan, A.S.; Laul, A.; Shah, K.; Adebayo, A.; Ebohon, O.J.; Irurah, D.K.; Rwelamila, P.D.; Agopyan, V.; Arruda, M.P.; John, V.M.; et al. (2002). Agenda 21 for Sustainable Construction in Developing Countries, WSSD ed.; CSIR Building and Construction Technology: Pretoria, South Africa.

Heerwagen, J. H., (2000). Green Buildings, Organizational Success, and Occupant Productivity. "Building Research and Information". 28 (5), 353-367.

Karolides, A. (2002). "Green Building Approaches in Green Building: Project Planning & Cost Estimating". RS Means Co Ltd; USA Pp 1 – 22.

Kayode, O and Olusegun, A.E (2013). Local Building Materials: a Tool Towards Effective Low-Income Housing in Nigeria. "Middle-East Journal of Scientific Research" 18 (4): 492-497

Kolev, M. EcoBuilding (2009). Job Creation in "Green Building Handbook for South Africa" CSIR Built Environment: Pretoria, South Africa.

Larson, Anita & Viera (1984) "Traditional Tswana Housing: A study in four villages in eastern Botswana", Stockholm, Swedish Council for Building Research.

Leaman, A., (1999). UK study links productivity to Ventilation Systems. "HPAC Magazine" 71(11), 14. Massachusetts, MA, USA.

Levine, M. D., Price, L. and Martin, N., (1996). Mitigating Options for Carbon Dioxide Emissions from Buildings: A Global Analysis. "Energy Policy" vol. 24, issues 10 and 11, pp. 937-949.

Lyamuya, P.K and Alam. K.N. (2013) "Earth Construction in Botswana: Reviving and Improving the Tradition". 20th Annual Assembly and Conference of CAA Dhaka

McGraw-Hill. (2013). "World Green Building Trends; Smart Market Report" McGraw-Hill: New York, NY, USA,

Miller, N., Spivey, J. & Florance, A., (2008). Does Green Pay Off? An online Draft paper updated from 2007. Available from: www.sandiego.edu/business/documents/Econ_of_Green

Monica, S., (2007). Commercial Green Buildings: The Business Case. "Realtors Commercial Alliance", Issue 6, Fourth Quarters,

Oliver, Paul (1969). "Shelter and Society" London, Barrie and Jenkins.

Oliver, Paul (1971). "Shelter in Africa" London, Barrie and Jenkins.

Rael Ronald (2009) "Earth Architecture" New York, Princeton Architectural Press.

Rapoport, Amos (1969). "House Form and Culture", Englewood Cliffs, Prentice-Hall.

RICS, (2010). Is sustainability reflected in Commercial Property Prices: An Analysis of the Evidence Base. "RICS Research Report". January

Robinson, J., (2005). Property valuation and analysis applied to environmentally sustainable development. In PRRES, 11th Pacific Rim Estate Society Conference 2005, Melbourne, 23-27 January 2005.

Russo, M.V. and Fouts, P.A., (1997). A resource based perspective on corporate environmental performance and profitability. "Academy of Management Journal", 40(3), 534-559.

Strawman, (2007). Encouraging Green Building Practices through the Comprehensive Plan Strawman. Outline of a Possible Approach. Presented for discussion; September 6/

Van der Merwe, C. South (2013). Africa's Built-environment Professionals begin to Embrace Green-building Practices. Available online: http://www.worldgbc.org/

Van Wyk, L. IGBC&E. (2012). A National Framework for Green buildings in South Africa. In Future Trends and Issues Impacting on the Built Environment, "Proceedings of the International Green Building Conference and Exhibition", Sandston, South Africa, 25–26 July 2012; pp. 1–8.

Wiel, S., et al., (1999). The Role of Building Energy Efficiency in Managing Atmospheric Carbon Dioxide. "Environmental Science and Policy" Vol. 1, issue 1, March, pp. 27-38.

Windapo, A.O (2014). Examination of Green Building Drivers in the South African Construction Industry: Economics versus Ecology. Open access Journal of Sustainability 9th September 2014. Basel, Switzerland. (http://creativecommons.org/licenses/by/3.0/).

Lukachko, A. and Lstiburek, J. (2008). Towards Sustainability: Green Building, Sustainability Objectives, and Building America. Whole House Systems Research "Building America Report- 0801" February, Building Science Press

Hansen, O. (2004). Green Buildings: Small Business Innovation Research, Special Solicitation Workshop (EPA March 2004).

ARE LEED® CERTIFIED BUILDINGS BETTER IN PERFORMANCE? A COMPARISON OF LEED® V. NON-LEED® CERTIFIED INSTITUTIONAL BUILDINGS

Erika Crews[1], Salman Azhar[2] and Amna Salman[3]
[1]Winter Construction, Atlanta, Georgia, USA
[2&3]McWhorter School of Building Science, Auburn University, Auburn, Alabama, USA

The US Green Building Council's (USGBC) LEED® assessment system has been a dominate name in the U.S. green/sustainable design and construction market since 2000. LEED® is a points-based system that allows buildings to receive certain levels of certification based on multiple performance categories, all of which strive to make the building operate as sustainable as possible. Though LEED® is viewed to be a successful program, its full effectiveness is still in question. The common argument is that the LEED® certification is based on projected consumptions rather than on actual data from the occupied building and therefore may not yield promised performance. The purpose of this research is to compare the performance of LEED® and Non-LEED® certified buildings of similar size and use in order to determine the validity of this argument. The study analyzed three buildings at Auburn University's main campus. The two LEED® certified buildings were the M. Miller Gorrie Center (LEED® Gold) and the Kinesiology Building (LEED® Silver). The one non-LEED® certified building being used as a baseline was the Science Center Classrooms. The main focus was on each building's energy and water consumptions. When all three buildings' performance were compared, the LEED® certified buildings did not perform the best. In some cases, there was not a significant difference between all buildings' energy and water consumptions. In addition to the energy and water consumption data, a short questionnaire was given to the buildings' residents. The questionnaire survey investigated the participant's knowledge of LEED® and determined if they were comfortable and happy with their respective buildings. Results showed that the majority of participants were very satisfied with their respective building's performance irrespective of its LEED® certification. Based on the limited data collected, this study did not find out any conclusive evidence that suggests the LEED® certified institutional buildings are better in performance and comfortness as compared to the Non-LEED® certified buildings.

[1] ejc0011@tigermail.auburn.edu
[2] salman@auburn.edu
[3] azs0072@auburn.edu

Crews, E. Azhar, S. and Salman, A (2017) Are LEED® certified buildings better in performance? A comparison of LEED® v. non-LEED® certified institutional buildings *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 287-301.

Keywords: cost, green building, human comfort, LEED®, sustainability,

INTRODUCTION

Buildings are designed for people and they need to keep people comfortable, efficient, healthy, and safe (Autodesk, 2017). The building performance of a building can be defined as its efficiency of functioning, its impact on natural environment, urban environment, and its users (Quirk, 2012). Green design seeks to create buildings that keep people comfortable while minimizing negative environmental impacts. Maintaining a person's thermal comfort means ensuring that they do not feel too hot or too cold. This means keeping the temperature, humidity, airflow and radiant sources within acceptable range (Autodesk 2017).

Throughout the world, there are several green building assessment programs that award certification to buildings and projects for implementing sustainable practices. One of the most well-known programs is the USGBC's Leadership in Energy and Environmental Design or LEED®. The LEED® is a point-based system that awards a level of certification (Certified, Silver, Gold, Platinum) based on the performance score a project receives. Within LEED®, there are five groups that a project can be categorized in to ensure that it is being scored fairly and that the correct requirements are being met. A project's team can decide if their project falls under *Building Design and Construction (BD+C)*, *Building Operations and Maintenance (O+M)*, *Interior Design and Construction (ID+C)*, *Neighborhood Development (ND)*, or *Homes* category. Once a project has been placed in the correct category, the certification process begins. There are four levels of certifications for LEED® 3.1: Certified (40-49 points), Silver (50-59 points), Gold (60-70), and Platinum (80 or more points). Despite all success that LEED® had been able to accomplish, its full effectiveness is now being questioned. One argument is that LEED® has shifted to be viewed as a "status symbol" rather than a means to better the environment. The main criticism is that the LEED® certification process is limited in scope and it only evaluates the buildings at time of completion. The performance points are awarded on the basis of projected data rather than the actual performance of the building (Quirk, 2012). Hence it is not necessary that a LEED® certified building always meet its performance expectations.

Newsham et al. (2009) analyzed energy use data from 100 LEED® certified buildings and found that on average, LEED® buildings use 18–39% less energy per floor area than their conventional counterparts. However, 28–35% of sampled LEED® buildings use more energy than their conventional counterparts. They also determined that the measured energy performance of LEED® buildings has little correlation with certification level of the building. Altomonte and Schiavon (2013) found that the occupants of LEED® certified buildings have equal satisfaction with the building overall

and with the workspace than occupants of non- LEED® buildings. Therefore, LEED® rating does not significantly affect building and workspace satisfaction. However, there are several studies that suggest that the LEED® certified buildings are more efficient and comfortable as compared to non-LEED® certified buildings (Miller et al., 2008; Navarro, 2009; Rehm and Ade, 2013). Hence it is difficult to determine which claim is correct. Moreover, most of the published research is based on the performance of commercial buildings and may not truly reflect the characteristics of other building types such as the institutional buildings.

The aim of this research is to analyze and compare the performance of LEED® versus Non-LEED® certified institutional buildings to determine if LEED® certified buildings are better in performance and human comfort. The specific objectives of this study are:

1. to analyze the LEED® buildings' actual performance to determine if they meet their designed performance;
2. to determine if the users of the building are satisfied with the building's performance and comfortness.

The scope of this research is limited to two LEED® certified and one non-LEED® certified building located at the Auburn University's campus. The building's water and energy consumption, along with users' living experience in the building, are evaluated. These buildings are: (1) M. Miller Gorrie Center — LEED® Gold; awarded 2008; (2) Kinesiology Building — LEED® Silver; awarded in 2013; and (3) Science Center Classroom — Non-LEED® certified Building completed in 2005. The results of this research will help university administrators to decide if they should invest in LEED® certified buildings.

LITERATURE REVIEW

Within the last couple of years, the ideology and need for more sustainable practices have become a heavily debated topic. This is especially important for the construction industry, due to the fact that it is one of the most energy intensive industries in today's society. Within the construction industry, programs such as LEED® (US), BREEAM (UK), Green Mark (Singapore), Green Globes (US, Canada) and others have assisted in introducing the concept of green building to the rest of the world (Clevenger *et al.*, 2012). The biggest name in green building assessment is LEED®. Since its founding in 2000, LEED® has steadily gained popularity. However, this increase in popularity and prestige came with an increase in certification flaws and shortcomings being identified by the public. When an owner makes the decision that they would like to build a sustainable building and aim to achieve a certain LEED® certification, the building's systems are then designed to meet the desired performance levels. Since LEED® certification is typically awarded once the building is completely constructed, the building is evaluated on the estimated performance data rather than the factual data to determine the number of points it should receive (Newsham, Mancini, & Birt, 2009).

In 2014, the USGBC asked the New Buildings Institute (NBI) to perform an energy study on 121 new buildings that had been awarded LEED® certification. The results were not promising. "…25% of the investigated buildings used more energy than predicted…" (Hua et al., 2014). Furthermore, 100 of the original 121 buildings were analyzed again with the conclusion that, "…28%-35% of LEED® buildings used more energy than their conventional counterparts" (ibid, 2014).

Torcellini et al. (2004) investigated six sustainable buildings in the USA. Extensive monitoring of energy flows, including lighting loads, HVAC loads and plug loads, was undertaken for a period of one year. Analysis showed that "all buildings performed worse than predicted, but all managed a substantial saving compared to a comparable code-compliant building. They concluded that the designers were optimistic about the behavior of the occupants and their acceptance of systems."

Turner (2016) evaluated 11 buildings in the Cascadia Region, USA. The author compared the actual utility usage to three different metrics: design energy use, energy use compared to code-compliant baseline, and the average energy use of the commercial building stock. The conclusions are as follows: "All buildings performed better than their baseline, six of the buildings performed better than their design energy use, and all but two performed better than the average commercial building stock. The authors noted that actual operational variables may have differed from those assumed in the baseline models, and that operational optimization was still underway in some buildings."

Diamond et al. (2006) investigated 21 LEED-certified buildings. Actual energy use was determined from utility billing data. The modelled energy data for the as-designed and baseline building was obtained from the LEED certification documentation submitted to the USGBC. They found that "on average, for the 18 buildings that had both simulated whole building design and actual energy use data, energy use was 1% lower than modelling predictions (which were 27% below baseline). However, there was large variability (standard deviation, s.d. 46%), and some performed better than predicted while others performed worse."

Fowler and Rauch (2008) analyzed performance data for 12 US federal government commercial buildings, all of these buildings had been designed with energy efficiency goals, and some were LEED® certified. All buildings had measured energy use below their modelled baselines, and energy use per floor area was 25–30% lower, on average, than the US commercial building stock. Baylon and Storm (2008) examined the characteristics of LEED® commercial buildings in the US Pacific Northwest, and compared them to regional non-LEED buildings. The mean energy use per floor area for the 12 LEED buildings was 10% lower than the 39 similar non-LEED buildings in the same region. This relatively small improvement was attributed to the relatively high prevailing energy standards for all buildings in the region.

Whenever LEED® is considered for a project, the topic of associated cost is always a big decision factor. The main question is if the additional certification cost will be able to be balanced with the savings that will take place once the building is operational. A study performed in 2011, looked at three LEED® Platinum buildings. Based on the results, the researcher concluded that the nicer and higher LEED® certification the building has, the better the savings. They concluded that "LEED® upholds its reputation of being an energy efficient, green building certification process" (Lee, 2011).

A much underutilized tool to measure the performance of buildings is Post-Occupancy Evaluations (POE). These evaluations, when used, are conducted once the building has been occupied and operational for one to two years. A POE that is complete, "…includes hard data, like a review of energy and water consumption patterns, and measures occupants' self-reported satisfaction with their space…" (Post-Occupancy Evaluations: Ignorance Isn't Bliss," 2013). A Post-Occupancy Evaluation study was conducted for eleven commercial buildings in the Cascadia Region of USA that yielded these results (Turner, 2006):

1. A large number of the buildings were performing efficiently when compared to conventional commercial buildings.
2. The median Energy Use Intensity (EUI) was 50kBtu per square foot.
3. Over twenty-five years, the mean present value of savings was $2 per square foot.

The use of POEs and the data they provide are anticipated to increase in the coming years, though there will have to be some modifications to the current POE. Azar and Menassa (2015) analyzed why modern POEs are sometimes difficult to conduct. One reason is that there is not a standardized way of performing these evaluations, nor is there a standardized way to analyze the data they produce. It was also determined that POEs failed to capture one major factor that contributes to whether or not a building is performing per its design - the human factor. To assist in constructing a possible framework for future POEs that will include human impacts, a case study was used. The proposed framework was used on a biochemistry laboratory space in Madison, Wisconsin. Data was obtained from the Building Automation System (BAS) and included energy consumption and occupancy information provided by the twelve occupancy sensors in the building. Once the data concerning occupancy was converted into format that can be used along with energy consumption data, the two data sets were compared. The results showed that the building's efficient HVAC system was not operating as intended, while the efficient lighting system was operating as designed. The findings further confirm that humans have a large impact on the ultimate efficiency of a building (Azar and Menassa, 2015).

Huizenga et al. (2015) compared 16 LEED® rated and 9 self-nominated 'green' buildings to examine occupants' level of comfortness. The study did not find a clear relationship between LEED® credits and occupant satisfaction. They suggested that LEED® certification may not guarantee a

better perception of indoor environmental quality by its occupants. On the contrary, Abbaszadeh et al. (2016) analyzed 33,285 responses from 181 buildings, of which 15 had been certified by LEED® and 6 had been indicated by their designer/owner as designed or operated in a sustainable way. The results revealed that, on average, occupants of green buildings showed statistically significant higher satisfaction.

Since LEED® has come under scrutiny dealing with if the buildings that it awards certification to are in fact sustainable buildings, some viewed it as an opportunity to take legal action. On October 8, 2010, Henry Gifford, a mechanical systems designer, and his lawyer filed a class action suit claiming, "…that the USGBC is fraudulently misleading consumers and fraudulently misrepresenting energy performance of buildings certified under its LEED® rating systems, and that LEED® is harming the environment by leading consumers away from using proven energy-saving strategies" (Roberts, 2010). Gifford was basing most of his argument on a study conducted by New Buildings Institute (NBI) and USGBC in 2008, which he re-analyzed and made his own conclusions. While the NBI stated that LEED® buildings are typically 25-30% more efficient, Gifford stated that LEED® buildings are 29% less efficient. Based on his conclusions, he demanded that USGBC pay $100 million in "…compensation to victims, in addition to legal fees" (Roberts, 2010). Gifford said he had been personally harmed by LEED® because people who want to get certification will not hire him due to the fact that he is not a LEED® Accredited Professional (AP). Just one year later in the fall of 2011, Henry Gifford's case was dismissed. Gifford's case began to fail when the claim of false advertisement could not be proven using the two tests under the Latham Act; The Strong Categorical Test and The Reasonable Commercial Interest Test. The Court dismissed the claims "with prejudice". This means that no one can bring forth a case with similar claims against the USGBC. After the verdict was given, CEO of USGBC Rick Fedrizzi said, "This successful outcome is a testament to our process and to our commitment to so what is right," (Alter, 2011). Fedrizzi further stated, "Thousands of people around the world use LEED® because it's a proven tool for achieving our mission of transforming the built environment. We're grateful that the Court found in our favor so we can give our full attention to the important work before us," (Alter, 2011).

The review of published literature provided conflicting evidence on the performance and comfortness of LEED® certified buildings versus non-LEED® certified buildings. In some cases, the LEED® certified buildings performed better and in others their performance was either equal or inferior to the non-LEED® certified buildings. Up to some extent, this difference is due to the means and methods used for data collection, types, and use of the buildings. It is important to note that most of the buildings in these studies were either commercial or mixed-use buildings. No research study has been found that compared the performance of LEED® v. non-LEED® institutional or academic buildings. This motivated us to conduct this research in an effort to determine if the LEED® certified institutional

buildings are superior and should the universities invest funds in constructing such buildings.

RESEARCH DESIGN AND METHODOLOGY

This study employed mixed-methods research design. The detailed methodology is as follows:

i. The preliminary data was collected through an extensive review of the existing literature concerning this particular topic. The literature review was continued throughout the study to ensure that it was up to date.

ii. Working with Auburn University Facilities Management division, the energy and water consumption data for the selected buildings was gathered. This (quantitative) data was then compared to the initial performance evaluation sheets that were submitted for LEED® certification of the individual building.

iii. A comparison of the two LEED® and one non-LEED® certified building was conducted to determine if there was a substantial difference in the actual energy and water consumptions versus the designed energy and water consumptions. Since the research scope was limited to academic buildings at the campus of Auburn University, there were only three buildings that were found to have almost equal size and intended use and can be easily compared. Hence only these three buildings were used for data collection.

iv. For qualitative data, a short questionnaire was sent to buildings' occupants. The purpose of this questionnaire was to gain a better understanding of the end users perceptions of their respective LEED® or non-LEED® certified building. The survey was randomly distributed to students, professors, and staff using the three buildings. All participants were of legal age (19 years of age or older in the state of Alabama). The target was to deliver the questionnaires to at least 100 occupants. A goal of minimum of 50 responses was set for drawing the reliable conclusions. All questionnaires had a cover letter to inform the participant about its purpose. The participation was optional. The initial contact was made with professors that have classes in the specific buildings. The professors were then asked which form of the survey (electronic or paper) would be best for their class and if an in-person presentation was needed to describe the purpose of the survey to the class (5-10 minutes of class time). The survey consisted of 14 questions. The questions collected background information of the respondent, his/her knowledge about LEED®, and level of satisfaction about building's performance and comfort.

DATA COLLECTION PROCESS

For this study, three buildings at Auburn University's main campus were selected. Information documenting each building's energy and water consumption was collected from Auburn University's Facilities Management division. The three buildings that were selected to be part of this study are as follows:

M. Miller Gorrie Center

The M. Miller Gorrie Center, commonly referred to as the Gorrie Center, was completed in 2008. It is part of the College of Architecture, Design, and Construction (CADC) and houses the McWhorter of Building Science. The project architect was Dan Fritts of CMH Architects and the general contractor was Brasfield & Gorrie Inc. The building is 37,278 square feet and is LEED® Gold certified. The Gorrie Center was the first building in the state of Alabama to receive the LEED® Gold status. It is an AIA Merit Award Winner and is designed to use 40% less electricity, 48% less chilled water for the building's HVAC system, and 27% less domestic water when compared to other buildings on campus with similar size and use (Crews, 2015).

Kinesiology Building

The Kinesiology Building was completed in 2013. It is part of the College of Education and houses the Department of Kinesiology. It mainly consists of laboratories and offices and has recently been declared an Official U.S Training Site for the U.S Handball Team. The building was designed by Infinity Architecture and the general contractor was Robins and Morton. The building is 33,556 square feet and awarded LEED® Silver Certification ("Auburn University School of Kinesiology," n.d.).

Science Center Classrooms

The Science Center Classrooms were completed in fall of 2005. It is part of the College of Sciences and Mathematics and houses Biological Sciences, Chemistry, and Biochemistry programs. Its construction was part of a three-phase construction project in which Sanders Hall was demolished and three new buildings were built which are: the Science Center Laboratory, the Science Center Classrooms, and the Science Center Auditorium. The architect for the project was Gresham, Smith, and Partners. The building was constructed using a multi-prime process where there were multiple contracts directly with the subcontractors. These contracts were then managed by a Construction Manager (CM). The CM was Robins and Morton. The Science Center Classrooms is 34,242 square feet and is the only building in this study that is not LEED® certified and is being used as a control/baseline building ("Auburn University Science Laboratory Center," n.d.).

Collected Data

Auburn University's Facility Management division provided the following 3-years data (2013-2015) for each building: Electricity usage (kWh),

Electricity cost, Electric usage (MMBTU), Chilled water usage (MMBTU), Chilled water cost, Hot water usage (MMBTU), Hot water cost, Domestic water usage (gallons), and Domestic water cost. Once the whole data was analyzed, a meeting with an energy analysis expert of the Auburn University was held to make sure that all information is correctly understood. The meeting provided the following information:

- The chilled water and hot water numbers were to be considered for energy usage and not for water usage. This water is used to regulate the HVAC systems in each building.
- Domestic water usage only encompasses the water used for toilets and sinks.
- Due to the fact that the Kinesiology Building was gradually occupied, the data for 2013 is slightly. Therefore, when the buildings are compared, some data from 2013 is not used to avoid outliers.

The data for each building is analyzed as follows: Electric Usage in kilowatt hours (kWh), Electric Usage in million metric British thermal unit (MMBTU), Chilled Water Usage in MMBTU, Hot Water Usage in MMBTU, Total Power Usage in MMBTU, and Domestic Water Usage in Gallons (Gal).

DATA ANALYSIS AND RESULTS

Due to the slightly different size and use of the buildings, the collected data is analyzed to compare the cost per square foot and usage per square foot of each building. The results are shown in Tables 1 and 2. Table 1 shows the average cost of each utility per square foot of the building while Table 2 shows the average usage per square feet of each building. This data indicated that the performance of Science Center Classrooms is the best followed by the Gorrie Center and the Kinesiology building.

Table 1: Utilities Cost per Square Foot of Facility

	Science Center Classrooms (Non-LEED®)	Kinesiology Building (LEED® Silver)	M. Miller Gorrie Center (LEED® Gold)
Electric (kWh)	$1.13	$2.66	$1.61
Chilled Water (MMBTU)	$2.84	$5.02	$5.27
Hot Water (MMBTU)	$5.58	$6.24	$3.52
Domestic Water (Gal)	$140.30	$133.08	$122.92

Table 2: Usage Per Square Foot of Facility

	Science Center Classrooms (Non-LEED®)	Kinesiology Building (LEED® Silver)	M. Miller Gorrie Center (LEED® Gold)
Electric (kWh)	6.899	10.985	9.090
Total Energy (MMBTU)	0.062	0.214	0.120
Domestic Water (Gal)	2.826	2.289	2.495

Figures 1-3 show the average usage of Electricity, Energy, and Water for the three buildings.

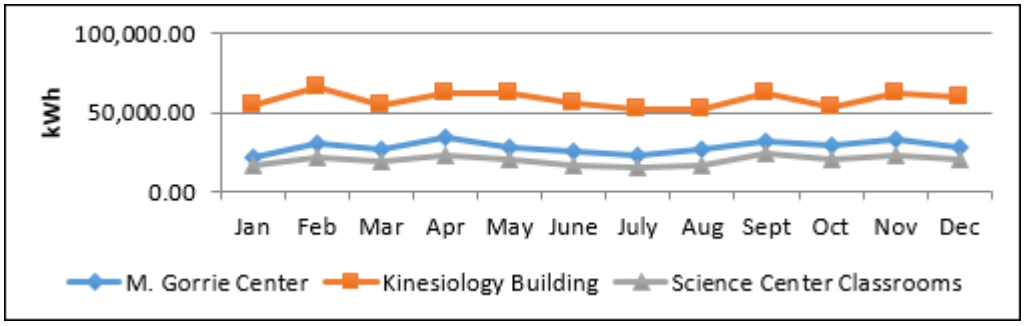


Figure 1: Average Annual Electricity Usage of Each Building (kWh)

Based on the average annual electricity use for the three buildings, the Science Center Classrooms (the only non-LEED building in this study) uses the least amount of electricity when compared to the two LEED® certified buildings. The average annual electricity use for three buildings indicates that between the months of May to August, the buildings seem to consistently use less electricity. One reason for this is that there are not many users during this time of the year because many students take the summer off. The biggest increase is between August and September, possibly due to the beginning of the fall semester.

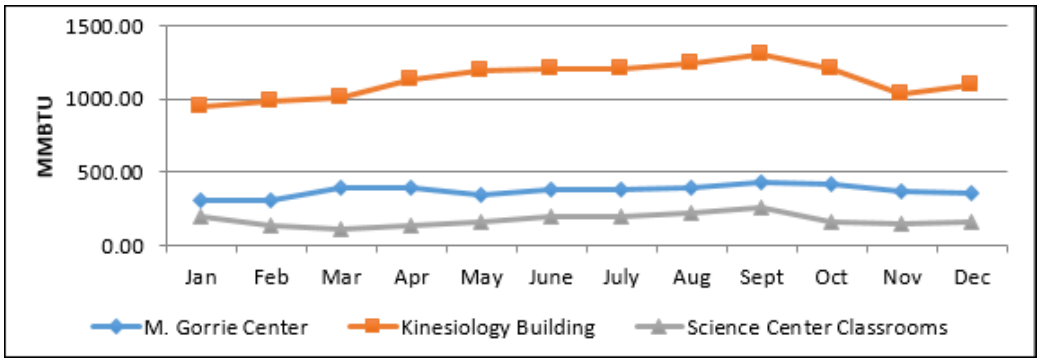


Figure 2: Average Annual Energy Usage of Each Building (MMBTU)

The energy usage data includes sum of the electric, chilled water, and hot water usage for heating and cooling. It is measured in MMBTUs for best comparison. Once again, the non-LEED® certified building is found to use less energy than the two LEED® certified buildings, though the gap between the Science Center Classrooms and the Gorrie Center is small. For Gorrie Center, the energy use is fairly consistent throughout the year with the largest difference occurring between February and March. For Kinesiology Building, the energy use is also fairly consistent throughout the year with a slight increase in April and then again in September. There is a large decrease in energy use between September and November. For Science Center Classrooms, the energy use is fairly consistent throughout the year with a slight increase in April and then again in September. There is a large decrease in energy use between September and November due to mild weather.

Figure 3 shows the average annual water usage of each building. The domestic water usage, which accounts for water used in the toilets and sinks, is very close for all three buildings. The Kinesiology Building experienced a drastic increase during the middle of the year, which possible means that there was a leak of some sort (which was later confirmed by the facilities division). Despite the decrease in number of students on campus during the summer semesters, there is not a significant decrease in water consumption. In Gorrie Center, there is a large increase from January to February and a large decrease from November to December. The difference between the first and end of the year is 1,500 Gal. In Kinesiology building, there is an increase in water usage during the summer semester. The rest of the year is fairly consistent. The difference between the first and end of the year is 2,000 Gal. In Science Center Classrooms, there is a large increase between January and February. The summer semester is consistent, possibly due to the decreased occupancy. A significant increase occurs between August and September. The difference between the first and end of the year is 3,500 Gal.

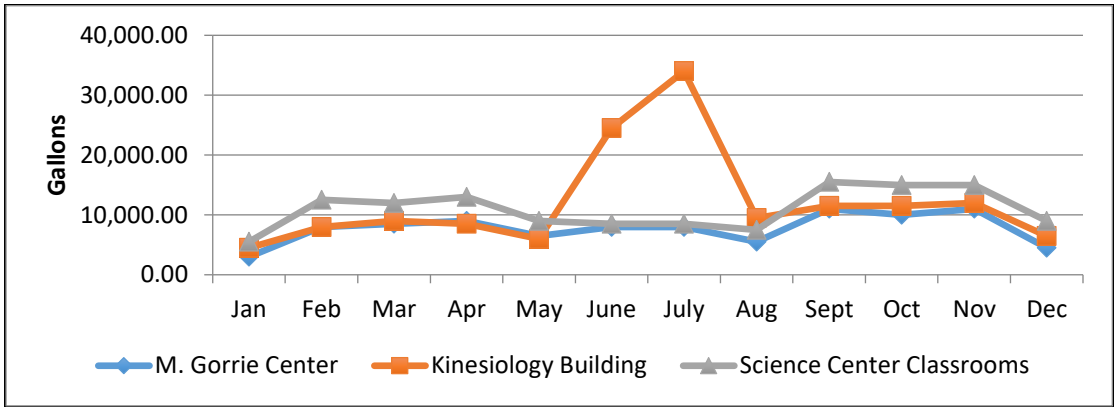


Figure 3: Average Annual Water Usage of Each Building (Gallons)

Results of questionnaire survey

A short 14 question survey was administered to gain a better understanding of people's knowledge of LEED® and to determine if a green building is something important to them. It was sent to 100 people and a total of 74 valid responses were received. It was determined that the data collected showed a 95% confidence level with a confidence interval of ±5.84. The main findings of the survey are as follows: On average, the participants spent 31 or more hours per week in their respective buildings. Almost all of the participants are comfortable in the buildings and generally enjoy using the building on a day-to-day basis.

They reported no particular difference in the comfort level among LEED® and non-LEED® certified buildings used in this research. When asked if participants had any previous knowledge of LEED®, the majority had never heard of LEED®. The few that had, were asked to summarize what they knew about the LEED® certification program. The common answer was that they had very basic knowledge about it but knew that it helps to design an energy-efficient building. An overwhelming number of participants considered sustainable living to be important, though not as many

considered working in a LEED® building as being important. Some important questionnaire survey results are shown in Figures 4 and 5.

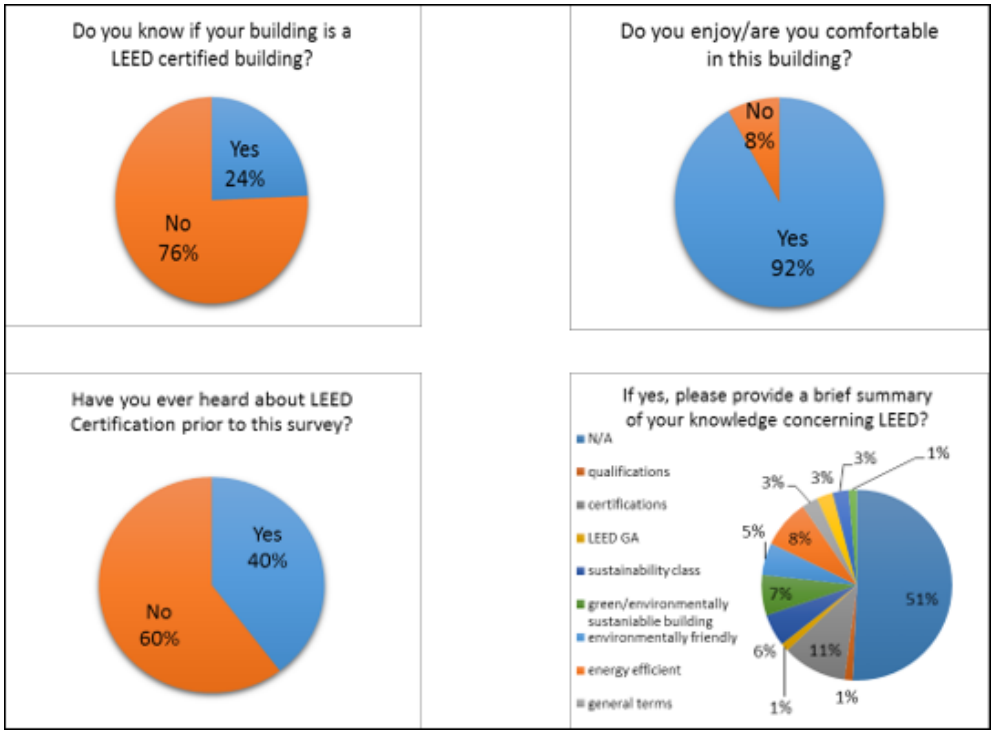


Figure 4: Survey Participant's Knowledge about the LEED® Certification System

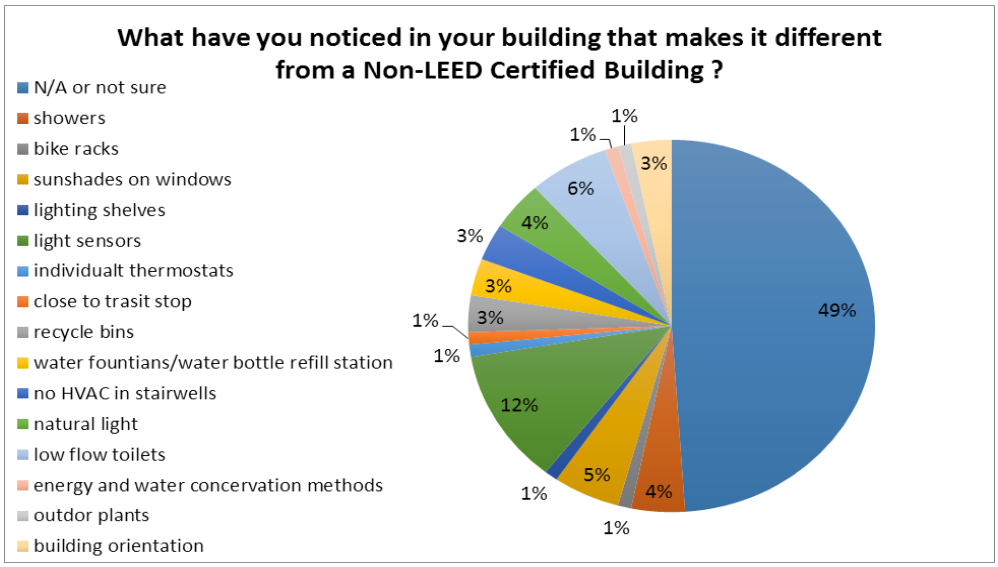


Figure 5: Survey Participant's Knowledge about Their Building

DISCUSSION

Based on our research results, it must be noted that just because a building has earned LEED® certification, does not necessarily mean that it is energy efficient. In our study, the non-LEED® certified building performance is even better than the LEED® certified buildings. For example, in terms of electricity and energy usage, the Science Center Classrooms, the only non-

LEED® building in this study, uses the least amount of electricity when compared to the two LEED® certified buildings. For domestic water usage, which accounts for water used in the toilets and sinks, all three buildings are close. The collected data also demonstrates the impact a building's occupants can have on its efficiency. We found that Post-Occupancy Evaluations (POEs) are very important to fully understand a building's performance and its occupants' reactions. The questionnaire survey results showed that the participants spend anywhere from two hours to thirty plus hours in the buildings. These people need to feel comfortable in the building so that they may be more productive. A building should be built with the future occupants in mind and it should meet the needs of the users. In our survey, 85 percent participants viewed sustainability as being important to them. Despite the large number of people who think about sustainability, only 71 percent of them thought that working in an environmentally friendly building is important.

This research study has some limitations, for example: (1) The data is collected from 3 buildings only and hence cannot be generalized; (2) the level of human comfort is not measured quantitatively and reported results are based on participant's perceptions only; and (3) the building's performance is measured in terms of their energy and water consumption only. Other parameters that can impact building's economic and environmental performance are not included in this study due to time limitations.

CONCLUSIONS AND RECOMMENDATIONS

The main conclusions of this research study are as follows:

1. The actual performance of a building is significantly dependent on its green design features. A non-LEED® building can perform better (as found in our study) if the designer has streamlined the design to make it more energy and water efficient. Hence the non-LEED® certified buildings may perform same or better than the LEED® certified buildings. In our study, the performance of all three buildings was more or less similar.
2. The level of human comfortness in a particular building is not influenced by its LEED® rating. Both LEED® certified and non-LEED® certified buildings can provide same the level of comfortness. In our study, occupants of all three buildings were found to be equally satisfied.

The above conclusions are based on the limited data collected in this research and hence should not be generalized. However, they do provide a good foundation for conducting further research into this topic to draw a conclusive evidence.

The following are our recommendations:

1. An extensive POE should be performed on all buildings every five years to ensure their performance levels are coherent with their design.

2. Auburn University Facilities management division should continue to monitor all LEED® certified buildings to ensure that they are operating as their intended design.
3. LEED® must continue to change and adapt to remain competitive in an ever-growing market for green/sustainable certification programs. The USGBC needs to learn from past projects and user feedback to ensure they are presenting the best possible product.

REFERENCES

Abbaszadeh S, Zagreus L, Lehrer D, Huizenga C. (2016). Occupant satisfaction with indoor environmental quality in green buildings. Proceedings of Healthy Buildings, 365-70.

Altomonte,S. and Schiavon, S. (2013). Occupant Satisfaction in LEED and Non-LEED Certified Buildings. Building and Environment, 68, 66-76.

Alter, L. (2011, August 17). Henry Gifford's $100M LEED® Lawsuit Dismissed "With Prejudice." Retrieved September 26, 2015, from http://www.treehugger.com/sustainable-product-design/henry-giffords-100m-LEED®-lawsuit-dismissed-with-prejudice.html.

Auburn University School of Kinesiology. (n.d.). Retrieved November 17, 2015, from http://www.robinsmorton.com/projects/auburn-university-kinesiology/

Auburn University Science Laboratory Center. (n.d.). Retrieved November 22, 2015, from http://www.robinsmorton.com/projects/auburn-university-science-laboratory-center/

Autodesk, Inc. (2017). Green Building Goals and Process. Retrieved from https://sustainabilityworkshop.autodesk.com/buildings/occupant-comfort

Azar, E., & Menassa, C. C. (2015). Optimizing the Performance of Energy-Intensive Commercial Buildings: Occupancy-Focused Data Collection and Analysis Approach. Journal of Computing in Civil Engineering, 0(0), C4015002. http://doi.org/10.1061/(ASCE)CP.1943-5487.0000521

Baylon, D. and Storm, P. (2008). Comparison of commercial LEED buildings and non-LEED buildings within the 2002-2004 Pacific Northwest commercial building stock. ACEEE Summer Study on Energy Efficiency of Buildings, American Council for an Energy-Efficient Economy (Washington DC, USA), 4-1–4-12

Clevenger, C. M., Nobe, M. C., & Marley, J. (2012). Utilization of Post-Occupancy Evaluations in LEED® Certified K-12 Schools. In ICSDEC 2012 (pp. 862–868). American Society of Civil Engineers. Retrieved from http://ascelibrary.org/doi/abs/10.1061/9780784412688.103

Crews, E. (2015). "Is LEED Relevant? A Study LEED Buildings Consumption", Unpublished Capstone, McWhorter School of Building Science, Auburn University, Auburn, AL.

Diamond, R., Opitz, M., Hicks,T., Vonneida, B., Herrera, S. (2006). Evaluating the energy performance of the first generation of LEED-certified commercial buildings. ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy-Efficient Economy (Washington DC, USA) 3-41–3-52.

Fowler, K.M., and Rauch, E.M. (2008). Assessing green building performance: a post occupancy evaluation of 12 GSA Buildings, Pacific Northwest National Laboratory Report number PNNL-17393.

Hua, Y., Göçer, Ö., & Göçer, K. (2014). "Spatial mapping of occupant satisfaction and indoor environment quality in a LEED® platinum campus building". Building and Environment, 79, 124–137. http://doi.org/10.1016/j.buildenv.2014.04.029

Huizenga C, Zagreus L, Abbaszadeh S, Lehrer D, Goins J, Hoe L (2015). LEED post-occupancy evaluation: taking responsibility for the occupants. Proceedings of green build conference.

Lee, D. (2011). LEED®: Sufficient for National Policy? University of California, San Diego.

Miller, N., Spivey, J., and Florance, A. (2008). Does Green Pay Off? Journal of Real Estate Portfolio Management, 14(4), 385–400.

Navarro, M. (2009). Some buildings not living up to green label. New York Times, 30. Retrieved from http://isites.harvard.edu/fs/docs/icb.topic1043659.files/11-4%20Some%20Buildings%20Not%20Living%20Up%20to%20Green%20Label%20-%20NYTimes.pdf

Newsham, G. R., Mancini, S., & Birt, B. J. (2009). "Do LEED®-certified buildings save energy? Yes, but….", Energy and Buildings, 41(8), 897–905. http://doi.org/10.1016/j.enbuild.2009.03.014

Post-Occupancy Evaluations: Ignorance Isn't Bliss. (2013). Environmental Building News, 22(6), 19.

Quirk, V. (2012, April 23). Where is LEED® Leading Us?…And Should We Follow? Retrieved December 4, 2014, from http://www.archdaily.com/227934/where-is-LEED®-leading-us-and-should-we-follow/

Rehm, M., and Ade, R. (2013). Construction costs comparison between "green" and conventional office buildings. Building Research & Information, 41(2), 198–208. http://doi.org/10.1080/09613218.2013.769145

Roberts, T. (2010, October 14). USGBC, LEED® Targeted by Class-Action Suit - BuildingGreen. Retrieved December 2, 2014, from http://www2.buildinggreen.com.spot.lib.auburn.edu/article/usgbc-LEED®-targeted-class-action-suit-0

Torcellini, P.A., Deru, M., Griffith, B., Long, N., Pless, S. and Judkoff, R. (2004). Lessons learned from the field evaluation of six high-performance buildings. ACEEE Summer Study on Energy Efficiency of Buildings, American Council for an Energy-Efficient Economy (Washington DC, USA), 3-325–3-337.

Turner, C. (2016). LEED building performance in the Cascadia Region: a post occupancy evaluation report. Retrieved from http://www.usgbc.org/chapters/cascadia/docs/pdf/POE_REPORT_2016.pdf).

ASCERTAINING THE IMPORTANCE OF PROJECT TEAM PERFORMANCE TO CONSTRUCTION PROJECT SUCCESS

Godfred Fobiri [1], Sarfo Mensah [2] and Ayirebi Dansoh [3]

[1,2]*Department of Building Technology, Faculty of Built and Natural Environment, Kumasi Technical University, Kumasi, Ghana*

[3]*Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*

Traditionally, a construction project is said to be successful when it meets the project objectives of time, cost and quality. Creation of a very effective project team is necessary for achieving successful project outcomes. The objectives of this study are to 1) find out important project team performance measurement criteria; and 2) ascertain the importance of project team performance to project success. Seven (7) main factors constituting project team performance measurement criteria were identified. Using survey approach, 70 questionnaires were distributed to project team members on newly completed and ongoing construction projects selected via purposive sampling method. Data collected were analyzed using the Relative Importance Indices (RII) technique. To ascertain the importance of the identified project performance to project success, a newly completed 5-storey hostel was selected a case study. The study revealed that performance of an individual project team member is very important to the overall performance of a project team. Consequently, there was an indication that improvement in project team performance improves overall project success. The relevance of project team performance to the overall project success has been verified empirically in this study. Attention has been drawn to the need for establishing a project monitoring system that evaluates individual project team member's performance as well as overall team performance in order to secure construction project success from the beginning to the end.

Keywords: case study, construction project success, project team performance, relative importance indices

BACKGROUND

There is no doubt that the construction industry plays an important role in economic development of any country. The Ghanaian construction industry

[1] Godfred.fobiri@yahoo.com
[2] sarfmenghana@gmail.com
[3] adansoh@yahoo.com

Fobiri, G., Mensah, S. and Dansoh, A. (2017) Ascertaining the importance of project team performance to construction project success *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 302-313.

contributes about 8.5 % to the total Gross Domestic Product (GDP) while employing 2.3% of Ghanaians (Ankomah, et al., 2010). Due to the complex nature of the construction industry, a great number of stakeholders are involved (Navon, 2005). Every project is unique on its own therefore new construction teams are formed for almost every new project. Burma (2014), affirm that team building is a very vital element of every industry and necessary for meeting today's global competitive demands and achieving customer expectations. The Ghanaian construction industry is not exempted from meeting global competitive demands. What characterizes a good project team is its ability to create good working relations and possibly achieve better outcomes, while disputes within teams are reduced (Demkin, 2008). Project teams are often confronted with problems such as absence of association, confusions, poor communications, and insufficient involvement from team members, which, tend to affect the performance of the project (Egan, 2002). For this reason, it is vital for project team leaders to find answers to questions that confront team members' integration, which is an essential element for success of a construction project.

Sound measurement of team performance is required for improving productivity, quality, health and safety, and team attitude across the whole construction process (Azmy, 2012). It is therefore important for project team performance variables to be developed to enhance the assessment and evaluation processes of Ghanaian construction projects to determine the level of influence of the project team members on the success of a project. The project team has an important role to play to ensure that project outcome is acceptable and the owner gets value for money spent (Kheni, 2010). Therefore, the aim of this study is to measure the influence of project team performance on project success by exploring project team performance measurement variables using a case study.

CONSTRUCTION PROJECT TEAM: COMPOSITION AND FORMATION

A project team works together collaboratively by sharing of knowledge and experience to ensure projects meet their objectives. Management of construction projects require quite diverse professional skills, knowledge and capability to work together with others in a team for the success of the project (Azmy, 2012). But, it is important to note that the construction project team comprises of individual professionals with varied experiences; each possessing a distinctive set of desires he/she aspires to attain in the delivery of the project. Moreover, construction teams and teamwork have been influenced by exceptional and diverse features in the industry. Thus, numerous obstructions and challenges against construction teamwork, including mistrust and disrespect, amongst the project members and also expert competition, which must be solved at all cost towards the development and maintenance of teamwork, exist across all the processes of project (Uher and Loosemore, 2004). Globally, these challenges have been identified to cause lack of corporation, misunderstandings, poor communications, disputes, conflicts, etc., in the project team's work.

Nawi et. al., (2014) indicated that failure of project team members to work collaboratively is one the causes of poor performance of the construction industry. Due to the crucial role construction industry plays in developing countries' economies, performance improvement of project teams ought to be the priority of industry practitioners and governments (Yimam, 2011). In view of the complexity of construction business operations, there is the need for construction firms to form and maintain an effective team, more importantly than having just an individual handling all or lots of functions on a construction project.

WIDENING PROJECT PERFORMANCE MEASUREMENT CRITERIA

Project performance measurement is widely based on three traditional criteria in literature. These include; project schedule, project cost and project quality (Atkinson, 1999; Hatush and Skitmore, 1997; Belassi and Tukel, 1996). The three indicators of performance are also referred to as the tangible construction project aspects (Riggs et al., 1992; Freeman and Beale, 1992). Further, there are additional important aspects that should be added to the three listed tangible performance measures. It has been suggested that soft measures should be included in the performance measures (Ashley et al., 1987; Pinto and Pinto, 1991). Examples of soft or non-tangible measures are: team members' performance and customer (project owner) satisfaction. Other soft measures include, safety and health, user anticipation, functionality and environmental performance (Chan and Tam, 2000). Moreover, another aspect identified in literature to be of great essence in performance measurement of project teams is construction change management (Construction User Roundtable, 2005). The manner in which teams deal with variation orders, services linked to changes and cost monitoring, quality and schedules related to changes are critical to the project success.

MEASURING TANGIBLE PROJECT PERFORMANCE CRITERIA (COST, DURATION AND QUALITY)

Project cost is a commonly used performance measurement criterion in the construction industry. Project teams are continually looking for ways and means by which a construction project could be completed within a specified budget to prevent having financial challenges against the client. The construction project team's ability to manage project within the budgeted cost is limited by cumbersome processes and uncertainties, which normally trigger variations to the project cost. Cost performance is related to the extent to which overall circumstances enhance the accomplishing of project tasks within budget estimates (Koelmans, 2004). Cost performance is mostly measured based on the cost variance between the budgeted cost and actual completion cost of a construction project.

Project duration or schedule is consistently considered as one of the conventional measures for determining project performance. Some project

owners and stakeholders perceive project duration to be the preeminent criterion for project success measurement (Svejvig and Andersen 2014). If a project fails to finish up within the predetermined time schedule for the project, it implies that it did not run as smoothly as expected. The construction project duration could be described as timeframe from the project inception to the completion and closing of project that is from preconstruction stage to post construction stage (Azmy, 2012). This is usually measured by considering the actual time used for completing the project as against the planned time.

The element of quality is key in all of construction activities. Quality acts as an assurance that the project attains the highest of standards the owner experts. Quality in the construction industry is described as the entirety of characteristics essential by a service or product to reach the satisfaction of a given need, and also the fitness of product for purpose (Al-Ibrahim (2014). Even though quality measurement is considered by others as subjective, it has been suggested that meeting technical requirement is one of the quality elements (McCorry et al., 2000). This also leads to the need to meet the element functionality of a facility delivered under a particular construction project (Chan and Ho, 2001). Therefore, the quality requirements of technicalities and functionality dilute subjective nature of the quality criterion, making it a tangible criterion to some extent. The concentration of this research however on the soft project performance criteria.

PROJECT TEAM AND SOFT CRITERIA FOR MEASURING PROJECT SUCCESS

Contrary to the tangible forms of project criteria, measuring the soft criteria is more complex and more subjective. Satisfaction is viewed as one of the subjective attributes of project success (Svejvig and Andersen, 2014). This element is a non-tangible aspect of construction project performance. It is vital for the client to be satisfied with the commissioned project and even with the construction processes, as this serves as an indicator of the performance of the project team. The ability of the project team to complete a project to the satisfaction of the project owner does contribute to the overall project success. This also enhances the project relationship and gives the project team a good reputation in the long term.

The ability to manage change successfully on a particular project is also necessary for achieving project success. Change has been found to be inevitable in most construction projects and sometimes very desirable to bring project to desired effect. The effect of variations associated with construction projects may come in any form; changed project information, changed communication, rearranged work methods, accelerated measures, intermittent cash flows, protracted costs and time, decrease in workers' morale and increase in waste (Senaratne and Sexton, 2011). Hence, the effective application of project change management practices could contribute to how well the team performed. It is required of the project team to adopt an effective change management system that properly coordinates

all aspects of the project leading to success. All differences from specifications and contract drawings must be noticed and well noted for project authorization and management and technical endorsement. Also, Azmy (2012) argues that change orders should cover other aspects, including quality, safety and schedule consideration as well as the impact of change on cost. This makes measurement of this soft criterion complex.

The concern for health and safety in the industry has also soared high in importance, and therefore, cannot be ignored. The emphasis of health and safety on construction sites is usually found during construction stage where greater percentage of all accidents occurs. It has been defined that health and safety refers to the extent to which general conditions enhance the accomplishment of project task in the absence of major injuries or accidents (Bubshait and Almohawis, 1994). Safety is usually analyzed by the extent and number of accidents and events on construction sites. If a project gained zero accidents, it is considered to have performed well on safety management practices. Also, keeping proper safety records documentation could contribute to project success. The element of health or wellbeing of workers is also important. It is difficult to measure the extent to which construction projects impair the health of worker. Nonetheless, the role of the project team is critical in ensuring satisfactory health and safety conditions during construction activities (Cantu, 2007).

THE PROJECT TEAM PERFORMANCE CRITERION

The focus of this paper is on the soft project measurement criterion of project team performance. In line with this, project team members' performance becomes a major issue to consider in determining the project outcome. The quality of project depends largely: on the knowledge, skills and experience of team leader; managerial system (making decisions, setting up objective specific to the project, approving the correct strategy, selecting the right people, delegating duties to subordinates, and finally evaluating the results); and the construction process engaged to deliver the project successfully (Takim et al., 2003). It is also noted that project team members' motivation, participation, consistency, capability and adaptability, augment the overall team's effectiveness which greatly contributes to project success (Ashley et al., 1987). The client would usually choose reputable team members who possess substantial technical skills and knowledge related to the performance of the construction jobs at hand (Azmy, 2012). Hence, it is good for the project group to be grounded on the principles of respectable work integrity and nice working relationships among team members. Taking the right approach in measuring the performance of the project team is therefore relevant to fulfilling the client's ultimate desire of having adequate project performance level. However, little has been done to empirically measure project team's performance. Hence, the need for using a case study to obtain field data for measuring project team's performance in this research.

RESEARCH METHODOLOGY

Responses from seventy questionnaires were obtained during data collection from construction project team members of projects in progress and newly completed projects in tertiary institutions in the Ashanti region. The questions were ethical and feasible covering respondents profile, project team characteristics and project performance measurement factors. Close-ended questions were adopted in view of its ability to offer stress-free response mode for respondents (Glasow, 2005). Moreover, quantitative data was also needed to facilitate determining and ranking team performance factors that significantly influence project success. The projects were selected through purposive sampling method. This selection method permitted obtaining current data from projects that also had specific experienced Built Environment (BE) professionals in an identifiable project team. Again, since projects in progress and newly completed projects were selected, data from a team that had not been disbanded were obtained. Thus, the method allowed accessing respondents that could offer current data, which were also relevant to the research subject (Levy & Lemeshow, 1999).

The Relative Importance Index (RII) technique was used to rank the significance of the factors identified for measuring team performance. The RII formula, as used by Adnan et al. (2008), is as given in box 1:

Box 1 The RII Formula

$$RII = \frac{5n^1 + 4n^2 + 3n^3 + 2n^4 + n^5}{5(n^1 + n^2 + n^3 + n^4 + n^5)}$$

Where:

n^1 = number of respondents selecting "not important"
n^2 = number of respondents selecting "slightly important"
n^3 = number of respondents selecting "important"
n^4 = number of respondents selecting "very important"
n^5 = number of respondents selecting "extremely important"

Subsequently, a case study approach was identified to be the most appropriate for measuring the influence of project team performance on project success using the identified project performance criteria. The project selected is a newly completed 5-storey hostel, which is complex. Easy access to project information was among the bases for selecting the project. Observations could be made from the project contract documents, variation orders, contract drawings and valuation and payment certificates, etc. These observations made corroborated the responses given by the respondents. The intent was to measure the level of influence of construction project team performance on project success by using the identified variations. The questions asked in the case study were based on the results of the survey carried out at the first stage of data collection.

RESULTS AND DISCUSSION

Out of 70 questionnaires distributed, 64 were retrieved as shown in Table 1. This represents 91.43% response rate.

Table 1 Type of project and their respective team members

Item	Type of Tertiary Institution	No. of Consultants Team members	No. of Contractors/Rep	Total	Type of Consultant
1	I-01	4	5	9	Public Consultants
2	I-02	3	4	7	Public Consultants
3	I-03	5	4	9	Public Consultants
4	I-04	1	2	3	External Consultants
5	I-05	3	3	6	External Consultants
6	I-06	2	4	6	External Consultants
7	I-07	2	3	5	External Consultants
8	I-08	2	3	5	External Consultants
9	I-09	2	3	5	External Consultants
10	I-10	1	2	3	External Consultants
11	I-11	3	3	6	External Consultants
	TOTAL			64	

Main factors of project team performance measurement

Seven (7) main criteria for measurement of team performance were identified through an extensive literature review and were ranked using RII. The seven (7) team performance measurement criteria have been arranged in a descending order of importance in Table 2. These team performance measures collectively describe the performance of team members on a construction project. The performance of an individual team members emerged as the most important factor that determines the overall team performance. All measures had a mean score above 2.5. This indicates that respondents regard all the team performance measures identified in this study as important.

Table 2 - Project team performance measurement criteria

Team Performance Measures	Mean	RII	Rank
Individual member's performance	4.151	0.830	1st
Project phases and tasks	4.102	0.820	2nd
Owner satisfaction	3.966	0.793	3rd
Project safety	3.911	0.782	4th
Project cost management	3.759	0.752	5th
Project schedule	3.715	0.743	6th
Change management	3.613	0.723	7th

Influence of the team's performance on success of a construction project

To measure the influence of project team performance on project success using the identified project performance measures, Construction of 5-storey hostel block for a tertiary institution was selected for the case study. This project happens to be a newly completed building which is within its defect liability period. In this case study, data were obtained from six experienced professionals who were part of the project team. These include: Project Manager, Quantity Surveyor, Structural Engineer, Services Engineer, Geotechnical Engineer, Contractor and the Client's representative. Weightings were assigned to the 7 identified team performance measurement criteria. The weighting for a given criterion was determined based on a ratio determined as shown in Table 3.

Table 3. Weightings for the major project performance measurement criteria.

TEAM PERFORMANCE MEASURES	Rank	Weighting	
Individual Members' Performance	1	7/28 =	25%
Project Quality Assurance	2	6/28 =	21%
Owner Satisfaction	3	5/28 =	18%
Project Safety Assurance	4	4/28 =	14%
Project Cost Management	5	3/28 =	11%
Project Schedule	6	2/28 =	7%
Change Management	7	1/28 =	4%
SUM	28		100%

The essence of assigning weightings was given an indication of the extent to which each criterion contributed to the team performance on a given project. Thus, it can be seen that an individual member's performance on a team is highly essential to success of the project team. Thus, each professional is expected to demonstrate competence in the execution of his/her duties as an expert in a given area of the project. The team's ability to manage change is regarded as contributing least to the performance of a team on a project.

In the case study, team members were asked to rank the importance of each of the seven main criteria identified. The mean ranking under each of the seven main criteria constituting team performance were determined in order to achieve the overall importance of team performance to the project success. These mean rankings are shown in Table 4.

The overall average mean ranking obtained from the case study is 2.99 as shown in table 4. This implies that in the opinion of the case study team members, team performance is important to project success. With regards to the factors that constitute team performance in this study, the performance of an individual member emerged as the factor that was very important to the overall performance of the team on the selected project with overall mean ranking of 4.10. The success of project depends largely on the knowledge, skills and experience (KSE) of individual team members, who would often make decisions, set up objective specific to the project, approve the correct strategy, select the right people, delegate duties to subordinates, and finally evaluate the results (Takim et al., 2003).

Table 4. Importance of team performance measures to project success

TEAM PERFORMANCE MEASURES	MEAN RANKINGS						
	Team member 1	Team member 2	Team member 3	Team member 4	Team member 5	Team member 6	Overall mean ranking
Individual member's performance	3.8	4	4.6	3.2	4.6	4.4	*4.10*
Project phases and tasks	2.8	3.2	3.8	2.4	4	3.8	*3.33*
Owner satisfaction	2.2	3.6	4.6	3	4.6	4.8	*3.80*
Project safety assurance	1.6	3	3.8	1.8	4.4	4.6	*3.20*
Project cost management	1	1.6	3.4	2.6	2.4	2.2	*2.20*
Project schedule	2	1.6	2.6	2	2.8	2.2	*2.20*
Change management	2.4	2	1.8	1.8	2	2.6	*2.10*
OVERALL MEAN RANKING	*2.26*	*2.71*	*3.51*	*2.40*	*3.54*	*3.51*	*2.99*

CONCLUSION

It has been ascertained that the performance of an individual project team member is very important to the overall performance of a given project team. Thus, individual project team member needs not to rely heavily on the performance of other team member(s) in order to perform his/her professional duties competently. Demonstration of individual professional competence irrespective of the behaviour of other team members is crucial to overall project team performance. A team member needs to also ensure effective communication on a project in order to maintain a better project team performance. Thus, project team leaders in the construction industry need to create a flexible and favorable working atmosphere for team members by clearly defining each team member's roles and responsibilities from the inceptions to completion. Also, it has been confirmed that how well a team performs on a project is important to the project success. Thus, the project team performance should constantly be improved from the commencement of a construction project to the commissioning. These

findings point to the need for establishing a project monitoring system that evaluates individual project team member's performance as well as overall team performance in order to secure construction project success from the beginning to the end.

REFERENCES

Adams, S., Simon, L., and Ruiz, B. (2002). "A pilot study of the performance of student teams in Engineering education." *Journal of the American Society for Engineering Education.* 12, 137-144

Adnan, H., Jusoff, K. and Salim, M.K. (2008) 'The Malaysian Construction Industry's Risk Management in Design and Build', Journal of Modern Applied Science, 2 (5), 27-33

Ahadzie D. K. (2007). A model for predicting the performance of project managers in mass house building projects in Ghana. University of Wolverhampton, UK.

Abdulaziz Al-Ibrahim (2014), Quality Management and Its Role in Improving Service Quality in Public Sector Senior Officer in the Strategic Planning Department, Qatari Interior Ministry, Doha – Qatar, J*ournal of Business and Management Sciences*, 2014 2 (6), pp 123-147. DOI: 10.12691/jbms-2-6-1

Ankomah, B., Boakye, N. A. & Fugar, F., 2010. Safety on Construction Sites: the role of the. *West Africa Built Environment Research Conference, Accra, Ghana,* pp. 477 - 498.

Ashley, D.B., Lurie, C.S., and Jaselskis, E.J. (1987). "Determinants of Construction Project Success." *Project Management Journal*, XVIII (2), 35 – 45.

Atkinson, R. (1999). "Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria." *International Journal of Project Management*, 17 (6), 337-342.

Azmy, N., (2012). the Role of Team Effectiveness in Construction Project Teams and project performance. *Iowa State University, Ames, Iowa*

Bai, J.F., and Yang, X.Y. (2011). "Research on construction project process performance measurement." *Industrial Engineering and Engineering Journal*, 1915-1918.

Busseri, M. A., Palmer, J. M., and Martin, T. (2000). "Improving teaamwork: the effect of self assessment on construction design teams." *Design Studies*, 21, 223-238.

Barkley, B. and Saylor, J.H. (1994). *Customer-driven Project Management: A New Paradigm in Total Quality Implementation.* McGraw-Hill, New York, 508.

Belassi, W., and Tukel, O. I. (1996). "A new framework for determining critical success/failure factors in projects." *International Journal of. Project. Management*, 14(3), 141–151.

Bubshait, A.A. and Almohawis, S.A. (1994). "Evaluating the general conditions of a construction contract", *International Journal of Project Management*, 12(3), 133-135.

Busseri, M. A., Palmer, J. M., and Martin, T. (2000). "Improving teaamwork: the effect of self-assessment on construction design teams." *Design Studies*, 21, 223-238.

Zebra Alakoc Burma (2014), Human Resource Management and It's importance for Todays

organizations, *International Journal of Education and Social Science*, Vol 1(2) 85 – 95 September 2014.

Chow, L. J., Danny & Skirtmore, M., (2005). Characteristics of teamwork in Singapore construction projects. *Journal of Construction Research 6(1):,* pp. 15 - 46.

Cornick, T. & Mather, J., (1999). *Construction Project Teams: Making Them Work Profitable.*. London: Thomas Telford.

Cantu, C. J. (2007). "Evaluating team effectiveness: Examination of the TEAM Assessment Tool" thesis, presented to University of North Texas, TX, in a partial fulfilment of the requirements for the degree of Doctor of Philosophy.

Chan, A.P.C. and Tam, C.M. (2000) "Factors affecting the quality of building projects in Hong Kong", International Journal of Quality & Reliability Management, 17 (4/5), 423 – 442.

Chan, A. P. C., and Ho, D. C. K. (2001). "Effect of inter organizational teamwork on project outcome." Journal of Management in Engineering, 17(1), 34-40.

Cleland, D. I. (1996). Strategic Management of Teams. Wiley-IEEE, 292. Construction Users Roundtable (2005). "Construction Measures: Key Performance Indicators", Cincinnati, OH.

Cornick, T., and Mather, J. (1999). *Construction Project Teams: Making Them Work Profitable*. Thomas Telford, London.

Demkin, J. A. (2008). *The architect's handbook of professional practice*. John Wiley and Sons, 1027.

Egan, J. (2002). *"Accelerating change."* London.

Freeman, M. and Beale, P. (1992). "Measuring project success." *Project Management Journal,* 23(1), 8-17.

Glasow, A. Priscilla (2005), *"Fundamentals of Survey Research",* Mitre Washington C3 Center, McLean Virgina.

Hatush, Z. and Skitmore, M. (1997). "Evaluating contractor prequalification data: selection criteria and project success factors." *Construction Management and Economics,* 15 (2), 129-47.

Hendrickson, C., and Au, T. (1988). *Project Management for Construction Fundamental Concepts for Owners, Engineers, Architects and Builders.* Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Koelmans, R.G. (2004) "Project success and performance evaluation. International Platinum Conference 'Platinum Adding Value', The South African Institute of Mining and Metallurgy, 2004. Read, Swatman & Voigt (Pty) Limited.

Kheni, N. A., (2010). The role of Construction education in sustainable waste material management in the construction indeustry. A study of built environment programmes run by Tamale Polytechnic.. *Laryea, S., Leiringer, R. and Hughes, W. (Eds): Procs West Africa Built Environment Research (WABER) Conference, 27-28 July, 2010, Accra, Ghana,* pp. 615-626.

Levy, P. S., & Lemeshow, S. (1999), "*Sampling of populations: Methods and applications*, (3rd ed). New York: John Wiley and Sons.

Lim, C. S. and Mohamed, M. Z. (1999). "Criteria of project success: an exploratory re-examination." *International Journal of Project Management,* 17(4), 243-248.

Per Svejvig and. Peter Andersen (2014) Rethinking project management: A structured literature review with a critical look at the brave new world, International Journal of Project Management, Volume 33, Issue 2, February 2015, Pages 278-290.

McCorry F, Garnick DW, Bartlett J, Cotter F, Chalk M. Developing performance measures for alcohol other drug services in managed care plans. Joint Commission Journal on Quality Improvement. 2000;26(11):633–643.

Navarre, C. and Schaan, J.L. (1990). "Design of project management systems from top management's perspective." *Project Management Journal,* 21(2), 19-27.

Nawi, M. N. M, Baluch, N. and Bahauddin, A. Y. (2014), Impact of Fragmentation Issue in Construction Industry: An Overview, *MATEC Web of conferences* Vo. 15. 01009 (2014), Owned by the authors, published by EDP Sciences, 2014

Parfitt, M.K. and Sanvido, V.E. (1993). "Checklist of critical success factors for building projects." *Journal of Management in Engineering*, 9(3), 243-9.

Pinto, M. B. and Pinto, J. K. (1991). "Determinants of cross-functional cooperation in the project implementation process." *Project Management Journal,* 22(2),13-20.

Riggs, J. L., Goodman, M., Finley, R., and Miller, T. (1992). "A decision support system for predicting project success." *Project Management Journal*, 22(3): 37-43

Senaratne, S. and Sexton, M. (2011). *Managing Change in Construction Projects: A Knowledge-Based Approach*. John-Wiley and Sons.

Takim, R., Akintoye, A., and Kelly, J. (2003). "Performance measurement systems in construction." Construction, 1(September), 3-5.

Uher, T. E., and Loosemore, M. (2004). *Essentials of Construction Management*. UNSW Press, Sydney, Australia, 408.

Walker, D. H. T. (1995). "An investigation into construction time performance." *Construction Management Economics*, 13(3), 263–274.

Walker, D. H. T. (1996). "The contribution of the construction management team to good construction time performance – an Australian experience." *Journal of Construction Procurement*, 2(2), 4-18.

WCPS, UK (1998) Workforce Compensation and Performance Service United States, Office of Personnel Management, Performance Appraisal for Teams: An Overview PMD-14 August 1998

Yimam, A. H., 2011. Project management maturity in the construction industry of developing countries: The case of Ethiopian contractors*., University of Maryland, College Park*

ASSESSMENT OF FIRE SAFETY PROVISIONS IN SELECTED PUBLIC BUILDINGS IN MINNA, NIGERIA

Shittu Abdullateef Adewale[1], Okechukwu Blessing Ijeoma[2], Tsado Abel John[3] and Shehu Muhammad Aminu[4]

[1,2,3]Department of Quantity Surveying, Federal University of Technology, Minna, Nigeria
[4]Department of Building Technology, The Federal Polytechnic, Bida, Nigeria

In Nigeria, there have been several forms of serious disaster confronting homes, lives and properties of people and the government. The most common ones are flood, building collapse and fire, of which fire outbreak is the most frequently recorded. This study addressed the problem of fire incidents which were reported to always occur more in public and private residential buildings as a result of non-compliance of building clients and occupants to the requirements of fire safety regulations. To solve this problem, the study assessed the level of fire safety provisions in public buildings in Minna, Niger State of Nigeria. In view of this, data were collected from both primary and secondary sources. T – Test was used to determine the differences between the stipulated requirements of fire safety regulations and the available fire safety measures provided in the selected public buildings. Regression analysis was employed to determine the relationship between population of building occupants and number of fire escape routes, and building floor area respectively in the selected public buildings. A significant difference was found between stipulated and available requirements of fire safety regulations with respect to fire extinguishers, firefighting equipment and fire escape routes in public buildings. The relationships between population and number of fire escape routes, and building floor area in public buildings were found to be significant. It was concluded that fire safety requirements are not adequately provided or complied with in public buildings in Minna. It was recommended that building occupants or owners should always comply with fire safety regulations.

Keywords: escape routes, fire safety provision, public buildings, population

[1] funsho@futminna.edu.ng
[2] aishatabdulahi2007@yahoo.com
[3] blessingiokechukwu@gmail.com
[4] asafa1013@gmail.com

Shittu, A. A., Okechukwu, B. I., Tsado, A. J. and Shehu, M. A. (2017) Assessment of fire safety provisions in selected public buildings in Minna, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 314-336.

INTRODUCTION

Fire safety is defined by Hakkarainen (2002) as the requirements which are related to prevention of ignition and fire spread, limitation of fire growth, evacuation provision and prevention of fire spread between buildings. Fire prevention or fire safety in buildings therefore has one of the top priorities in the design of buildings (Klapwijk, 2012). It is essential that building occupants are trained or enlightened on the issue of fire safety. In view of this, Mallonee *et al*. (1996) described fire safety training as a way of increasing public fire safety knowledge and improving their response to a fire with the aim of reducing the number of fire-related casualties. This is because residential fires, workplace fires, and environmental fires such as bushfires result in severe and fatal burn injuries (Mallonee *et al*., 1996).

In the context of this work, fire safety is regarded as the essential measures of fire prevention, prevention of fire spread and means of emergency evacuation and fire quench in the event of fire outbreak. Public buildings, on the other hand, are regarded as buildings which accommodate people from different places temporarily especially for the purposes of commercial or official engagements.

The studies of fire have shown that most accidental fire starts from three main causes. These are Malfunctioning of equipment, Misuse of heat sources and Electrical wiring error in housing projects. Housing has been universally acknowledged as the second most indispensable item in human need after food. Housing has a profound impact on the safety of individuals and human beings. This present study considered issues surrounding fire safety management in public buildings in Minna, Niger State.

In Nigeria, there has been serious disaster confronting the homes, lives and properties of people. The most common ones are flood, building collapse and fire. A lot has been written on flood and building collapse, but the incidence of fire is still lax in literature. Fire is still the result of flammable materials being combusted and the essential ingredient for the propagation of fire is air, which is sufficient to start ignition or means of ignition and oxidation (Shittu *et al*., 2015).

The slightest contact of highly inflammable liquid contents, such as gasoline (petrol), paraffin (kerosene), or gas with fire brings explosive services of destruction, inferno and loss of lives and properties (Adeleke, 1993). It was in this light that the Aqua Group (1984) reported that there must be presence of the three basic elements or ingredients of fire, which is referred to as fire's own eternal triangle before fire can break out.

According to Oludare (2000), there has been emphasis on the provision of firefighting equipment for the fire service offices in the country. Millions of Naira are being spent to train fire-men in fire-men combat, but little has been done to look at fire safety in the buildings where there is likely to be occurrence of fire. In most times, fire fighters are being blamed for fire incidents in public buildings, and all their possible loopholes seriously explore. But little has been said or explored about the activities of the other

stakeholders in the construction and uses of public buildings, which are mostly responsible for the causes of fire outbreak (Makanjuola *et al*, 2009).

Some instances of fire outbreak in Nigeria included the one that occurred where two students lost their lives in the University of Ilorin, Kwara State in 2009 as a result of electrical fault. Another serious and memorable incidence of fire outbreak in Nigeria was the fire which struck the 6-storey building of the Nigeria Ports Authority (NPA) in Marina on Thursday the 19th day of June 2008 (Odueme and Ebimomi, 2008). The Nigerian Telecommunications Limited (NITEL) headquarters in the same Marina was gutted by mysterious fire in the early 80s during the second republic. Also, not too long Ibadan branch of the Central Bank of Nigeria (CBN) was up in flames leading to lost several vital documents. In the same vein, it was reported that fire outbreaks in Nigeria records 1000 death and 700 fire accidents annually.

Findings by many researchers, among which are Mogbo (1998), Anyawata (2000), Shittu (2001) and Shittu *et al*. (2013 a and b), confirmed the fact that fire incidences affect buildings of individuals, corporate organizations, government parastatals, and incidence of fire leads to damage to lives and properties and eventually financial losses. The major causes of these fire incidences have been attributed to electrical and gas faults, resulting in financial and non-financial losses. Fire incidents were also reported to have occurred more in public and private residential buildings than in other building types, this has also been attributed to the non-compliance of building clients and occupants to the requirements of fire safety regulations (Shittu *et al*., 2013b). Fire-related accidents often result in injuries and sometimes death, which can be prevented through fire safety training (Huseyin. and Satyen, 2006). To estimate the extent to which fire safety training should be provided, it is essential to assess the current level of fire safety knowledge within the general community. Aliyu and Abdulrahman (2016) also reported that fire safety measures have become an issue of neglect in most tertiary institution hostel buildings in Niger State and have contributed to the continuous fire outbreak.

It is as a result of these that this study set out to examine fire safety provisions in selected public buildings in Nigeria using Minna as a case study. The choice of Minna was for the fact that Minna being the closest State capital city to Abuja experiences rapid growth in terms of construction of public buildings especially for commercial and official purposes. Most of these buildings are constructed in Minna Central Area and most of the old residential buildings are bought and converted to public buildings for commercial and official purposes. Majority of the people resident in Minna have businesses in this area. Therefore, the level of compliance to the requirements of fire safety provisions in these building types can never be over emphasized due to the population of lives and worth of properties accommodated therein. As a result of the problem identified, the following are the questions to be answered by this research:

i. What is the current trend of fire cases in public buildings in Minna?

ii. What is the difference between required number of firefighting equipment and available number of firefighting equipment provided?

iii. What is the difference between required number of fire escape routes and available number of fire escape routes provided in the selected public buildings?

iv. What is the relationship between population of building occupants and the number of fire escape routes?

v. What is the relationship between building floor area and number of escape routes?

vi. What are the measures in ensuring compliance to the requirements of fire safety provisions?

SURVEY OF PREVIOUS WORKS

The concept of fire disaster

Fire is referred to as the rapid oxidation of combustible material and gases producing heat and light (oxygen, heat and fuel) in the absence of one of these elements there cannot be fire (Aqua Group, 1984). Fire is one of the most destructive hazards which threaten buildings. It has the potential to affect the occupant, the building and its components. Also, areas not directly damaged by the flame or heat may be smoked, dirt and falling debris or by the huge volumes of water used in firefighting. According to Malven (1997), when substantial heat is generated, over 500 – 600 degrees Celsius, flashover occurs and the fire becomes fully developed, engulfing the whole compartment. Decay follows when all the fuel or oxygen within the compartment is totally consumed. An example often quoted is that a wooden log is difficult to ignite but thin sticks can be ignited easily and will burn fiercely when piled together.

According to Patterson (1993), building fire safety in its most simplified form is based on three general strategies; first is to prevent ignition; if it occurs, to prevent spread; and if spread occurs, to minimize damages to the lives and properties, occupants and fire-fighters. Mogbo (1998) researched on the environment and fire incidences in Nigeria and the implications on public policies and politics. Shittu (2001) studied the incidence of fire outbreak in public and residential buildings of Kwara State from 1990 - 1999; Shittu (2007) researched on a comparative analysis of fire outbreak between the military and civilian era in Niger State in domestic and public buildings and Shittu (2009) studied the incidence of fire outbreak in North-Central Nigeria; Nwabueze (2012) also studied the enhancement of fire safety in hostel designs; and Shittu *et al.* (2013a and b) and Shittu *et al.* (2016) studied the appraisal of fire safety provisions in tertiary institutions buildings in Minna, Niger State and Katsina, Katsina State respectively. These previous researches have shown that the incidence of fire outbreak is a national issue affecting all building types and requires urgent attention in form of prevention against ignition and fire spread and compliance to fire safety regulations.

Causes of fire

The problem of fire in human settlements can be disaggregated into cause of the fire, spread of the fire, escape from the fire and fire-fighting. According to Shittu (2007), majority of fire outbreaks in domestic buildings were caused by electrical fault rather than gas faults. Fire in buildings can be credited to various factors. According to Hassan (1999) the causes of fire can be grouped under Accidents, Carelessness and Willful acts.

Marsha and Williams (2012) reported the following common causes of residential fires: Careless cooking; Faulty wiring, especially in old houses; Overloaded electrical outlets; Careless smoking; Space heaters; Careless use of candles and incense; Storing belongings too close to furnaces and hot water heaters; Vandalism, drug use, and makeshift heat sources in vacant buildings; Kids playing with matches; and Arson. In addition, Aliyu and Abdulrahman (2016) attributed the causes of fire to accident, faulty electrical equipment and wiring system, fire spread and carelessness.

Classification of fire

Hassan (1999) and Aliyu and Abdulrahman (2016) classified fire into four classes:

i. Class A is a type of fire involving burning materials e.g. wood, paper, textile and other combustible materials. Fire in this class are best extinguished by water agent in form of jet or spray, this blanket (fire blanket) can be used to cover the fire in an enclosure.

ii. Class B fire involves flammable substances e.g. petrol, kerosene, paint and other inflammable solvents. This class of fire is best extinguished with foam or dry powder, carbon dioxide (CO_2).

iii. Class C is a type of fire involving combustible gases or liquefied petroleum gases in form of liquid or gas leak e.g. propane, butane, methane, etc. This can be extinguished with foam, dry powder, and CO2 water agent spray to the container.

iv. Class D is a type of fire involving metals e.g. calcium, potassium, aluminum etc. Powdered granite, limestone, dry sand and dried powdered extinguisher are best used for this class of fire.

Factors influencing fire spread

According to Ahiamba (1985), the rate of spread of fire depends on the fuel and available oxygen. Also, it depends on the construction of the building. The rate of fire spread depends on the following: -

1. Combustibility: This is the rate at which a material burns. For example, petrol has much higher combustibility than wood.
2. Flammability: Hydrocarbon gases are more flammable than hydrocarbon liquids. In the same way hydrocarbon liquid are more flammable than ordinary combustible. Example, cooking gas is more flammable than petrol or kerosene, and petrol is more flammable than wood.

3. Design and construction: A well designed and constructed building will help to reduce the rate of fire spread. For example, a tall building with a badly designed and constructed stairwell and lift shafts will favour fire spread in the building from one floor to another.
4. Contents of building: The material of furnishing (fuel) to a great extent determines the rate of fire spread. Timber furnishing and finish will favour fire spreading and its sustenance unlike steel which is considerably, the reverse.

Cases of fire outbreak in Niger State - Nigeria

Mogbo (1998) pointed out that the following private and public buildings had faced the trauma of fire outbreak:

(a) The incidence in part of the Kure Ultra-modern, Minna, Niger Sate burning down about 50 shops.

(b) Federal Polytechnic at Bida in Niger State respectively.

(c) A fire broke out opposite NANA'S PLACE were residential buildings were razed to the ground.

(d) There were also other cases where a fire broke out in Jatau community in Minna, Niger State where lives and properties were lost.

Daily independent, August 26, 2010, reported a fire incident that gutted about eight rooms of the G-block of a male hostel at Usman Danfodio University, Sokoto. Christianity Today Magazine, March 12, 2004, again reported the case of a building fire that destroyed twenty-six lives in Nigeria, because there was only one entrance and exit to the building. In addition, in 2005, fire incident occurred in the female hostel of the Federal University of Technology, Minna, Niger State which destroyed property and another incidence also occurred in 2009 and at the Bosso campus (temporary site) of the same institution. A recent incidence of fire outbreak was reported by Voice of the Nigerian Tertiary Institutions in 2013 that the Community Campus Radio Station of the Federal University of Technology, Minna, popularly referred to as Search FM 92.3 was gutted by a mid-night inferno on Wednesday 16, January 2013 destroying properties worth over =N= 50 million. The fire outbreak which occurred around 12:00 a.m. as a result of electric spark gutted the whole studio and other offices of the station. This is in line with the discoveries of Shittu (2001), Shittu (2007) and Shittu (2009) that the major cause of fire outbreak in Nigeria is electrical faults.

Fire safety

Fire safety is defined by Encyclopaedia Americana (1993) as the precautions that are taken to prevent or reduce the likelihood of fire that may result in death, injury or loss of property. Passive Fire Protection Federation (2013) viewed fire safety from three perspectives of passive protective measures as given below:

i. Passive fire protection is the primary measure integrated within the constructional fabric of a building to provide inherent fire safety and

protection by responding against flame, heat and smoke to maintain the fundamental requirements of building compartmentation, structural stability, fire separation and safe means of escape.

ii. Passive fire protection measures achieve their intended purpose by raising the fire resistance of the structure, protecting the structure against the effects of fire, reducing fire spread through secondary ignition, limiting the movement of flame and smoke, and minimizing the danger of fire-0induced collapse or structural distortion.

iii. Passive fire protection design, incorporating passive fire protection materials, systems and assemblies, serves by fire containment to protect life, safeguard the building structure, protect assets, maintain building serviceability after fire, minimize rebuild costs, and facilitate quick business recovery and continuity.

Effective fire safety in buildings goes beyond meeting codes. It requires a systematic and diligent approach on the part of the architect for fire prevention, protection and control in all the aspects of building design, construction and use (Malven, 1997).

In view of this and reporting on the theory of fire safety design, Aliyu and Abdulrahman (2016) reported that the rate of fire spread depends on the following: -

i. Combustibility

This is the rate at which a material burns. For example, petrol has much higher combustibility than wood.

ii. Flammability

Hydrocarbon gases are more flammable than hydrocarbon liquids. In the same way hydrocarbon liquid are more flammable than ordinary combustible. Example, cooking gas is more flammable than petrol or kerosene, and petrol is more flammable than wood.

iii. Design and construction

A well designed and constructed building will help to reduce the rate of fire spread. For example, a hostel building with a badly designed and constructed stairwell and no room compartmentalization will favour fire spread in the building from one floor to another.

iv. Contents of building

The material of furnishing (fuel) to a great extent determines the rate of fire spread. Timber furnishing and finish will favour fire spreading and its sustenance unlike steel which is considerably, the reverse.

Findings from the study of Marsha and Williams (2012) suggested that fire safety messages that trigger an emotional response might be the most effective at motivating behaviour change. While incentives, such as gift cards or mortgage or rent rebates, may help with the initial adoption of some fire safety measures, real-life stories of loss and devastation shared by ordinary, relatable citizens will not only grab residents' attention, they

might also give people the intrinsic motivation necessary to sustain appropriate fire safety practices over time.

General requirement of fire safety

The following requirements are enforced under the law:

1. Evacuation of building: Whenever an unfriendly fire occurs in any building, premises, or fire area of any kind, or upon the initiation of a fire alarm all occupants shall evacuate the building, premises or fire areas immediately and shall not re-enter the building, premises, or fire area unless permission is given by the fire chief or fire office in charge of the scene.
2. Notify the fire department/fire service: Whenever an unfriendly fire occurs in any building or premises of any kind, the owner, manager, occupant or any person in control of such building or premises upon discovery of any fire even though it has apparently been extinguished, immediately shall cause notice of the existence of such fire, circumstances of same and the location therefore to be given to the fire department.
3. Maintaining a fire hazard: No person shall knowingly maintain a fire hazard
4. Notification of fire department of inoperative fire safety equipment: Persons owning, controlling, or otherwise having charge of any fixed fire extinguishing or fire warning system or stand pipe system shall notify the fire department and office of the state fire marshal at any time such system or systems are inoperable or taken out of service. Both shall also be notified when service is installed.
5. Interference with fire protection equipment: No person shall render any portable or fixed fire extinguishing system or device or any fire warning system inoperative or inaccessible, except as may be necessary during emergencies, maintenance, drills or prescribed testing.

Fire prevention

Fire prevention in buildings is required to prevent premature structural failure and to limit fire spread (Herbert, 1999). Herbert (1999) also asserted that for these purposes, the following provisions are necessary: - sub-division of the building into a number of fire compartments which are: elements of structure to be provided with appropriate fire resistance; compartmentation of places of special fire risk; restrictions to linings of walls and ceilings so as to limit their contribution to the development of fire and to have adequate resistance to the spread of fire along their surfaces; the provision of fire doors to limit the spread of fire and smoke; limitation of fire spread at junctions between building components, service penetrations and in cavities; and structural fire preventions are also necessary to protect the means of escape.

Fire warning and alarm systems

The provision of an appropriate fire detection and alarm system is an essential element of the fire safety measures in a hostel (Malven, 1997). It provides early warning of the occurrence of fire and thereby facilitates the activation of appropriate emergency procedures, including evacuation. Early detection also improves the chances of restricting the growth and spread of fire within the building by the use of first aid fire-fighting equipment, where safe to do so, and by early call-out of the fire services (Herbert, 1999). A fire detection and alarm system should be provided in all hostels. The system should incorporate automatic fire detection (heat or smoke type detectors, as appropriate) throughout the premises and suitably located manual activation facilities. Large buildings should be divided into fire alarm zones, as required by the standard, which will facilitate identification of the alarm source.

In order to make fire detection and alarm system to effectively serve its purpose, there is the need for an adequate provision of escape routes in buildings. This enables the occupants to exit the building and seek for help immediately. Unfortunately, previous studies including that of Shittu *et al.* (2015) and (2016) have reported that the provision of fire escape routes in buildings is inadequate.

Research gap identified

A lot has been written on flood and building collapse but the incidence of fire outbreak is still lax in literature, in spite of the fact that fire disaster occurs more frequently than flood and building collapse. Efforts have been made by many researchers to address the problem of fire outbreak.

In the foreign scene, Huseyin and Satyen (2006) researched on the level of fire safety knowledge among people of different age groups and investigate its relationship to the level of fire safety training, and the manner in which people from different age groups would respond to a fire based on their fire safety training in Melbourne, Australia. The study revealed that middle-aged individuals would respond more accurately to a fire than younger and older adults. The findings demonstrate the importance of fire safety training in enhancing people's fire safety knowledge and their response in the event of a fire which could lead to a reduction in the rate of fire casualties. The study therefore suggested an incorporation of fire safety training as part of health improvement programs to reduce the number of fire-related injuries and fatalities.

In addition, Marsha and Williams (2012) carried out a qualitative study on Fire Safety Education & Outreach Programs at Memphis, Tennessee. The study revealed that for a variety of reasons, fire danger is not as salient or as pressing a concern for most Memphis residents as is crime. However, the statistics regarding the frequency of residential fires in high-risk Memphis neighbourhoods shocked most of these participants into a much more proactive and preventative mindset. Addressing the problem will require a long-term, coordinated effort and the great majority of respondents believe that responsibility lies with the Fire Department, elected officials,

community leaders, property owners, and residents themselves. The study of Marsha and Williams (2012) also showed that there are four key strategies to effective fire prevention and safety. These are:

1. Raise awareness of the risk of fire danger and educate the public regarding ways to protect themselves, their families, and their property.
2. Provide financial assistance (in the form of grants) to low income and elderly homeowners who are in need of electrical wiring upgrades.
3. Tear down vacant buildings.
4. Strictly enforce building codes in rental properties.

Also in the field of fire safety education and awareness, Clare, Garis, Plecas and Jennings (2012) researched on reduced frequency and severity of residential fires following delivery of fire prevention education by on-duty fire fighters using a cluster randomized controlled study in Surrey, British Columbia. The study specifically examined the frequency and severity of fires pre and post - the home visit intervention in comparison to randomized high-risk cluster controls. The study discovered that the frequency of fires has reduced in the city overall, however, the reduction in the intervention cohorts was significantly larger than for controls. In addition, it was found that when fires did occur within the intervention cohorts, smoke detectors were activated more frequently and the fires were confined to the object of origin more often post-home visits. No equivalent pattern was therefore observed for the cluster control. It was concluded that on-duty fire-fighters can reduce the frequency and severity of residential fires through targeted, door-to-door distribution of fire prevention education in high-risk areas.

In the context of the Nigerian research domain, Shittu (2001) discovered that the amount of fire outbreak in residential and public building of Kwara State and discovered that the amount of financial loss due to fire incidences on the average was about 4% of capital expenditure from 1990-1999. Shittu (2007) studied the incidence of fire outbreak in Niger State from 1993-2004 between the military (1993 - 1998) and civilian (1999 - 2004) political dispensations and found out that the incidence of fire outbreak in both domestic and public buildings were significantly more frequent during the civilian era than the military era in Nigeria. Shittu *et al.* (2013) researched on the appraisal of fire safety provisions in tertiary institutions buildings in Minna, Niger State of Nigeria and revealed that building clients and users do not comply with fire safety regulations with respect to the provisions of firefighting equipment's and number of escape routes in buildings. Shittu *et al.* (2015), on the other hand, studied the relationship between cost of fire incidences and capital expenditure in Kwara State and discovered that there is no improvement in the trend of fire incidence in Kwara State over the last two decades.

Finally, Aliyu and Abdulrahman (2016) researched on the assessment of fire safety provisions in tertiary institution hostel buildings in Niger State. The study used a well-structured questionnaire and observation schedule to

acquire data in some selected tertiary institutions in Niger State. The study found that the fire safety equipment is not available or not functional in the hostels also; most of the students in the hostels are not conversant with the usage of such equipment. It was recommended that proper scrutiny of hostel buildings be made by the school management from time to time to ensure that all fire safety precautions are in functional condition, and orientation of students in the hostels about what to do in occurrence of fire outbreak.

These studies have however failed to study the incidence of fire outbreak in relation to level of compliance of building clients and occupants/users to the requirements of fire safety regulations. Although Shittu *et al*. (2013b) made an effort along this direction but did not consider the major building types mostly affected by the incidence of fire outbreak which are public and private residential buildings. In order to fill this gap in knowledge, this study was set out to assess level of fire safety provisions in public buildings in Minna, Niger State of Nigeria. In order to achieve this, the study set out to achieve the following objectives:

i. To review the current trend of fire cases in public buildings in Minna.
ii. To determine the difference between the required number of fire extinguishers and the available number of fire extinguishers provided in the selected public buildings.
iii. To determine the difference between required number of firefighting equipment and available number of firefighting equipment provided.
iv. To determine the difference between required number of fire escape routes and available number of fire escape routes provided.
v. To determine the relationship between population of building occupants and the number of fire escape routes.
vi. To determine the relationship between building floor area and number of escape routes.

The objectives of the study led to the formulation of the following null hypotheses:

$H_0$1: The differences between available and required firefighting equipment, fire extinguishers and fire escape roués are statistically not significant.

$H_0$2: The relationship between population/building floor area and number of fire escape routes is statistically not significant.

The review of literature gave rise to the theoretical framework upon which the research methodology for this study is based (see Figure 2.1).

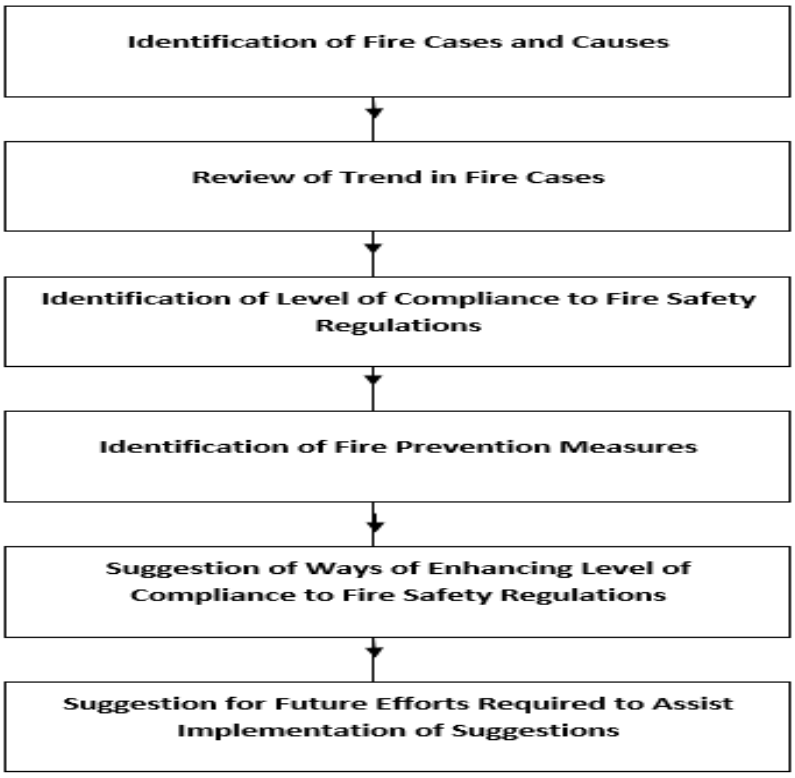


Figure 2.1: Theoretical Framework.

RESEARCH METHODOLOGY

This study adopted a mixed methods research approach. The study encompassed a review of literature survey from journals, conference papers and post projects to identify the major barriers in the appraisal of fire safety provisions in public buildings. Data collection was from both primary and secondary sources. The use of interview and physical measurement were employed to gather data from the primary source on the level of compliance of buildings owners/occupants to the requirement of fire safety regulation.

The study examined selected public buildings in Minna Central Area of Niger State, Nigeria. The selected public buildings were mostly commercial public buildings situated along Bosso Road in Minna Central. The choice of Minna Central Area was because it is an area where compliance to Fire Safety Regulations is most likely to occur. Ten public buildings were purposively selected from the public buildings situated along Bosso Road in Minna Central based on the age of the building, size and population of occupants in the buildings.

Primary source of data collection was also through direct measurement of floor areas and number of escape routes from the public buildings sampled. Data on the recorded cases of fire outbreak and losses were collected from the archive of Niger State Fire Service, Minna as the secondary source of data collection. Data was collected on recorded fire cases for a period of ten years (2006-2015).

Table 3.1: Procedure for Data Collection and Analysis

S/NO.	OBJECTIVES	DATA REQUIRED	VARIABLES	SOURCE	METHOD OI ANALYSIS
1	To review the current trend of fire cases in public buildings in Minna, Niger State.	Archival Data (Data Collection Checklist)	Number of recorded cases of fire incidents	Niger State Fire Service	Descriptive (bar and line graphs)
2	To determine the difference between the required number of fire extinguishers and the available number of fire extinguishers provided.	Archival and Primary Data (Checklist & Physical Measurement)	Number of Fire extinguishers required by Fire Safety Regulations. Number of Fire Extinguishers Available in Sampled Buildings.	Fire Safety Regulation and Physical Measurement.	Inferential (T - Test)
3	To determine the difference between required number of firefighting equipments and available number of firefighting equipments provided	Archival and Primary Data (Checklist & Physical Measurement)	Number of Fire Fighting Equipments Required by Fire Safety Regulations. Number of Fire Fighting Equipments Available.	Fire Safety Regulation and Physical Measurement.	Inferential (T - Test)
4	To determine the difference between required number of fire escape routes and available number of fire escape routes provided.	Archival and Primary Data (Checklist & Physical Measurement)	Number of Fire Escape Routes Required by Fire Safety Regulations. Number of Fire Escape Routes Available.	Fire Safety Regulation and Physical Measurement.	Inferential (T - Test)
5	To determine the relationship between population of building occupants and the number of fire escape routes.	Archival and Primary Data (Checklist & Physical Measurement)	Population of building occupants (independent variable) and number of fire escape routes (dependent variable).	Interview and Physical Measurement.	Inferential (Regression Analysis)
6	To determine the relationship between building floor area and number of escape routes.	Archival and Primary Data (Checklist & Physical Measurement)	Building floor area (independent variable) and number of fire escape routes (dependent variable).	Interview and Physical Measurement.	Inferential (Regression Analysis)

Source: Researchers' Field Survey (2016)

The use of bar and line graphs was employed to review the current trend of the incidence of fire outbreak in Niger State from 2006 – 2015. The use of T – Test was employed to determine the differences between the required number of fire extinguishers and the available number of fire extinguishers provided in the selected public buildings; between the required number of firefighting equipment and the available number of firefighting equipment provided; and between the required number of fire escape routes and the available number of fire escape routes provided. The use of regression analysis was employed to determine the relationships between the

population of building occupants and the number of fire escape routes; and between the floor area of buildings and the number of fire escape roués provided in the selected buildings. This was justified by the studies of Shittu *et al.* (2013b) and (2016) where it was discovered that number of fire escape routes depends on the population of building occupants and building floor area. Table 3.1 gives the procedure for data collection and analysis for this study based on the theoretical framework.

The decision rule used for the T – test in this study is given below:

- If $T_{calulated} > T_{tabulated}$ then the difference is significant i.e. reject H_o
- If $T_{calulated} < T_{tabulated}$ then the difference is not significant i.e. accept H_o

Below are the decision rules for each of the tools of the regression analysis employed in this study:

F test:

The decision rule here states that:

- If $F_{calulated} > F_{tabulated}$ then relationship is significant i.e. reject H_o
- If $F_{calulated} < F_{tabulated}$ then relationship is not significant i.e. accept H_o

P test:

The decision rule here states that:

- If P value < significance level then relationship is significant i.e. reject H_o
- If P value > significance level then relationship is not significant i.e. accept H_o

Coefficient of determination (R^2):

The decision rule here states that:

- If $R^2 \geq 50\%$ then relationship is strong.
- If $R^2 < 50\%$ then relationship is weak.

RESULTS AND DISCUSSIONS

Data presentation

The data collected for the study are presented in the Appendix section as Tables A1 and A2. Table A1 shows the data collected on fire statistics for a ten- year period (2006 - 2015). This data helped to make a review of fire trend in the recent time. Table A2 gives a presentation of data collected for 10 selected public buildings. This assisted to assess the level of fire safety provisions in public buildings of Minna.

Results of current trend of fire outbreak in Niger state from 2006 – 2015

The results of the descriptive analysis are presented in Figures 4.1 – 4.3. The discussion for each figure thereafter follows below. Figure 4.1 shows the trend of fire outbreak in public buildings of Niger State from 2006 – 2015.

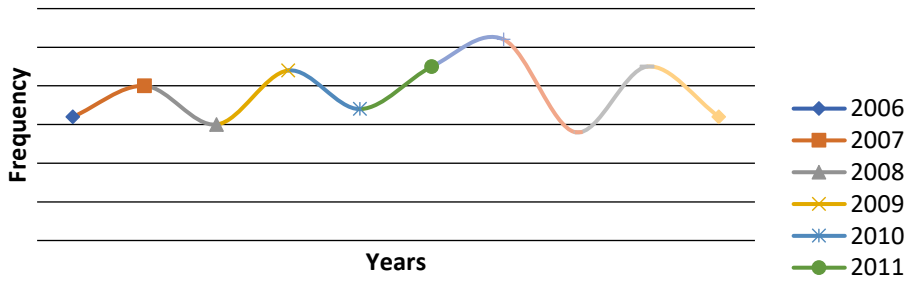


Fig. 4.1: A Ten - year Trend Fire Outbreak in Public Buildings in Niger State from 2006 - 2015

Figure 4.1 shows that fire outbreak in public buildings in Niger State has fluctuated between 2006 and 2015. The highest cases were recorded in year 2012 while the least recorded cases of fire outbreak were in year 2006. The trend differs from that observed by Shittu (2001) where the cases of fire in public buildings were observed to constantly increase from 1993 – 2004. Figure 4.2 shows a trend comparison of the major causes of fire outbreak in Niger State from 2006 – 2015.

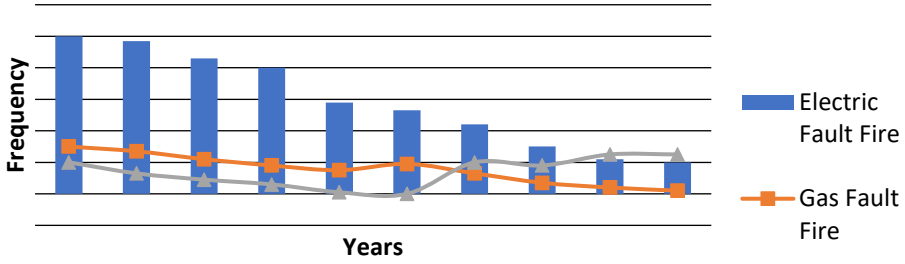


Fig. 4.2: Trend Comparison of Major Causes of Fire Outbreak in Niger State from 2006 - 2015

It was revealed in Figure 4.2 that the cases of fire outbreak occur more as a result of electrical faults than gas faults and bush burning. In the last two years under review, the cases of fire outbreak due to bush burning became the highest recorded. While cases of fire outbreak due to gas faults and bush burning fluctuated over the period under review, cases of fire outbreak due to electrical faults decreased constantly over the period under review. It was most importantly that there was an improvement in the recorded cases of fire due to these three major causes of fire outbreak. This is because the recorded cases of fire outbreak due to each of these causes decreased significantly during the last five years under review, except for the causes of fire outbreak due to bush burning. The result of this analysis agrees with the findings of Shittu (2001), Shittu (2007) and Shittu (2009) where it was also discovered that the cases of fire outbreak recorded as a result of electrical faults were higher than the ones for gas faults and bush burning. Figure 4.3 shows the trend comparison between the amount of financial loss

and financial salvage during the incidence of fire outbreak in Niger State from 2006 – 2015.

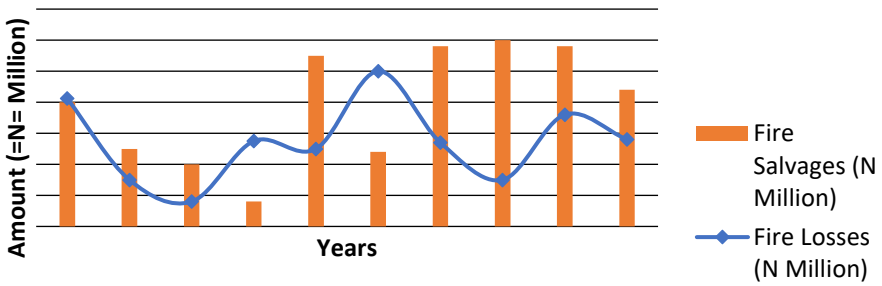


Fig. 4.3: Trend Comparison between the Amounts of Financial Loss and Financial Salvage during Fire Outbreak in Niger state from 2016 - 2015

It was shown in Figure 4.3 that the amount of financial losses recorded is usually less than the amount of financial salvage over the study period, except in 2009 and 2011. This implies that more properties are being saved than the ones lost to fire outbreak. This agrees with the findings of Shittu (2001) and Shittu (2007) where it was also discovered that the amount of financial losses recorded is usually less than the amount of financial salvage from 1990 – 1999 in Kwara State and 1993 – 2004 in Niger State respectively.

Results and discussions for t - tests

The first T – Test shows that there exists a statistically significant difference between the required number of escape routes and the available number of escape routes in the selected public buildings in Minna. The observed mean value of the number of required escape routes was 2.40 while that of the number of available escape routes was 1.00. The observed T calculated value from the result of the analysis was 5.250 and was greater than the T tabulated value of 2.26, while the Probability (P) value of 0.001 observed was less than the level of significance of 0.05 which the analysis was based upon. The null hypothesis was therefore rejected based on these. This therefore implies that the standard number of escape routes required is not being complied with in public buildings in Minna. This agrees with the findings of the study of Shittu *et al.* (2013b) where it was also found that the standard number of escape routes required is not being complied with in tertiary institution buildings in Minna. The results of the first T – Test are summarised in Table 4.1.

Table 4.1: T – Test between the Required and Available No. of Escape Routes

Test No.	Variables		Type of Model	Observations						
	X_1	X_2		Mean Value (%)	T_{cal}	T_{tab}	P_{value}	LOS	Remark	Action On Hypothesis
1	Required No. of Escape Routes	Available No. of Escape Routes	Paired Sample	$X_1 = 2.40$ $X_2 = 1.00$	5.250	2.26	0.001	0.05	SSD	Reject H_O

Source: Researchers' Field Survey (2016)

KEY: SSD: Statistically Significant Difference

The second T – Test shows that there exists a statistically significant difference between the required number of fire extinguishers and the available number of fire extinguishers in the selected public buildings in Minna. The observed mean value of the number of required fire extinguishers was 10.70 while that of the number of available number of fire extinguishers was 6.40. The observed T calculated value from the result of the analysis was 3.023 and was greater than the T tabulated value of 2.26, while the Probability (P) value of 0.014 observed was less than the level of significance of 0.05 which the analysis was based upon. The null hypothesis was therefore rejected based on these. This therefore implies that the standard number of fire extinguishers required is not being complied with in public buildings in Minna. This is in line with the findings of the study of Shittu *et al.* (2013b) where it was also discovered that the standard number of fire extinguishers required is not being complied with in tertiary institutions buildings in Minna. The results of the second T – Test are summarised in Table 4.2.

Table 4.2: T – Test between Required and Available No. of Fire Extinguishers

Test No.	Variables		Type of Model	Observations						
	X_1	X_2		Mean Values (%	T_{cal}	T_{tab}	P_{value}	LOS	Remark	Action on Hypothesi
2	Required No. of Extinguisher	Available Number of Extinguish rs	Paired Sample	$X_1 = 10.7($ $X_2 = 6.40$	3.023	2.26	0.014	0.05	SSD	Reject H_O

Source: Researchers' Field Survey (2016)
KEY: SSD: Statistically Significant Difference

The third T – Test shows that there exists a statistically significant difference between the required number of firefighting equipment and the available number of firefighting equipment in the selected public buildings in Minna. The observed mean value of the number of required number of firefighting equipment was 17.30 while that of the number of available number of firefighting equipment was 8.00. The observed T calculated value from the result of the analysis was 4.225 and was greater than the T tabulated value of 2.26, while the P value of 0.002 observed was less than the level of significance of 0.05 which the analysis was based upon. The null hypothesis was therefore rejected based on these. This therefore implies that the standard number of firefighting equipment required is not being complied with in public buildings in Minna. The finding from the study of Shittu *et al.* (2013b) also agrees with this. The results of the third T – Test are summarised in Table 4.3.

Table 4.3: T – Test between No. of Required and Available Fire Fighting Equipments

Test No.	Variables		Type of Model	Observations						
	X_1	X_2		Mean Values (%)	T_{cal}	T_{tab}	P_{value}	LOS	Remark	Action on Hypothesis
3	Required No. of Firefighting Equipment	Available No. of Firefighting Equipment	Paired Sample	$X_1 = 17.3$ $X_2 = 8.00$	4.225	2.26	0.002	0.05	SSD	Reject H_0

Source: Researchers' Field Survey (2016)

KEY: SSD: Statistically Significant Difference

Results and discussions for regression analysis

It was observed in the first regression analysis that there exists a weak, negative and non-significant relationship between population of building occupants and the number of escape routes in the selected public buildings in Minna. The coefficient of determination (R^2) value observed was 0.2% implying weak relationship and the correlation coefficient (R) observed was 4.4% indicating weak degree of association between the variables. The negative correlation observed between the variables indicates a tendency that an increase in the population of building occupants will be followed by a decrease in the number of escape routes and vice versa. The value of F calculated of 0.015 observed was less than the value of F tabulated of 5.32 while the probability (P) value of 0.905 observed was greater than 0.05. This led to the acceptance of the null hypothesis in this case. This finding is in line with the findings of Shittu *et al*. (2016) where it was also found that number of escape routes does not significantly relate with the population of building occupants. Table 4.4 summarises the results of the first regression analysis.

Table 4.4: Summary of Regression Results between Population and No. of Escape Routes

Analysis No.	Variables		Type of Model	Observations					Inferences		
	X	Y		Regression Equation	R/R^2 (%)	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Remark	Action on Hypothesis
1	Population	Nr. of Escape Routes	Linear (Simple	Y = 1.115 - 0.005x	4.4/0.2	0.015	5.32	0.905	Weak	NS	Accept H_0

Source: Researchers' Field Survey (2016)

Key: NS = Not Significant

The second regression analysis also revealed a weak, negative and non-significant relationship between building floor area and the number of escape routes in the selected public buildings in Minna. The R^2 value observed was 3.2% implying weak relationship and the R value observed was 18% indicating weak degree of association between the variables. The negative correlation observed between the variables indicates a tendency that an increase in the building floor area will be followed by a decrease in the number of escape routes and vice versa. The value of F calculated of 0.267 observed was less than the value of F tabulated of 5.32 while the

probability (P) value of 0.619 observed was greater than 0.05. This led to the acceptance of the null hypothesis in this case. This finding also agrees with the findings of Shittu *et al*. (2016) where it was also found that the number of escape routes does not significantly relate with the floor area of building. Table 4.5 summarises the results of the second regression analysis.

Table 4.5: Summary of Regression Results between Floor Area and No. of Escape Routes

Analysis No.	Variables		Type of Model	Observations					Inferences		
	X	Y		Regression Equation	R/R^2 (%)	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Remark	Action on Hypothesis
2	Building Floor Area	Nr. of Escape Route	Linear (Simple)	Y = 1.397 - 0.001x	18/3.2	0.267	5.32	0.619	Weak	NS	Accept H_0

Source: Researchers' Field Survey (2016)

Key: NS = Not Significant

CONCLUSIONS AND RECOMMENDATIONS

Findings from the results of the analysis led to the following conclusions:

i. The incidence of fire outbreak in public buildings in Niger State fluctuated from 2006 - 2015 and more properties were being saved than the ones lost to fire outbreak.

ii. Fire safety requirements are not adequately provided or complied with in public buildings in Minna, Niger State. This is because significant differences exist between the required and available numbers of escape routes, fire extinguishers and firefighting equipment.

iii. The relationship between population of building occupants and number of fire escape routes and building floor area is not significant respectively. This also implies that the requirements of fire safety requirements are not being complied with.

The following recommendations were made based on the findings of this study:

i. Building occupants or owners should always comply with the fire safety regulations on the number of firefighting equipment required for public buildings of different specifications.

ii. Building owners should always use the area of building and population of building occupants as basis in order to make provision for fire safety devices.

iii. Fire sprinkler systems should be provided for public buildings and water hydrants should be installed by the Government in all public areas in cities where water can be easily fetched in case of fire outbreak.

iv. Finally, the Government should set up an agency to constantly inspect the level of compliance of public buildings to the provisions of fire safety regulations.

LIMITATION OF THE STUDY

The study is only applicable to public buildings used for commercial and official purposes. In order to be able to extend its application to other building types, a fresh research should be undertaken adopting the procedures of this research. The following areas are suggested for further research in view of the limitation of this study:

i. A comparative analysis of the level of compliance with the provisions of the fire safety regulations between public and private buildings.

ii. Impact of the level of compliance with the provisions of the fire safety regulations on the number of recorded fire outbreaks in public and private buildings.

REFERENCES

Adeleke, S. (1993). Fire: An Ambivalent Substance. *The Herald*. 25th October. 12.

Ahiamba, E. E. (1985). *Fire Hazard and its Prevention in Buildings (A Case Study of Bendel and Lagos States of Nigeria)*. BSc. Thesis, Department of Architecture, Bendel University, Ekpoma.

Aliyu, W. I. and Abdulrahman, M. E. (2016). Assessment of Fire Safety Provisions in Tertiary Institution Hostel Buildings in Niger State Sustainable Built Environment and Climate change; The challenges of Post 2015 Development Agenda. School of Environmental Technology Conference, SETIC, 2016

Anyawata, C.H. (2000). *Analysis of fire outbreak in Niger-Delta, Nigeria.* Unpublished B. Tech Thesis, Department of Quantity Surveying, Federal University of Technology, Minna.

Aqua Group (1984). *Fire and Building.* Granada Publishing, Great Britain.

Clare, J., Garis, L., Plecas, D. and Jennings, C. (2012). Reduced Frequency and Severity of Residential Fires following Delivery of Fire Prevention Education by on-duty Fire Fighters: Cluster Randomized Controlled Study. *Journal of Safety Research*. Volume 43: 123-128.

Encyclopedia Americana (1993). Encyclopedia Americana International Edition. Danbury, Connecticut. (11) 243 – 251.

Hakkarainen, T. (2002). *Studies on Fire Safety Assessment of Construction Products*. Technical Research Cenre of Finland. VTT Publications 459. 1 – 109.

Hassan, H. (1999). Fire and Safety Management in Buildings. *The Professional Builders Journal*. June/July. 32 – 35.

Herbert, G. (1999), *Fire safety in hostels.* McGraw-Hill, Inc.

Huseyin, I. and Satyen, L. (2006). Fire safety training: Its importance in enhancing fire safety knowledge and response to fire. *The Australian Journal of Emergency Management*. November 2006. 21(4): 48 – 53.

Klapwijk, I. N. (2012). *The Governance of Fire Safety: Using Networks, Markets, Hierarchy? ….Or a form of Anarchy?* Master Thesis. School of Management and Government. University of Twente.

Makanjuola, S.A, Aiyetan, A. O and Oke A.E. (2009), Assessment of Fire Safety Practice in Public Buildings in Western Nigeria. *RICS COBRA Research Conference*, University of Cape Town, September 2009. 1-21.

Mallonee, S., Istre, G. R., Rosengberg, M., Reddish- Douglas, M., Jordan, F. Silverstien, P. and Tunell, W. (1996). 'Surveillance and Prevention of Residential Fire Injuries. *The New England Journal of Medicine* 335(1): 27-31.

Malven, F. (1997); *Time savers standards, for architectural design standards*, seventh edition, McGraw-Hill, Inc.

Marsha, E. Williams, M. E. (2012). Fire Safety Education & Outreach Programs: Memphis, Tennessee: A Qualitative Research Project. Summary Report Prepared for The National Fire Protection Association. December 2012. Harvest Research Group LLC.

Mogbo, T.C (1998). Fire Outbreak and the Urban Environment in Nigeria: Implication on Public Policy and Politics. In A. A. Ndanusa (Ed.); *The Quantity Surveyor*. A Journal of the Nigerian Institute of Quantity Surveyors, Lagos. January – March. 31- 38.

Nwabueze, T. M. (2012). *Proposed Nnamdi Azikwe UniversityUniversity Postgraduate Hostel, Awka: Enhancing Fire Safety in Hostel Designs.* An unpublished MSc. Thesis. Department of Architecture, Faculty of Environmental Sciences, School of Postgraduate Studies, Nnamdi Azikwe University, Awka.

Odueme, S. and Ebimomi, V. (2008). Fire in NPA House. In Wole Olujobi (Ed). *Daily Independent*. Lagos. 23rd June. 3(1511). I.

Oludare, L (2000). Season of Fire, Shelter Watch, May/June 29-30.

Passive Fire Protection Federation (2013). *Gateway to UK Fire Protection*. Ganders Business Park, Kingsley House, Bordon, Hampshire, UK. Retrieved from http://www.org/pfpf_definition.htm on 12/03/2013.

Patterson, J. (1993). *Simplified design for building fire safety*. John Wiley and sons Inc.

Shittu, A. A. (2007). A comparative analysis of Fire Outbreak in Domestic and Public Buildings in Niger State during the Military and Civilian Era (1993-1998 and 1997-2004 Respectively). In L. M. Ojigi (Ed.): *Environmental Technology and Science Journal*. School of Environmental Technology, Federal University of Technology, Minna, Nigeria. 2(2): 139-146.

Shittu, A. A. (2009). Analysis of Fire Incidences in Domestic and Public Buildings of Some Selected States in North- Central Nigeria. In Z. A. Uji (Ed.): Journal of Environmental Sciences, Faculty of Environmental Sciences, University of Jos, Jos, Nigeria. Vol. 13(I/II): 54-61.

Shittu, A. A., Oke, A. A., Adamu, A. D. & Shehu, M. A. (2013a). A Comparative Analysis of Fire Incidences in Domestic and Public Buildings during the Military and Civilian Era in Kwara State, Nigeria (1990 – 1999; 2000 – 2009). In A. S. Abdulkareem, S. A. Abdularahaman, A. A. Amadi & M. Abdullahi (Eds.). *3rd Biennial Engineering Conference: Conference Book of Proceedings*. School of Engineering and Engineering Technology, Federal University of Technology, Minna, Nigeria. Tuesday, 14th – Thursday, 16th May 2013. 255 – 267.

Shittu, A. A., Adamu, A. D., Oke, A. A., Aliyu, S. & Shehu, M. A. (2013b). Appraisal of Fire Safety Provisions in Tertiary Institutions Buildings in Minna. In M. Zubairu (Ed.). *Centre for Human Settlement and Urban Development (CHSUD) Journal*. Federal University of Technology, Minna, Nigeria. December 2013, 4(1): 64 - 72.

Shittu, A. A., Idiake, J. E. and Akanmu, W. P. (2015). Relationship Between Cost of Fire and Capital Expenditure in Kwara State. In A. Nasir, A. S. AbdulRahman and A. S. Kovo (Eds). *Procs: 1st International Engineering Conference (IEC 2015)*. School of Engineering and Engineering Technology, Federal University of Technology, Minna, Nigeria. 1st – 3rd September. 243 – 250.

Shittu, A.A (2001). *An Analysis of Losses due to Fire Incidence in Residential and Public Buildings of Kwara State (1990-1999)*. Unpublished B.Tech. Thesis Quantity Surveying Department, Federal University of Technology Minna, Nigeria.

Shittu, A. A., Idiake, J. E., Oyewobi, L. O., Tsado, A. J., Bilyaminu, B. & Mac-Barango, D. O. (2016). Viability of Fire Escape Routes in the Student Hostels at Selected Katsina State Tertiary Institutions, Sustainable Built Environment and Climate Change; The Challenges of Post 2015 Development Agenda. *In*: Y. A. Sanusi, O. F. Adedayo, R. A. Jimoh & L. O. Oyewobi (Eds.): *Proceedings of School of Environmental Technology International Conference (SETIC 2016)*. School of Environmental Technology, Federal University of Technology, Minna, Nigeria. 10th – 12th May. 66.

APPENDIX

Table A1: Research Data on Fire Statistics from 2006 - 2015

Year	Electric Fault Fire	Gas Fault Fire	Bush Burning Fire	Public Building Fire	Fire Losses (N Million	Fire salvages (N Million)
2006	100	30	20	32	412	400
2007	97	27	13	40	150	250
2008	86	22	9	30	80	200
2009	80	18	6	44	275	80
2010	58	15	1	34	250	550
2011	53	19	1s	45	500	240
2012	44	13	20	52	270	580
2013	30	7	18	28	150	600
2014	22	4	25	45	360	580
2015	20	2	25	32	280	440

Source: Niger State Fire Service, Minna (2016)

Table A2: Research Data on Fire Safety Provision

Buildings	Standar No of Escape Route	Available Escape Route	No of Required Fire Extinguishe s	No of Available Fire Extinguishe s	Floor Area (sqm^2)	No of Required Fire Fightin Equipment	No of Available Fir Fighting Equipment	Population
House 1	4	2	14	1	250	18	1	15
House 2 (Hospital Complex)	4	3	25	15	600	32	15	34
House 3 (Church Hall)	2	0	10	4	300	14	6	17
House 4(Balls Hall)	2	1	8	8	600	10	8	30
House 5 (Lecture Hall)	2	0	4	1	200	6	1	9
House 6 (Event Center)	2	2	8	10	270	12	10	15
House 7(Shop Mob)	2	0	6	4	900	35	14	42
House 8 (Office Complex)	2	0	12	7	900	10	8	38
House 9 (Library)	2	2	10	8	500	18	8	27
House 10 (Show Room)	2	0	10	6	400	18	9	24

Source: Researchers' Field Survey (2016)

ASSESSMENT OF LIGHT LEVELS AND VISUAL COMFORT IN A LECTURE HALL OF A UNIVERSITY IN AKURE, NIGERIA

Afolami, A. J.[1], Akeremale, I. D.[2] and Ikudayisi, A. E.[3]

[1,3]*Department of Architecture, Federal University of Technology, P. M. B. 704, Akure, Nigeria*

[2]*School of Architecture and Built Environment, University of Newcastle, Callaghan, NSW, 2308, Australia*

The challenge of having a well-lit auditorium at 200lux - the international lighting association recommended light level suitable for lecture halls was brought to the fore in this paper. The aim of the work was to determine typical light levels in the 750-capacity lecture theatre, compare with international benchmarks the current light level in the building towards definition of baseline characteristics of lecture theatres. Artificial and natural light levels was assessed in the 750-capacity lecture theatre in the Federal University of Technology, Akure, Nigeria in July 2017 between 7am and 7pm hourly, through the use of Precision Gold N21FR, a hand held multimeter, it was discovered that the average illumination in the hall around 7pm was as low as 0.01lux on 22nd July. The average artificial light level was also determined using calculation method and it recorded 3.14Lux. The result from the work would serve as input for possible redesign of the lighting system of the lecture theatre under study.

Keywords: compact fluorescent bulbs, lamp holders, light levels, visual comfort.

INTRODUCTION

Adequate lighting in buildings is a major functional requirement in Architecture. Light levels is an objective assessment that determines the illumination of a space and visual comfort involves perception of building users concerning such values as how bright or how dark a building interior is (ASHRAE, 2009, p.10.1). The problem of artificial lighting in the seven hundred and fifty capacity lecture theatre (750 LT) stems from the fact that power supply in Nigeria and by extension the Federal University of Technology, Akure is epileptic in nature, thus lectures tend to be delivered

[1] jaafolami@futa.edu.ng

[2] igbayemi.akeremale@uon.edu.au

[3] ayoikudayisi@gmail.com

Afolami, A. J., Akeremale, I. D. amd Ikudayisi, A.E. (2017) Assessment of light levels and visual comfort in a lecture hall of a university in Akure, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 337-346.

some of the time without power to the lighting system. How critical is this situation, when lectures take place at say 7am - 9am and between 5pm and 7pm, when naturally light levels from the sun / windows is low? And how satisfied are the users of the space concerning the natural and artificial lighting overall? Since naturally, light levels drop from the external wall to the building interior (Baiche and Walliman, 2000).

What is the natural light level, during the afternoon say 2pm as compared to the light levels in the critical 5-7 pm period? The aim of the work is to determine typical light levels in the 750-capacity lecture theatre and compare with international benchmarks. This research is significant towards developing light level aspects of the Nigerian building code, the Nigerian building code discusses generally without any specifics for lecture theatre design.

LITERATURE REVIEW

The importance of natural light to the human daily rhythm cannot be overestimated. It influences body temperature, sleep and hormonal changes, for example at nightfall, the body releases melatonin, which causes sleepiness. Exposure to excessive lighting outdoors can cause untimely ageing of the skin, eye impairment and skin cancer. In building interiors on the other hand, excessive lighting can cause glare (Sassi 2006, pp.102 - 104). In western nations, the availability of electricity is taken for granted, while in developing nations, Nigeria in particular, lack of constant electricity is rather the norm than an exception. Therefore, designing buildings that integrate natural and artificial lighting techniques should be encouraged. Some of the building design techniques to be considered includes but is not limited to: the use of narrow blocks, orientating the longer side of buildings in east – west direction, integrating the use of atrium and courtyard in building design (Brophy and Lewis, 2011). Low levels of lighting affects performance of tasks and can cause sluggishness, over a period, the occupant can develop depression affecting the wellbeing of an individual (Sassi, 2006, p.98). Artificial lighting is usually used to supplement natural lighting, since natural lighting reduces at some distance away from the windows (Chadderton, 2007, p. 261)

Visual comfort involves perception of building users concerning such values as how bright or how dark a building interior is (ASHRAE, 2009, p.10.1). Furthermore, visual comfort is one of the sub credits for health and wellbeing aspect of the Building Research Establishment Environmental Assessment Method (BREEAM, 2014). Furthermore, indoor environmental quality section of Leadership for Energy and Environmental Design (LEED) of the US, supports daylight for 75% of spaces and view opportunities for at least 90% of occupants (Hepner and Boser, 2006, p.201). Since green rating systems deliver buildings that push boundaries of design further than what is presently available in the building codes, a gap exists as to the quality of lighting in buildings that are designed within the scope of building codes using a lecture theatre as a case study. Furthermore, limited studies are

available on adequate light levels of lecture theatres in Nigeria. A lecture theatre according to Macmillan Dictionary is "a large room with rows of seats where students listen to lectures". The Illuminating Engineering Society of North America, IESNA, a foremost lighting society has suggested that measuring and reporting illuminance measurements can be used for comparison, to determine compliance with specifications and to reveal the need for maintenance (IESNA, 2000).

RESEARCH METHODOLOGY

Case study method used for the assessment (National renewable energy laboratory, NREL, USA, 2005, p.5-6, Creswell, 2009). It entails a building assessment of the 750-capacity lecture theatre, this entails physical description of the artificial lighting installations, the seating arrangement and measurement of the window sizes in the building interior.

The Research Area

The Federal University of Technology, Akure (FUTA) is located in Akure South Local Government Area in Ondo State, Nigeria. The seven hundred and fifty capacity lecture theatre is located within the university. There are two distinct seasons; the raining season, which begins in April and Ends in October and the dry season which begins in November and ends in March (Ondo 2012). The seven hundred and fifty capacity lecture theatre has a floor area of 594.032 square metres, with external dimension of 27.40m by 21.68m. The lecture theatre has a racked seating arrangement with the highest floor to ceiling dimension being 7.2m and the lowest dimension as 4.05m. The racked seating is arranged in three rows, with two rows aligned with the windows and a middle row (see figure 1). The windows are made up of aluminium casements, with each bay measuring 3m by 1.5m, having an area of 4.5m^2.

Each window bay has ten panes, dimensioned 600mm x 750mm, in filled with plain glass. The top five panes are fixed, while the lower ones are projected. The two longer side of the building has five numbers of these windows (see figures 1, 2 and 5). The artificial lighting system has six, compact fluorescent lamps (CFL) each of 85Watts capacity. The longer side of the building is oriented in the east – west axis, with the windows located in the north and south elevations of the building (figure 5). Google earth site shot (figure 3) and the front elevation are also presented (figure 4). The seven hundred and fifty ETF lecture is bounded in the north by the school of Engineering and Engineering Technology building, (51m), in the south by the School of Agriculture and Agricultural Technology main building (51m), in the west by the large lecture theatre (46m), the 750 LT building is located 72m from the access road.

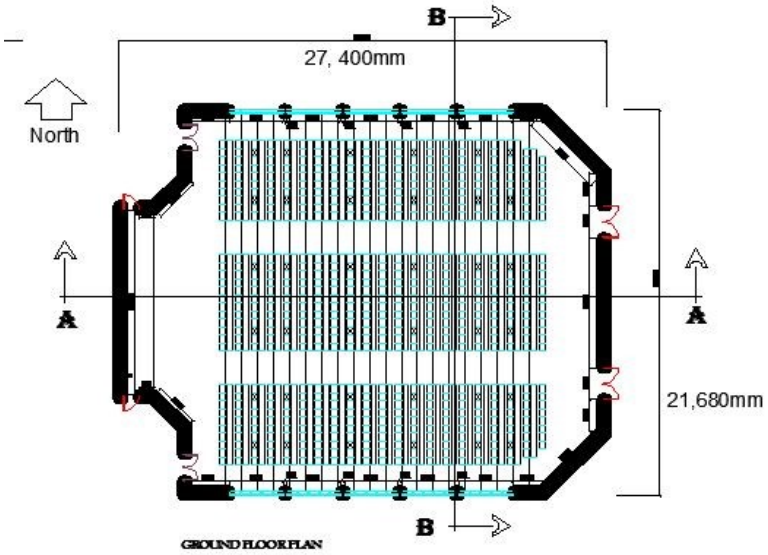


Figure 1. The Ground Floor Plan of the 750 capacity Lecture Theatre, Federal University of Technology, Akure Nigeria. (Source: field study, 2015)

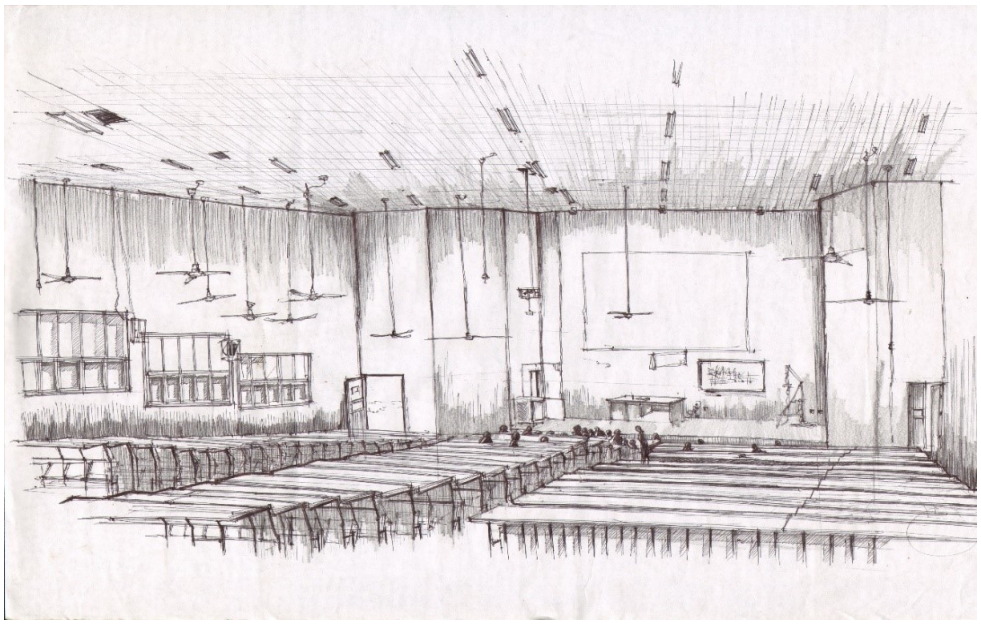


Figure 2. An interior perspective of the 750-person capacity lecture theatre, Federal University of Technology, Akure, Nigeria showing fluorescent tubes with baton base on the ceiling initially planned for the space but not put to use in practice (sketch by Okwananke Christian, 2015)



Figure 3. A Google Earth site location of the 750-capacity lecture theatre within the Federal University of Technology, Akure, retrieved from Google earth (2015)



Figure 4. East side elevation of the 750 Capacity Lecture Theatre, FUT Akure. (Source: field study 2015)



Figure 5. South Side Elevation of the 750-capacity lecture theatre, FUT Akure. (Source: field study 2015)

Light Level Assessment

The thirty-six positions where the lighting assessment was carried out where 1500mm, 6000mm and 12000mm away from the side wall on both side and 800mm from the floor. These points correspond to starred seats as noted in figure 1. Furthermore, the lighting positions were the fourth row from the rear, the fourth row from the front and the fourth seat away from the central aisle. These positions correspond to the middle of windows earlier described in figure 4. This also made it easy for repeatability hourly form7 am to 7pm. The selected spots is very easily replicable because the instrument is placed flat on the reading tables and the sensor pointed towards the stage in the hall. Readings are taken in thirty-six various positions and the average is considered as the average illuminance of the reading room (National renewable energy laboratory, NREL, USA, 2005, p.5-6). The walls are painted with light brown emulsion paint and the ceiling, made up of 600 x 600mm, white acoustics ceiling boards.



Figure 6. Precision Gold N21FR, a hand held multimeter, retrieved from maplin (2017)

The illuminance, the measure of illumination of a surface for artificial lighting was calculated using:

Illuminance, E = Cos INC x l/d^2 (lux).....equation 1

Where l = luminous intensity in candela

d = distance (m)

INC = the angle of incidence of the extreme light ray (Szokolay 2008)

The average illumination, for the artificial lighting through calculation method was 3.14 lux

RESULTS AND DISCUSSION

The building assessment shows that the initially designed four feet fluorescent lighting system numbering forty-three (43) have been abandoned and replaced with six compact fluorescent lamps (CFL) each of 85Watts capacity. The average light level for the compact fluorescent is 3.14 Lux. The Illuminating Engineering Society, IES benchmark light level for a lecture theatre is 200 lux (Szokolay, 2008, p.192). The measured natural light level through fenestration for the hours 7am, every hour to 7p.m is attached in the appendix (Table 1). The average natural light levels peaked at 11am with 493.39Lux while the lowest was at 7:00pm with an average

illumination of 0.01lux (figure 7). The highest individual measurement occurred at 9:00 am with 1,920 Lux on row 6, while 7p.m. recorded the lowest value of 0Lux.



Figure 7. Time series analysis of the average illumination in the 750-capacity lecture theatre, Federal University of Technology, Akure for 22 07 2017

CONCLUSION

Results shows that natural light levels was as low as 0.01 Lux on the 22nd July 2017 at the 750 capacity lecture theatre. The artificial light level also fell short, as low as 3.14Lux. The implication for the low artificial light levels is that when the natural light level is low as it sometimes will say from 7-9a.m and 4-7pm, the artificial light level is inadequate to cater for the need of the users because it is very well below the 200Lux IESNA bench mark for lecture theatres.

REFERENCES

American Society of Heating, Refrigeration and Air Conditioning Engineers, USA, ASHRAE (2009). *ASHRAE Fundamentals*.

Baird, G. (2009). Incorporating user performance criteria into building sustainability rating tool (BSRTs) for buildings in operation, *Sustainability*, 1, pp. 1069-1086; doi:10.3390/su1041069

Brophy, V. & Lewis, J.O. (2011). A green Vitruvius, principles and practice of sustainable architecture design, London, Earthscan.

Chadderton, D. V. (2007). *Building services engineering* (5th Ed.). London. Taylor & Francis group

Creswell, J.W. (2009). *Research design, qualitative, quantitative and mixed method approaches*. California, USA, Sage publications Inc.

Flynn, J. E., Hendrick, C., Spencer, T. and Martyniuk, O. (1979). A guide to methodological procedures for measuring subjective impressions in lighting. *Journal of Illuminating Engineering Society (IES)*, 8(2), pp. 95 - 110.

Hepner, C. M., & Boser, R. A. (2006). Architects' perceptions of LEED indoor environmental quality checklist items on employee productivity. *International Journal of Construction Education and Research*, 2(3), pp.193-208; doi: 10.1080/15578770600907156.

Illuminating Engineering Society of North America (IESNA, 2000). *Lighting Handbook* (9th Ed), New York.

Kim, H. & Haberl, J. S. (2012). Field-Test of the new ASHRAE/CIBSE/USGBC performance measurement protocols: intermediate and advanced level indoor environmental protocols. *ASHRAE transactions*

Kothari, C. R. (2004). *Research methodology; methods and techniques*. New Delhi, New Age International Publishers.

National renewable energy laboratory, Battelle, USA (NREL, 2005). *Procedure to measure indoor lighting energy performance*, (Technical report No: NREL/TP-550-38602), retrieved from http://www.nrel.gov/docs/fy06osti/38602.pdf

Ondo (2012). Towards Habitable and Competitive Cities in Nigeria. An Address delivered by the Ondo State Governor; Dr. Olusegun Mimiko, at the *Nigerian Urban Summit 2012; Towards Habitable and Competitive Cities*, held at Sheraton Hotel and Towers, Abuja, November 13.

Sassi, P. (2006). *Strategies for Sustainable Architecture.* New York. Taylor & Francis.

Szokolay, S.V. (2008). Introduction to architectural science; the basis of sustainable design (2nd Ed.). Amsterdam, Elsevier.

The picture, precision gold N21FR (2017) retrieved from http://images.maplinmedia.co.uk/digital-multimeter-with-environment-testing.jpg?w=283&h=283&r=4&o=OB26sm9VYEdYyzbqLVRXby6nxbEj&V=X2ES

Yudelson, J. (2009). *Green Building through Integrated Design*. New York, McGraw-Hill.

APPENDIX

Table 1: Measurement in Lux for the 36 points in the 750 lecture theatre, Federal University of Technology, Akure Nigeria on the 22nd July 2017

Time	Grid line	2A	2B	2C	2D	2E	2F	Avg. Illum. (Lux)
7AM	Row 3	220	58	35	41	28	98	80
	Row 6	270	93.5	33	31.5	26	111	94.16666667
	Row 9	260	94.5	30	32	29	73	86.41666667
	Row 13	240	86	24	20.5	235	109	119.0833333
	Row 16	180	52	12	11.5	17	87.5	60
	Row 19	121	30	7.5	7	9.5	46	36.83333333
								79.41666667
8AM	Row 3	127	41	23	30	52.5	183	76.08333333
	Row 6	153	45	25	26	50.5	180	79.91666667
	Row 9	119	41	23	27.5	49	193	75.41666667
	Row 13	115.5	35	18.5	23.2	37	181	68.36666667
	Row 16	104.5	26.5	12.5	14.5	25.5	134	52.91666667
	Row 19	67	17.5	8.5	10.1	15.5	95	35.6
								64.71666667
9AM	Row 3	560	185	120	135	230	1260	415
	Row 6	820	200	121	157	330	1920	591.3333333
	Row 9	750	190	137	154	240	960	405.1666667
	Row 13	540	176	85	95.5	188	1050	355.75
	Row 16	340	112	53	51.5	725	530	301.9166667
	Row 19	230	69	34	34.5	55	220	107.0833333
								362.7083333
10AM	Row 3	550	220	153	152	270	820	360.8333333
	Row 6	750	240	135	140	300	780	390.8333333
	Row 9	610	210	132	130	210	1230	420.3333333
	Row 13	730	220	130	128	230	1770	534.6666667
	Row 16	420	150	71.5	70	142	710	260.5833333
	Row 19	290	81.5	43.5	45.5	85.5	600	191
								359.7083333
11AM	Row 3	880	300	200	210	370	1530	581.6666667
	Row 6	940	270	200	220	420	1900	658.3333333
	Row 9	870	320	210	220	260	1570	575
	Row 13	1120	250	147.5	172	300	1600	598.25
	Row 16	730	180	110	115	190	1000	387.5
	Row 19	360	108.5	58.5	64.5	126	240	159.5833333
								493.3888889
12 noon	Row 3	830	200	162	169	230	960	425.1666667
	Row 6	870	200	160	168	240	1140	463
	Row 9	710	200	126	145	200	1140	420.1666667
	Row 13	650	165	125	111	185	730	327.6666667
	Row 16	630	174	84	85	135	750	309.6666667
	Row 19	240	90	53.5	51	74	145	108.9166667
								342.4305556
1:00 PM	Row 3	560	210	194	200	230	590	330.6666667
	Row 6	550	220	189	190	220	600	328.1666667
	Row 9	640	250	182	175	173	630	341.6666667
	Row 13	580	220	192	175	250	690	351.1666667
	Row 16	570	210	120	125	200	860	347.5
	Row 19	200	102	65.5	68	87	310	138.75
								306.3194444

Table 1 cont'd: Measurement in Lux for the 36 points in the 750 lecture theatre, Federal University of Technology, Akure Nigeria on the 22nd July 2017

2:00 PM	Row 3	570	137	86	105	168	440	251
	Row 6	660	158	104	108	153	380	260.5
	Row 9	660	130	97.6	103	200	670	310.1
	Row 13	940	148	86	94.5	180	860	384.75
	Row 16	660	132	66	67	119	700	290.6666667
	Row 19	188	55	40	41	56	200	96.66666667
								265.6138889
3:00 PM	Row 3	1620	76.5	50	68	103	370	381.25
	Row 6	1600	101	65	74	109	290	373.1666667
	Row 9	450	98	67	78	123	410	204.3333333
	Row 13	450	92	55	58	109	490	209
	Row 16	440	83	41	42	85	390	180.1666667
	Row 19	136	39	26.5	27	39.8	100.5	61.46666667
								234.8972222
4:00 PM	Row 3	230	57	34.5	23	34	148	87.75
	Row 6	180	57	27.5	22.5	32.5	142	76.91666667
	Row 9	156	36	24.5	18.5	26.5	100.5	60.33333333
	Row 13	128	33	15.5	12.9	21.5	123	55.65
	Row 16	112	21.8	9	8.1	16.3	111.5	46.45
	Row 19	38	10.7	7	6.2	8.5	37.3	17.95
								57.50833333
5:00 PM	Row 3	200	63	33	26	32.5	76	71.75
	Row 6	152	31	18	21.5	29	88.5	56.66666667
	Row 9	153	25.5	14.5	14.5	22.5	63	48.83333333
	Row 13	155.5	31.5	13.5	10	16.5	69.3	49.38333333
	Row 16	136.5	28.5	13	7.5	11.7	61.5	43.11666667
	Row 19	45	13.5	8.5	4.5	5.5	13.5	15.08333333
								47.47222222
6:00 PM	Row 3	36	8.5	5.5	4.5	8	33	15.91666667
	Row 6	43	11.5	5.5	6	9	36	18.5
	Row 9	46	12	7.5	7.5	11	47	21.83333333
	Row 13	60	13	6.6	5.5	10	58	25.51666667
	Row 16	60	11.5	5	4.5	9	61	25.16666667
	Row 19	23	6.5	3.5	2.7	4.5	19	9.866666667
								19.46666667
7:00 PM	Row 3	0.2	0	0	0	0	0	0.033333333
	Row 6	0	0	0	0	0	0	0
	Row 9	0	0	0	0	0	0	0
	Row 13	0	0	0	0	0	0	0
	Row 16	0	0	0	0	0	0	0
	Row 19	0	0	0	0	0	0.2	0.033333333
								0.011111111

ASSESSMENT OF PRECEDENT ANALYSIS PROCESS IN ARCHITECTURAL DESIGN PEDAGOGY IN NIGERIAN UNIVERSITIES

Sarah K Goshi[1], Abubakar Danladi Isah[2], Julius O. Onuwe[3]
[1,2,3]Department of Architecture, Federal University of Technology Minna, Nigeria

In architectural design pedagogy, precedent studies (also commonly referred to as case studies) are employed as educational tools to deliver information on the completed building, the design process or challenges faced by the architect and the solutions proffered. However, the manner of reporting on cases studies has been criticised as being oftentimes anecdotal and offering an incomplete picture, lacking an appropriate precedent assessment format. In this regard, this study seeks to explore if precedent analysis is engrained in the method used to analyze existing buildings by students of architecture in Nigerian universities. The students' format of analyzing existing buildings is studied and compared to Alexander Tzonis widely employed' framework for precedent analysis. Consequently, a case study using mixed research method was adopted. In the process, data was collected via questionnaire survey and document study of archived students' theses. The results show that the students' approach to precedent analysis is partially thorough and falls short of the acceptable standards. In addition, the outcome indicates that students receive minimal guidance from design mentors which contributes to under-studying existing buildings. Consequently, students face challenges that include the lack of access to the buildings' drawings particularly construction floor plans and sections that leads to incomprehensive assessment. Afterwards, the study established that students of architecture in Nigerian universities require more tangible guidance for proper precedents' analysis. Also, there is the need to facilitate access to building drawings or access into the buildings. Professional bodies and regulatory agencies such as Nigerian Institute of Architects and Architects' Registration Council of Nigeria should assist in enabling online documentation of certain buildings' drawings for study purposes. The findings suggest the need for operational guidelines in conducting precedent studies by students in Nigerian universities.

Keywords: architectural design, pedagogy, case studies, Nigerian universities, precedent analysis

[1] ganasarah2003@yahoo.com
[2] arcmuzaifa@futminna.edu.ng
[3] misi4u_ju@yahoo.com

Goshi, S., Isah, A. D. and Onuwe, J. O. (2017) Assessment of precedent analysis process in architectural design pedagogy in Nigerian universities *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 347-363.

INTRODUCTION

Architectural training has consistently prioritized the use of precedents in the design process —from Antiquity through the Middle Ages to the Renaissance as well as in the French Ecole des beaux arts. Even today, precedent studies (or case studies as they are commonly referred to) continue to be employed as a component of the design process for students (Kuhn, 2001) as it allows them to appreciate and gain post occupation experience of users' interaction with buildings, thereby ensuring that mistakes are avoided in the students' own designs as well as serve as a reference for new design solutions and development. Precedents usage in design also ensures that designers are informed of users' desires thereby promoting sustainable design based on the reconciliation of conflicting values and concepts. This is most important when new approaches are desired to deal with reoccurring planning and design problems. Precedent based learning ensures the reduction of design errors enabling imaginative and advance design relying on evidence based design solution. Consequently, students are taught how to design by studying and explicitly analysing previous works of architecture (Guney 2011). According to (Omer, Cumming, Shealey and Tuncer, 1996) it is imperative for students to be exposed to a rich repertoire of outside buildings.

The manner in which students conduct studies into the built environment, has been criticised by several authors including Stevenson, (2014); Salama, (2006); Christenson and Bakr (2007); Restrepo and Christians (2005) as well as Boling, Gray and Smith (2015). Case studies of existing buildings that should provide students with practical appreciation of design problems, phenomenon and solutions in order to support their studio design proposals are often given less priority. Instead more attention is given more to the product of design by both students and mentors, than is paid to the process by which the finished product was achieved. Hypothetically, the process of conducting these precedent studies by students requires investigation as they usually form part of the studio requirements of the design process. Meanwhile, studio based learning is an integral part of design education and it is characterized by a pedagogical model that includes practical learning and critical thinking using reasoning methods- an analogical and metaphorical reasoning towards design solving problem (Choi and Kim 2016).

Studio based pedagogy inculcates the principles of experiential learning, a hands on, learning by doing approach which focuses on the students' active involvement in their learning process. Facdev@niu.edu (2016) defines experiential learning as "a philosophy and methodology in which educators purposefully engage with students in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values". Experiential learning is also referred to as learning through action, learning by doing, learning through experience, and learning through discovery and exploration. In Experiential learning students partake in real life activities which they reflect on activities, and incorporate their new understanding of

those activities into their lives (Bohn & Schmidt, 2008.) The theory, despite its limitations, is recognized as a useful framework for teaching and learning design (Tezel and Casakin 2010; Prakash, 2015).

Although learning content is important, learning from the process is at the heart of experiential learning. During each step of the experience, students will engage with the content, the instructor, each other as well as self– reflect and apply what they have learned in another situation.

In architectural design pedagogy, experiential learning takes place via the vehicle of studio based learning; problem based learning as well as precedent based learning. Students are expected to study and analyse existing buildings as part of their design process. However, in order for the precedent to be useful, the knowledge embodied in it needs to be made explicit and this calls for precedent analysis. (Guney,2011)

Experiential learning is a minimal guided approach to pedagogy. It has been argued though, that minimal guidance does not work and students need to be properly guided by mentors. (Kirschner, Sweller &. Clark 2006).

Background studies

Precedent Studies as part of the Design Process

Precedents could be regarded as previous works and assertions that could serve as an illustration or regulation towards a subsequent act of similar analogy. Still, a precedent could be in the form of a person or thing that serves as a model. DeFazio (2008), referred to precedents as phenomena which exist in cognitive or physical form that provides information on existing design which gives insight towards solutions to the next iteration of a new design. He further outlined syllabi, lecture materials, visual and auditory materials, lab and homework assignments, projects, papers, performance results, episodic memory, and similar artifacts of previous works as samples of precedents. A precedent serves as a source of inspiration and an Idea or guide to a method while designing. Fang (1993) described a precedent as a pre-existing building or other built environment that could serve as an example or a constraint for the current work. Additionally, precedents refer to the representation of knowledge about a past design in a form that makes it applicable or reusable in a new but similar problem situation (Akin, 2008). It is therefore evident that using works of precedents provides solutions to similar problems thereby serving as a reference point when new design products are to be generated or developed. Gabi Goldschmidt has suggested that the phenomenon should be referred to as reference rather than precedent (Goldschmidt, 1998).

Historically, the use of precedents in architectural education dates back to the French Ecole des Beaux Arts (Taneri, 2008). In Architecture to be specific, precedents are widely employed by both students and professionals when new designs are being conceived (Kuhn,(2000); Zarzar,(2003); Difazio,(2008); Van den Toorn and Guney,(2011); Boling, Gray and Smith (2015); Akin,(2008).Hence, precedents are sources of knowledge for designers and are important in generating images of likely solution space in order to attain impressions related to modes, styles, trends, uses of

materials and fabrication techniques, better still they are potential sources of inspiration (Restrepo and Christiaans, 2005). Precedents are applied in a number of different ways in architectural design pedagogy. They could be used to illustrate the results of using certain materials or manufacturing processes. Also, in comparing differences in styles or design movements or in discussing the effects of changing the spatial relations among components in order to monitor trends, or as sources of knowledge and inspiration. Nevertheless, this study focuses on the evaluation of built forms as precedents by students of architecture in Nigerian universities.

Value of Precedent Learning in Architecture

As mentioned earlier, the term 'precedent study' is often used synonymously with 'case study' (Sarvimaeki, 2013). Although there are controversies associated with the employment of case studies as a research method (Zainal, 2007; Sarvimaeki,2013), this has not dampened their effective usage in many disciplines, such as law, business, medicine, psychology, sociology, cultural anthropology, engineering, and urban planning as well as architecture. Case studies act as an integrated, important and indispensable part of the curriculum in most schools of architecture.

In order to facilitate a holistic learning process and education, students need to participate fully in all the three processes of development of case studies as identified by Hancock (2017), analysing the case studies, interpreting the case studies into real design solutions by applying the concepts and ideas of design, building construction as well as applying graphical and drawing tools.

Kwok, (2003) identifies the use of case studies as an educational method employed in architectural design pedagogy in a variety of ways. Frequently, these case studies are presented as studies of completed buildings emphasizing issues such as information about the building, its design process or how the designer handled challenges peculiar to the building. However, ----- Go ahead to explain that oftentimes, the design process, no matter how crucial to the design output is neglected and the case study report is mostly anecdotal.

Anecdotally speaking, the use of case studies in architectural design pedagogy has received little attention among Nigerian educators and only a few authors have attempted to give a guide as to how studies into the built environment should proceed. Among them are Uji (2009) Oluigbo (2016). In conducting these case studies into the built environment parameters to be considered, according to Uji (2009), include the client, the consultants and the contractor's opinion about the building's performance; functionality of the spaces provided, circulation, construction materials, structural form and aesthetics. The extent to which the goal of the design is achieved should also be investigated. Similarly, Oluigbo (2016), provided a framework that combined design documentation with theoretical data collection and analysis particularly for masters' students. According to him the existing buildings being studied could be described based on the subject matters that

include history and background, site planning and landscaping, form and expression, structure and materials, as well as building services.

While Uji and Oluigbo's framework might be appropriate for the students in first or second year of study, the more advanced student needs to be able to evaluate buildings using a more standardized precedents' analysis framework.

Precedent based learning initiates from the consideration of earlier examples. This learning approach is stimulated by explicit analysis of previous works of architecture (Guney and Van den Toorn, 2011). Precedent analysis could be a quick exercise or it could be pursued in-depth depending on the goal of the study– whether to obtain a few ideas or just one notable one from multiple projects. The goal could also be to conduct an in-depth analysis of a few projects in which case many categories would be viewed and studied (Clement, 2012). Therefore, there is much to be learnt from existing buildings that could help develop ideas for one's own project by observations and on the spot discussions (Van der Voordt and Van Wegen, 2005).

Again, building performance should ideally be measured by the client's requirements. However, for the student conducting a precedent study this might not be readily available. In such instances, the student could rely on generally acceptable performance standards of buildings and those perhaps peculiar to such building types under study. Architectural precedents' value could be described by their performance, operation and morphology— the POM system (Tzonis, 1992). According to Guney and Van den Toorn, (2011) most studies centered on analyzing architectural works are based mainly on morphology— that is configuration/ spatial organization. The concept of performance in relation to function and operation attributed to Alexander Tzonis is of major importance for design methodology since it lays the foundation for integrating experiences from former plans into contemporary design.

The POM system

According to Tzonis, the POM system relates issues that express broadly architectural knowledge, fundamental concepts and structures which contain evidences in precedent, principles and rules of Architecture. It thus suits the reasoning mechanism that guides and develops architectural needs into design products (Tzonis, 1992). Its attributes and composition enables the mechanism to aid design explanation, generation and could be adapted for precedent analysis in design pedagogy. The POM system relies mainly on four major components that include Performance, Operation, Morphology and Context with performance and operation usually related.

Performance could be examined using variables of functionality, safety and physical state across the life cycle of a building in its anticipated or actual performance conditions. Students need to analyse building performance in order to appreciate users' interaction with existing buildings and comprehend prevailing situations with regards to the overall building efficiency. Also, students need to analyse how the form and operation of the

building enhance its performance. These can be summed up as a means of grounding student design approaches in reality and giving them the experience and tools to be able to do so (Stevenson, 2014). Operation of a building refers to the functional state, the manner in which the building form allows ease of way finding, facilities and equipment mechanism, control, and maintenance- ability. Operation implies the use of the building and the role the building form plays in this process (Tzonis and Heintz, 1995) such as linking people, equipment and objects with activities hosted in the building (Tzonis 1992).

Urban building's formal aspect in its spatial composition, materials' structure and its artifact attributes constitutes its morphology (Tzonis, 1992). Moreso, buildings' form is examined through its physical properties (Fang 1996). Thus, configurational attributes and physical constitution of design products constitute the morphological features for examination. Context refers to the situation, background and environment within which the buildings is located. Again, it is important to note that morphology, operation and performance are related. This relationship Tzonis illustrates with a corridor's specific shape which defines its morphology and an advantage of peoples' safe evacuation potentials (related to the performance and operation) with lighting conditions of particular context. Utility functions and cultural functions are typical contextual components of buildings to be examined. Consequently, Van der Voordt and Van Wegen (2005), categorized the functions of buildings into utility functions and cultural functions. Utility functions on one hand include protective functions, domain/territorial functions, spatial organization of activities and climate regulation. Cultural functions on the other hand include social function, cultural function as well as economic functions. However, Zarzar (2003), asserts that the function a building is designed to attain determines its performance. Thus, performance of a building indicates the requirements that conditions the building for possible use satisfactorily as intended and expressed in measurable terms that are objectively verifiable.

Accordingly, buildings are evaluated for their reachability, parking facilities, accessibility, construction, efficiency and ergonomic, as well as fire and public safety. Also, the physical conditions— lighting, noise, heating, draught, privacy, spatial orientation, building physics and overall environment. Van der Voordt and Van Wegen, (2005) enumerated the functional quality of a building to include the protection of people and property from harmful effects of wind, rain and inquisitive people; domain or territorial function which makes operation possible with others' influence thus ensuring security and privacy; social function that create spaces and places to carry out activities that define the quality of life effectively and cultural function relating to form and character of the spatial environment. Similarly, they referred to the functional quality of a building as the extent to which it provides a proper level of support to the desired activities, creates a pleasing interior climate, has a positive symbolic or cultural meaning and contributes to a favourable economic return and an optimum price–performance ratio. Therefore, a functional building is a building that is

suitable for the activities for which it was intended. The people inside the building must be able to function efficiently, comfortably, healthily and safely. This means that people must be able to reach and get into the building easily and move round the building comfortably. The building must be sufficiently in harmony with human perceptions– in the way it looks sounds, smells and feels. People must also feel physically comfortable, which means that the building must not be too hot or too cold nor must it be dirty, dark or noisy. People must be able to see how the parts of the building fit together and able to find their way round. All kinds of psychological needs must be considered. For instance, the need for privacy, social contact, freedom of choice and autonomy are crucial for consideration. The building must also be capable of being adjusted to suit changing circumstances, new activities and different users. With this as a basis, the concept of functional quality could be measured from nine aspects: Reachability and Parking facilities; Accessibility; Efficiency; Flexibility; Safety; Spatial orientation; Privacy; Territoriality and Social contact; Health and as well Physical well-being and Sustainability.

METHODOLOGY

The study in exploring the phenomenon of students' format of analysing precedents in their design projects adopted Tzonis' (1992), POM system for precedent analysis as methodology. The POM system approaches precedents from four critical assessment components comprising Performance, Operation, Morphology and Context. Thus, the evaluation criteria for precedents analysis were based on these sub-categories as indicators while the attributes examined and used to measure the indicators were developed from appropriate previous research works. In order to achieve this, the research question requires that information be solicited using a structured questionnaire and document checklist for examining previous theses submitted to the department. To scrutinize precedents' analysis phenomenon the research adopted Yin's (2003) case study research strategy which adequately outline five components of case study research asserted to be appropriate due to the research's focus on a phenomenon and contemporary issues. Advantageously, case study research helps refine and optimize the understanding of ideas (Stake, 2010). Therefore, to understand Architecture students' precedents' analysis process and archival content, the research qualitatively considered a case study strategy.

Purposefully, focusing on Department of Architecture the researchers selected Federal University of Technology Minna, Nigeria for the study. Students in their third, fourth and fifth year of study were considered eligible for participation in filling the questionnaire. Also considered fit to provide data were students who are in the master's degree programme. These categories of students gave a total population of 268 from which a sample of 200 respondents well distributed across the levels was randomly selected to partake in the study. However, 184 forms were returned accounting for 91.5% response rate. These groups are considered to be highly developed in design reasoning and thinking, creativity and having

adequate understanding of precedent procedures and analogies leading eventually to inventive design ideas. Subsequently, two evaluation criteria based on related research works were advanced. Observation checklist and questionnaire form were used to solicit information. They were based on questions related to the background and covers Tzonis' four orders categorized for the POM system using a five-point Likert scaling system ranging from "strongly agree to strongly disagree" as response format. The data solicited was analysed using regression analysis with statistical criteria for interpreting the findings.

RESULTS AND DISCUSSION

Three methods of analysis were employed for the data solicited from the field. First, descriptive and inferential statistics was used to process the information derived through questionnaire survey. Secondly, qualitative content analysis was used to process information deduces using observation schedule. Descriptive analysis shows that an average of 65% of the respondents have completed between 4 and 11 design studio projects while 32% have attempted 1-3 and the remaining 3% have completed 12-15 design projects. This implies that the sample has been exposed to to studio learning experience after attempting several studio projects. Accessibility to building was identified as the major challenge faced by students while conducting precedents studies of buildings with 122 attestations recorded from the respondents. Security and lack of guidance recorded 74 and 73 attestations respectively leaving difficulty in identifying appropriate case study with least attestation of 23. This indicates that they are not able to conduct in-depth evaluation, thereby raising the need to examine the method adopted by students in conducting case studies. Observation schedule stood out as the main instrument used for precedent analysis recording 123 confirmations. Questionnaire and Interview guides recorded 55 and 44 confirmations respectively. Additionally, 45 confirmations were distributed among Internet sourcing (21), Photographs (15) and use of sketches (9).

Afterwards, the Likert scaled questionnaire items where first subjected to reliability statistics test in order to establish the internal consistency of the items contained in the questionnaire instrument. Accordingly, the four factors represent 60.4 percent of the variance of the variables. Building performance consisting of fifteen variables (alpha = 0.83). Morphology was loaded with ten variables (alpha = 0.81) while Context contained eleven variables (alpha = 0.84) and Building operation was loaded with twelve variables (alpha 0.84). The overall reliability was conducted on the 48 questionnaire items as they were subjected to reliability test and alpha = 0.935(see Table 1), a value above the allowable threshold. Subsequently the items were weighed through confirmatory factor analysis conducted on Building Performance, Morphology, Context and Building Operations. This was to ascertain the factors that weigh higher and contribute more in establishing the factors. In other words, to identify strong and weak variables both for the acceptance of the variables in the factors' composition as well as for further regression analysis. In order to achieve this principal

component analysis was used as an extraction method which resulted in their loading values ranging between 0.523 and 0.806 thus based on these values they fit into the factor models and are also accepted for subsequent regression analysis. Furthermore, the Berrlett's test of sphericity confirmed the correlation of variables within the factors, while the measure of sampling adequacy using Kaiser-Meyer-Olkin (KMO) indicated practical level of common variance with KMO = 0.854 (see Table 2) thus factor analysis is appropriate.

Further still, regression analysis was used to ascertain the level at which the precedent assessment variables adopted in the instrument provide predicting explanation on the students' case study approaches. Thus, relating their comprehension of the process and adoption during case studies of architectural precedents. The regression analysis results show that a statistically significant relationship exists among the variables measured, thus the models fit the data and are acceptable as the independent variables explaining the dependent variables in the four models. Specifically, the analysis revealed that in Model 1 – Building Performance (R^2= 0.24, Adjusted R^2= 0.29, P< 0.01) which shows that only 24% of the variation was explained. For Model 2 – Morphology (R^2= 0.20, Adjusted R^2= 0.16, P< 0.01). It means only 20% of the variation accounted for morphology, as for Model 3 – Context (R^2= 0.23, Adjusted R^2= 0.19, P< 0.01) and for Model 4 - Building Operation (R^2= 0.20, Adjusted R^2= 0.15, P< 0.01), thus 23% of the total variation accounted for context and 20% accounted for building operation respectively. So, the proportion of the variation in the variables that accounted for Building Performance, Morphology, Context and Building Operation are statistically significant.

In sum, Building Performance, Morphology, Context and Building Operation clearly show a positive effect on precedent analysis from the data exploration. Although the results can be considered statistically significant in most parts and the data supports the supposition measured in the multiple regressions, the strength of the relationship between the independent variables and dependent variables indicates low level awareness of students on the concept of precedent analysis.

Taking a qualitative approach, data was solicited from previous undergraduate and master's degree thesis submitted within the past five years using a checklist. By means of ranking based on a five-point scale measure; where 1 = Very Comprehensive, 2 = Comprehensive, 3 = Fair, 4 = Sketchy and 5 = Poor the theses were examined by a jury consisting of experts who have been teaching design for not less than ten years. Their submissions were computed and the average for each factor comprising of average summation of other variables were established.

Table 1. Reliability Statistics, KMO and Bartlett's Test

Cronbach's Alpha.935	Cronbach's Alpha Based on Standardized Items.937	N of Items48
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.854
Bartlett's Test of Sphericity	Approx. Chi-Square	3963.675
	Df	1128
	Sig.	.000

Table 2Variables Measured.

Model	Dependent Variable	Independent Variables-Predictors (constant)
1	Building Performance	Aesthetics, Stakeholders perception, Material durability, Privacy, Inventory of functions, Building sustainability, Ergonometric safety, Building services, Circulation patterns, Fire safety, Environmental friendliness, Flexibility of building plans, Building safety, Structural stability
2	Form Morphology	Space sizing, Spatial configuration, Colour of elements, Structural elements, Building Geometry, Building direction, Distribution of components, Texture of elements, Building positioning
3	Context	Design principles, Site planning, Cultural or Symbolic meaning, architectural style, Geographic condition, Legal requirements, Historical background, Fitness to environment, Zoning regulations, Relation with other buildings
4	Building operation	Cost comparison, Landscaping elements, Efficiency of lift elevator, Artificial lighting, Facility reachability, HVAC system, Facility sustainability, Installation of fire measures, Facility accessibility, Acoustic effectiveness, Packing facilities

Table 3Regression Analysis - Model Summary

				Std. Error	Change Statistics				
Model	R	R2	Adjusted R2	of the Estimate	R Square Change	F Chang	df1	df2	Sig. F Change
Building Performance	0.545	0.297	0.240	0.792	0.297	5.141	14	170	.000
Form Morphology	0.453	0.205	0.164	0.932	0.205	4.996	9	174	.000
Context	0.485	0.235	0.191	0.963	0.235	5.346	10	174	.000
Building operation	0.448	0.201	0.150	0.854	0.201	3.958	11	173	.000

Thereafter scores were rated to view the general opinion of these experts in assessment of the level of compliance with the precedents analysis indicators during their case study assessments. A total number of fifteen theses labelled using codes A to O were randomly assessed until data saturation occurred. The result as contained in Table 3 shows that generally the students were rated poor in the application of the four precedents analysis indicators as contained in the POM system. It therefore means that the indicators are not adequately understood by the students because even where these indicators appeared in the theses they were inadequately measured. Such an outcome could mean that there is an absence of a proper precedents assessment framework as partially observed from the case study report pattern in the theses or that the mentors do not provide the required guidance.

Table 4 Content Analysis of Observation Checklist. (Scale - Very Comprehensive = 1, Comprehensive = 2, Fair =3, Sketchy = 4 and Poor = 5) (Rating

	Indicators	Students' Thesis Jury Analysis														
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
I	Building Performance Metrics															
	Average Score	2	4	3	4	3	3	1	3	1	1	1	3	1	2	1
	Rating	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Ii	Building Operation															
	Average score	2	5	2	4	4	3	1	3	0	5	3	1	4	1	3
	Rating	5	4	5	5	5	5	5	5	5	4	5	5	5	5	5
iii	Morphology															
	Average score	2	2	1	3	1	0	0	2	1	1	1	0	1	3	1
	Rating	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5
Iv	Context															
	Average score	2	2	2	2	3	3	1	3	2	2	2	2	2	1	1
	Rating	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

SUMMARY AND CONCLUSION

The primary goal of this study was to explore the assessment process of existing buildings by students of Architecture during case study as a requirement in studying design. This was examined in relation to POM system as indicators with their variables derived from literature. The models developed shows statistical significance in the relationship between the exogenous and the endogenous attributes. However, the low value recorded in the coefficients is indicative of inadequate understanding and application of Precedents' analysis principles. This is in agreement with the results from univariate analysis that shows a high percentage of students confronted with problem related to lack of accessibility to buildings being studied, security challenges as well as lack of adequate mentoring even as observation remains the main method adopted for Precedents' Analysis. Similarly, the result from content analysis of data recorded from observation indicates a poor application by undergraduate finalists and masters students of precedent analysis principles.

Significantly, this study has initiated discussion on design case study assessment approach in Nigerian universities. It has also successfully established the lack of proper precedent study framework leading to the need for operative guidelines for precedents analysis in order to assess the built environment by students in Nigerian universities. It then calls on regulatory agencies and professional bodies to assist in the provision of platforms where information of important buildings can be assessed for research purposes.

LIMITATIONS AND FURTHER RESEARCH

Even though the results show statistical significance in all the models, the study has some limitations that could affect the reliability and validity of the findings. First, the regression models recorded low coefficients. Second

although the sample size is large enough for statistical analysis its focus on one case study only makes it illustrative and findings cannot be generalized. Third, the study did not establish the knowledge level of the mentors and experts with regards to the principles and concepts of precedent analysis as the focus was only on the students. Consequently, we could not define the framework adopted by these students as our basis of measurement was concentrated on POM system. Similarly, the variables utilized for measuring the indicators are subjective and inexhaustive by the models, but limited to those mentioned.

These limitations pave the path for future research. Covering a bigger sample that includes more universities can lead to possible empirical generalization. A more holistic scope that will examine the mentors and design tutors as well as design jury sessions could lead to the formation of Precedent assessment framework for architectural design pedagogy in Nigerian universities.

REFERENCES

Clement, L. (2012). Analysis of Precedent retrieved from http://faculty.capd.ksu.edu/lcweb/LAR%20433/433%20Analysis%20of%20Precedent.html. 16/04/2016.

Akin, O. (2008). Case Based Instruction Strategies in Architecture. Carnegie Mellon University retrieved from http://www.sciencedirect.com/science/article/pii/SO142694X01000461.

Bohn, D. M., & Schmidt, S. J. (2008). Implementing experiential learning activities in a large enrollment introductory food science and human nutrition course. Journal of Food Science Education, 7(1), 5-13. DOI: 10.1111/j.1541-4329.2007.00042.x. Retrieved on 4/5/2015

Boling, E., Gray, M.G. and Smith, K.M. (2015). Studio Teaching in the Low-Precedent Context of Instructional Design. Learn X Design Conference Proceedings of the 3rd International Conference for Design Education Researchers Cumulus 28th June- 1st July 2015, ISBN 978-952-60-0069-5 vol 1- 4.

Christenson, M and Bakr, A. A. (2007). The Good, Bad, and Ugly in Architectural Case Studies.In Flux: Design Education in a Changing World. Proceedings of the 5th International DEFSA Conference, 3-5 October 2007, Cape Town, South Africa, ISBN 978-0-620-39561-8, CD-ROM.

Choi, H. H. and Kim, M. J. (2016). The Potential of Reasoning Methods as a Teaching Strategy Supporting

Students' Creative thinking in Architectural Design, International Journal of Architectural Research10(3) Archnet-IJAR.

DeFazio, J. (2008). Designing with Precedent: A Cross-Disciplinary Inquiry into the Design Process, Unpublished PhD Dissertation submitted to the Department of Instructional Systems Technology Indiana University, USA.

Fang, N. (1993): A Knowledge Based Computational Approach to Architectural Precedent Analysis. Unpublished PhD dissertation. Delft University Press, Netherlands.

Guney, A. and Van Den Toorn, M. (2011). Precedent Analysis in Landscape Architecture; In Search of an Analytical Framework, IASDR DELFT Diversity and Unity. Proceedings of the 4th World Conference on Design Research. 31st Oct to 4th Nov. Delft, the Netherlands. Edited By N.F.M.Roozenburg, l.L.Chen and P.J. Stappers.

Ghaziani, R., Montazami, A., and Bufton, F. (2013). Architectural Design Pedagogy: Improving Student Learning Outcomes- Association of Architectural Educators Conference 2013 retrieved from http://architecturaleducators.files.wordpress.com on 8/3/2015.

Hancock, F. E. (2017): The case study method in Architecture teaching. http://docplayer.net/40719774-The-case-studies-method-in-architecture-teaching.html. Retrieved 6/6/2017

Iordanova, I. and Tidafi, T. (2000). Using Historical Know-how to Model Design References a Digital Method for Enhancing Architectural Design Teaching in Martens B., Brown, A., and Gero J. S. (ed.) Computer Aided Architectural Design Futures 2005: Proceedings of the 11th, Media International CAAD Futures Conference held at Vienna University of Technology Vienna, Austria June 20-22, 2005 Published by Springer Science and Business Media.

Kuhn, S. (2001). Learning from the Architecture Studio: Implications for Project-Based Pedagogy. International Journal of Engineering Education. 17(4 and 5), pp. 349-352.

Kirschner, P.A., Sweller J. & Clark R.E. (2006): Why Minimal Guidance during Instruction does not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. Educational Psychologist. 4(:2), pp. 75-86, DOI: 10.1207/s15326985ep4102_. Retrieved on 31/5/2017

Kwok, A.G. (2003): Case Studies as Research. Proceedings of the ARCC Spring Research Conference, April 2003. Retrieved from pages.uoregon.edu/akwok/pdfs/arcc03caseppr.pdf. Retrieved on 6/6/2017

Lawson, B. (2005). How Designers Think. The Design Process Demystified.4th edition Architectural Press. United Kingdom.

Lawson, B. and Dorst, K. (2009). Design Expertise. Architectural Press. New York U.S.A.

Northern Illinois University Faculty Development and Instructional Design Center (2016): Experiential Learning. Retrieved from facdev@niu.edu, www.niu.edu/facdev, 815.753.0595 on 15/04/2016. Pg 1

Oluigbo, S. N. (2016). A framework for the Application of Case Study Research in Architectural Design Theses in Nigeria. Nigeria Institute of Architects' Journal. September 2015 vol1 and 2.

Omer, A., Cumming M., Shealey M. and Tuncer B. (1996). An Electronic Design assistance Tool for Case Based representation of Designs. Automation Construction, 6(4), pp. 265-274 doi: 10.1016/S0926-5805(97)00047-2 retrieved on 31/5/2016

Pasman, G. (2003). Precedents in Design, Unpublished PhD Dissertation, Delft University of Technology.

Restrepo, G. and Dairo, J. (2005). From Function to Context to Form: Precedents and Focus Shifts in the Form Creation Process. Proceedings of Creativity and Cognition conference 2005, Published by Transactions of the Association for Computing Machinery Acm, 2005, ISBN 1595930256.

Salama, A M. (2006). Learning from the Environment: Evaluation Research and Experience Based Architectural Pedagogy Center for Education in the Built Environment Transactions, 3(1), pp 64-83 (20).

Sarvimaeki, M. A (2013): A Case Study on Case Studies. ARCC Conference Repository, 2014.pp 338-342

Stake R. E. (2010). Qualitative Research: Studying how things Work. Guilford Press.

Stevenson, F. (2014.). Architectures of Consequence: A Methodology for 'Live' Building Performance Evaluation in the Studio. Association of Architectural Educators 2014 Conference Proceedings. Retrieved from https:/architecturaleducators.file.wordpress.com retrieved 14/06/2016

Smith, P. L. and Ragan, T. J. (2005). Instructional Design (3rd Ed.). Hoboken, New Jessy, Wiley Revolutionary Models, 2000.

Taneri, B. (2013). Architecture Students' Perceptions of Design and its Transformations throughout their Education. Unpublished Master's thesis Submitted to the Graduate School of Engineering and Sciences of İzmir Institute of Technology.

Tzonis, A. (1992). Huts, Ships and Bottle racks: Design by Analogy for Architects and/or Machines Research in Design Thinking. Proceedings of a Workshop meeting held at the Faculty of Industrial Design Engineering, Delft University of Technology, the Netherlands, May 29-31, 1991. Edited by Cross,N., Dorst,K. and Roozenburg,N. pp 139 -164.

Yurtkurana, S., Kırlı, G, and Taneli, Y. (2013). An Innovative Approach in Architectural Education: Designing a Utopia. 2nd Cyprus International Conference on Educational Research, (CY-ICER 2013).

Uji, Z.A. (2009). Tools and Instruments of Research in Design and Allied Disciplines. Ichejum Publications, Jos, Nigeria.

Van den Toorn, M. and Guney, A. (2011). Precedent Analysis in Landscape Architecture; In search of an Analytical Framework.TU Delft and IASDR.

Van der Voordt, and Van Wegen, (2005). Architecture in Use an Introduction to the Programming, Design and Evaluation of Buildings. Architectural Press.

Yin, R. (2003), Case Study Research: Design and Methods. London, Sage Publishers.

Zainal, Z. (2007): Case study as a research method. Jurnal Kemanusiaan bil.9, Jun 2007

Zarzar, M.K. (2003). Use and Adaptation of Precedents in Architectural Design toward an Evolutionary Design Model. Unpublished PhD dissertation. Delft University Press, Netherlands.

APPENDIX I

Questionnaire

Form No ☐☐☐☐

Precedents' Analysis Approach by Architecture Students of Nigerian Universities

Precedents' analysis is an integral part of the design process as taught in the architectural design studio. This questionnaire is aimed at examining how architecture students studying in Nigerian universities approach precedent analysis of existing architectural works. The survey is strictly for academic purpose and aimed towards establishing a precedents analysis framework for Departments of Architecture in Nigerian universities. Any information provided will be treated with optimal confidentiality, thus your honest response is required.

SECTION A. Bio-Data and preliminary information

1. Year of study 300 level ☐ 400 level ☐ 500 level ☐ Masters ☐
2. Number of design studio projects completed to date. 0-3 ☐ 4–7 ☐ 8 – 11 ☐ 12 – 15 ☐
3. Identify the challenge(s) you have encountered while conducting precedent studies (case studies).
   Security ☐ Identification ☐ Accessibility ☐ Lack of guidance ☐
4. Identify the Guide / Instrument you've employed in the conduct of the precedent study.
   Observation checklists ☐ Questionnaire ☐ Interview guide ☐
   Others (specify)……

SECTION B. Significance level of checking for Precedents' Study attributes during Case studies.

	Building performance	1	2	3	4	5
1	Examining building performance is integral to precedents' analysis.					
2	I prepare an inventory of functions accommodated within a facility whenever I conduct a precedent analysis.					
3	I examine stakeholders' (client, contractor and users) perception about the building's performance.					
4	I examine the level of privacy afforded to the occupants by the buildings.					
5	I examine if the buildings' plans are flexible.					
6	I examine the ergonometric safety of the building.					

7	I examine how safety of the building for the public's use.					
8	I examine both vertical and horizontal circulation patterns in the building.					
9	Fire safety is one of the attributes examined.					
10	I examine the structural stability of the building.					
11	I examine environmental friendliness of the building.					
12	I examine the building's level of sustainability.					
13	I catalog the Materials employed and explore their durability and appropriateness.					
14	I take into cognizance the building services available during precedent analysis					
15	I examine the aesthetic attributes of both the interior and exterior components of the building.					

Please indicate the significance you attach to these attributes while conducting precedents' studies (case studies) for your design proposals/projects. Provide your responses guided by the legend- Strongly Agree [1] Agree [2] Neutral [3] Disagree [4] Strongly Disagree [5].

	Operation	1	2	3	4	5
1	Studying the mode of building operation is essential to precedent analysis.					
2	In analyzing a building, I study the effectiveness and adequacy of the parking facilities.					
3	I access the appropriateness of landscaping elements employed.					
4	I examine artificial lighting control in facilities studied.					
5	I examine the building's acoustics' effectiveness.					
6	I appraise fire safety measures/ installations put in place within the facility.					
7	I examine the efficiency of the lift /elevator system in the facilities studied.					
8	I examine the HVAC (heating, ventilation and air conditioning) system within the building studied.					
9	I appraise the facility's accessibility for both visitors and users (e.g. ease of locating the entrance).					
10	I access how reachable the facility is and how this reachability is achieved.					
11	I examine how sustainability is achieved in the building (e.g. energy savings, conservation of natural resources/ ecological friendliness).					
12	I investigate the cost of putting up the building against cost of maintaining it.					

	Morphology	1	2	3	4	5
1	Accessing the form/morphology of a building is a key aspect of precedents analysis.					
2	I access the spatial configuration of the building and determine the main organizing idea(s) [linear, axial, grid, central, clustered or radial].					
3	I explore the distribution of major components of the whole scheme (e.g. number of rooms; toilets)					
4	The shape/ geometry of the building is one of the features I usually study.					
5	I examine the positioning of thebuilding on site.					
6	I examine how the structural elements give the building its form.					
7	I examine the direction of the building(s) and the individual components.					
8	I take note of the colors of the various elements of the building.					
9	I take note of the textures of the building's various elements.					
10	I endeavour to find out the size of spaces and the overall size of the facility.					
	Context	1	2	3	4	5
1	There is the need to consider the context when investigating a precedent.					
2	I examine the geographic conditions within which the building is situated.					
3	I research into the history and background of the building project					
4	Site planning forms part of my investigations.					
5	I examine how the building fits into the environment and relates to other buildings around it.					
6	I evaluate how the building meets up with legal requirements.					
7	I examine whether or not the building adheres to zoning regulations.					
8	I explore how the building relates to other buildings of the same era.					
9	I consider any cultural or symbolic meanings attached to the building or parts of it.					
10	The architectural style of the building forms are part of components I examine.					
11	I study the design principles that the building's architect employ.					

CHALLENGES AND OPPORTUNITIES OF SUSTAINABLE INFRASTRUCTURE DEVELOPMENT IN DEVELOPING ECONOMIES

Sitsabo Dlamini[1]

[1]*School of Construction Economics & Management, University of the Witwatersrand, South Africa*

The development of sustainable infrastructure is a key-factor for addressing the challenges of finite resource availability, ecological deterioration and climate alteration. The global environmental system can no longer support carbon-intensive infrastructure with the energy consumption and carbon emissions they trigger. Therefore, sustainable infrastructure development is demanding a different approach that safeguards the environment and its finite resources within the context of an ethically, culturally and socially valuable development process. This study investigated the challenges and opportunities that lie at the nexus of climate change and infrastructure development. A sectoral analysis of the infrastructure sector was undertaken to understand this in the context of developing economies. The sectoral analysis method studies the size, demographic, pricing, competitive and other economic dimensions of a sector. Using secondary data sourced from various global reports, the study revealed that half of global GHG emissions were associated with the infrastructure sector. This may appear negative, but the developmental opportunities for mitigation and adaptation were found to be positive. Maximizing economic, social and environmental value in infrastructure development must guide investments. The study also identified the significance of prioritizing mitigation and adaptation-related infrastructure investment needs and the balancing of such needs with economic growth priorities for developing economies. The study concluded that there is need to implement cost-effective measures to climate-proof future baseline infrastructure, with the implication to effect changes to construction codes and climate-risk assessments at planning stage.

Keywords: development, economic growth, infrastructure, political economy, sustainability

INTRODUCTION

The development of sustainable infrastructure is central to the competitive performance of an economy's industrial, technological and commercial base.

[1] sitsabo.dlamini@wits.ac.za

Dlamini, S. (2017) Challenges and opportunities of sustainable infrastructure development in developing economies *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 364-379.

It impacts on every aspect of the realization of human settlements and the creation of infrastructure that supports economic growth. It also plays a fundamental role in meeting the basic needs of society.

It is now imperative that the development of infrastructure is informed by an overarching approach that supports the combination of energy efficient measures with the need to secure people's comfort and the quality of life. The IPCC[2] has predicted that the earth will be between 1.8°C - 4°C warmer by the end of the 21st century. Economies that ignore climate change will continue to develop infrastructure stocks that are not suited to the new climatic conditions. The global efforts to stabilise the atmospheric concentration of GHGs[3] have the potential to hamper opportunities for economic growth in such economies. Ignoring such efforts could lead to economies becoming locked-in to high-carbon growth paths, which will compromise economic growth.

The development of sustainable infrastructure in developing economies lies within a broader international debate on sustainable development. The perceived ambiguity and even the contradictory nature of the phenomenon of sustainability make it hard to comprehend. Agencies within the international development community and the business world often use the term sustainable development. They however use it for promoting activities that may essentially not be associated with sustainability issues. These may range from polluting the ecosystem, increasing inequity and social exclusion, and consuming resources at a rate faster than nature can replace them. This trend has given rise to considerable tension between the proponents of what has been described as weak sustainability, and those demanding a stronger approach, as well as between the developed and developing worlds (CIB & UNEP-IETC 2002).

According to Johnston et al. (2007), the term sustainability refers to the nature of development that satisfies the needs of society in the present, without compromising the ability of future generations to meet their own needs. Infrastructure is defined as the basic physical and organizational structures and facilities that are needed for a society or an economy to function (Black et al. 2009). Included under infrastructure is water, sewerage, electricity, gas, communication, air transport, railways, harbours and roads (ONS 2011). Therefore, the definition of infrastructure used in this paper is generally limited to describe fixed assets.

Black et al. (2008) defined sustainable infrastructure as the designing, building, and operating of infrastructure assets in ways that do not diminish the social, economic and ecological processes required to maintain human equity, diversity, and the functionality of natural systems. Therefore, the development of sustainable infrastructure demands that social, environmental, climatic, cultural and economic factors are taken into

[2] International Planning Commission on Climate
[3] Green House Gases

consideration (Davy 2006). Infrastructure assets that are built today will shape tomorrow's communities.

An understanding of sustainable infrastructure development in developing economies will help diffuse sustainable infrastructure innovations and policies to different economies across the globe. The next section of this paper examines the established views on sustainability issues as they relate to the infrastructure sector. The development of sustainable infrastructure in developing economies is then discussed, starting from global debates.

LITERATURE REVIEW

The development of sustainable infrastructure and the financing thereof are indispensable components of the economic growth process. Changes in climate increase the risk of damage and destruction to infrastructure facilities. The paucity in existing developmental approaches has been the depletion of natural resources. This may hamper the economic and social development initiatives of a developing economy. Given the high stakes and the urgency of action required, the amortisation of infrastructure facilities over their long economic life is important as 21st century demands for climate change beg for sustainable approaches to infrastructure development.

Historic views: Bruntland to Rio

Since the Bruntland Commission Report of 1987, the infrastructure sector has been preoccupied with trying to understand this role (World Commission on Environment and Development, 1987). While it may be argued that this has been a challenging task, some progress has been achieved. The 1992 Earth Summit in Rio formulated the Agenda 21 programme to address, among others, how the infrastructure sector should respond to the challenges paused by climate change. The programme became a blueprint for sustainable development, encompassing all sectors of society. Building on the 1992 Earth Summit, a number of other initiatives have been undertaken globally to address sustainable development (Du Plessis 2001).

According to Ugwu and Haupt (2005), understanding how construction affects sustainable development is made difficult by the multi-dimensional perspectives of sustainability. These include the economy, society and environment. In their study to identify key performance indicators for infrastructure delivery, Ugwu and Haupt, found that the role of the infrastructure sector in sustainable development was particularly difficult to comprehend in developing economies. Such economies need to provide massive infrastructure to stimulate economic growth. This priority competes with others such as poverty alleviation, institutional strengthening and sociocultural dimensions that sustain harmony and co-existence. Consequently, issues relating to sustainable development remain elusive in most developing economies.

Du Plessis (2001) observed that while most developing economies were starting to pay attention to environmental impact issues, there were still

challenges in socioeconomic components of sustainable construction. Good development strategies and policies are enacted, but their implementation remains a challenge. In the context of South Africa, Du Plessis cited problem areas such as the provision of affordable housing, job creation, entrepreneurship, capacity building and gender equality as still lagging behind. Du Plessis was optimistic that a shift to a more optimistic development model was inevitable, given the fact that developing economies are by nature of the survival challenges experienced, used to innovation, adaptation and doing more with less. While developing economies may hold the key to sustainable development, developed economies also hold some alternatives for sustainability. This view suggests that both developing and developed economies hold the values and knowledge that can contribute to a new vision for development that would be beneficial to all. The magnitude of construction work aimed at adapting old buildings to be responsive to the consequences of climate change is a case in point in Sandton, South Africa and London, UK. Figures 2.1 and 2.2 encapsulate this.



Figure 2.1: Green building projects in Sandton



Figure 2.2: Green building projects in London

The UN (2002) found that the efforts of developing economies to achieve sustainable development in infrastructure were undermined by conflicts, insufficient investment and unsustainable burdens, among others. The problem with the various global summits since the Bruntland Commission Report is that they fail to explain how to translate the abstract concept into practical decision-making at project level (Ugwu and Haupt 2005). Broad-based sustainability goals have been promulgated at the macro level. This therefore presents the need for further research into unpacking the national strategic sustainability objectives at micro level, including the implementation strategies thereof.

According to Du Plessis (2001), the rollout process of sustainable development suffers from the lack of appropriate incentives and capacity for the implementation. The infrastructure sector has very little regard for environmental considerations. Du Plessis also argued that there is no clear understanding of the tremendous innovation in building materials, service systems and construction processes that will be required. He asserted that to save the planet, the construction sector would have to completely reinvent itself. He described this as one of the key issues that needed to be addressed by both developed and developing economies in order to move forward.

Ugwu et al. (2006) concurred with Du Plessis (2001) in that the process of translating strategic sustainability objectives into concrete action at project-

specific levels is a difficult task. Ugwu et al. contended that the multidimensional perspectives of sustainability such as economy, society, environment, combined with the lack of structured methodology and information at various hierarchical levels, further exacerbate the problem of implementation. Ugwu et al. proposed an analytical decision model and a structured methodology for sustainability appraisal in infrastructure projects. The model discusses the development of key performance indicators encapsulated within the analytical model. It concludes by discussing other potential applications as part of integrated sustainability appraisal in infrastructure design and construction.

From Rio to Johannesburg

Extensive collaborative research in both developed and developing economies, led to a consensus on the significance of the infrastructure sector to sustainable development. An internationally agreed agenda on sustainable construction was propagated through the International Council for Research and Innovation in Building and Construction (CIB) in 1999 (CIB & UNEP-IETC 2002). This became known as the CIB Agenda 21 on Sustainable Construction. Why is this agenda important for African economies? Du Plessis (2001) suggested that global programmes such as the CIB Agenda 21 of Sustainable Construction would help identify the transition strategies and financing options for developing economies to enhance their investments in sustainable infrastructure. Such programmes would help policy makers to understand how and why decision-making prevented developing economies from developing sustainable patterns of infrastructure development.

Subsequent to the CIB Agenda 21 on Sustainable Construction, it was observed that the development of sustainable infrastructure in the developing world required a different approach from that taken by the developed world. Why? The problems and their scale, the development priorities, the capacity of the local industries, public sector institutions and the skills levels found in developing economies were thought to be often radically different from those found in developed economies. Certain cultural and worldview differences between the developed and developing economies were also viewed as having an impact on the understanding and implementation of sustainable infrastructure development (Bhattacharya et al. 2012).

These observations led to the commissioning of a special Agenda 21 for Sustainable Construction in Developing Countries (Du Plessis 2001). This special agenda was promulgated as part of the action plan for the implementation of Agenda 21 on Sustainable Construction. It was tasked to further the CIB's proactive approach on sustainable construction. This research project has been undertaken in partnership with UNEPIETC, CSIR Building and Construction Technology and the CIDB of South Africa (Chinowsky et al. 2015).

What is the mandate of the CIB-UNEP A21 for Sustainable Construction in Developing Countries? The commission was mandated to provide a research

and development agenda, as well as a strategy for action for sustainable construction in developing economies. The idea was to investigate a more sustainable model of infrastructure development. Large-scale development is needed in developing economies to address issues such as inadequate housing, rapid urbanisation and lack of infrastructure. However, these problems need to be addressed in a way that is socially and ecologically responsible (Bhattacharya et al. 2016).

Due to the rapid rate of urbanisation experienced in most developing economies and the increasing pressures on what are often limited resources, there is need to make sustainable interventions now, while the requisite infrastructure is being developed. While the level of underdevelopment in developing economies may be a cause for despair, it also provides an opportunity for cautious development of infrastructure that is sustainable. This will assist in ensuring that the development path chosen avoids the problems currently experienced in the developed economies, such as high carbon emissions. Developing economies need not go through the same process of development as that followed by developed economies. Instead, developing economies can choose to base all future infrastructure developments on the principles of sustainability.

Contemporary arguments

The development of sustainable infrastructure includes a wide variety of systems that are essential to economic growth. Climate change poses certain risks to infrastructure assets. Given the fact that the development of infrastructure is costly and built to last for long, climate change affects infrastructure assets. The level of impact is dependent upon the type of infrastructure and its location.

What is the significance of infrastructure in society? According to the USAID (2013), infrastructure serves as the foundation for economic, social and cultural life of society. Therefore, resilient and reliable infrastructure is essential. However, poor knowledge exists regarding the risks posed to infrastructure by climate change. This presents the opportunity to give greater consideration to climate change issues in the planning, design and construction of infrastructure assets.

The significance of infrastructure in society can also be associated with the fact that infrastructure forms an integral part of the economic and social vitality of communities. It represents major financial commitments that influence investment in other sectors of the economy. This begs the need for infrastructure assets to be designed and maintained to be low-carbon, resilient and responsive to the impacts of climate change over time (USAID 2013).

The importance of building sustainable infrastructure cannot be overemphasized. Energy, buildings and transport infrastructure are key sources of greenhouse gas (GHG) emissions. In the development of these infrastructure assets, it is imperative to fight shy of utilizing unsustainable technologies that may give rise to a lock-in effect that perpetuates a dependency on the use of fossil fuel and increases in GHG emissions. Most

economies in the African continent still need to build the requisite infrastructure to meet their development needs. Such economies can exploit sustainability issues to ensure cost effectiveness, enhanced access, minimal carbon emissions and increased resiliency to counter changing climatic conditions (Roaf et al. 2009).

Why is sustainable infrastructure development important for developing economies? According to Ryan-Collins et al. (2011), developing economies bear little historic responsibility for the emissions that are causing climate change. However, they stand to suffer the most severe consequences. Burton et al. (2006) identified three main reasons for this imprudent dilemma facing the developing world. First, climatic impacts will be more acute at lower latitudes where most developing economies are located. Second, developing economies are more reliant on climate-sensitive sectors of the economy, such as agriculture and fishing. Third, developing economies have lower capacity to adapt due to their weaker institutions, lower human and financial capital, and constrained access to technology and credit. The World Bank (2010a) concurred with the view by Burton et al. The World Bank continued to argue that within developing economies, it is those individuals in the lowest income brackets that are most vulnerable to impacts of climate change.

What then? If developing economies are not the ones responsible for most of the GHG emissions, why is sustainable infrastructure development important for developing economies? Using a stressor response methodology, Chinowsky et al. (2015) ascertained that climate change was a potential threat to Vietnam's development. They found that although the Vietnamese economy may not necessarily be responsible for the causes of climate change, but their current and future infrastructure would be vulnerable to the impacts. Among other things, their findings specifically indicated that predicted changes in temperature, precipitation and flooding presented real threats to Vietnam's road infrastructure. Based on their analysis, Chinowsky et al. asserted that high returns can be achieved through the use of adaptation policies that seek to seal unpaved roads and make them more precipitation and flood-resistant. The costs of adaptation were lower when maintenance savings were taken into account. Such maintenance savings offset the higher construction costs of roads with improved surfaces. Therefore, sustainable infrastructure development is important.

How then should developing economies model their strategies for sustainable infrastructure development? According to Ryan-Collins et al. (2011), the perspectives and priorities of developing countries in relation to climate change mitigation and adaptation differ depending on their stage of economic development. In their study of climate compatible development in the infrastructure sector, Ryan-Collins et al. observed that less developed countries (LDCs) placed greater emphasis on adaptation.

What is adaptation? The UN (2002) defined adaptation as a process by which strategies to moderate, cope with and take advantage of the

consequences of climatic change is enhanced, developed, and implemented. The focus on adaptation by most LDCs was motivated by the fact that such economies contribute relatively low GHG emissions due to their lower levels of industrialisation. By the same token, a majority of LDCs were found to be highly vulnerable to the impacts of climate change (Burton et al. 2006). Ryan-Collins et al. (2011) continued to argue that more industrialised developing countries (IDCs) such as South Africa, faced the prospect of emissions limitations in the relatively near future.

What are emissions limitations? The World Bank (2010a) defined emissions limitations as the legal standards required to regulate GHG emissions from industry into the atmosphere. The standards set quantitative limits on the permissible amount of specific air pollutants that may be released from specific sources over specific timeframes. Ongoing international discussions are underway through forums such as the Intergovernmental Panel on Climate Change (IPCC), in a bid to frame the necessary standards. This therefore begs the need to devote significant resources to mitigation in order to enable continued rapid growth, while also taking measures to cope with climate change impacts in developing economies.

What is mitigation? The IPCC (2007b) defined mitigation as a public good that require collective action, while the UN (2002) defined it as the actions mobilized to limit the magnitude of long-term climate change. It involves reductions in human emissions of GHGs. Burton et al. (2006) contended that mitigation policies have the potential to substantially reduce the risks associated with human- induced global warming. These arguments clearly delineate the gaps and limitations in existing literature.

Studies in sustainable infrastructure development since the Bruntland Commission Report of 1987 indicate that the global challenges in this area are driven by a broad set of megatrends, such as changing demographic profiles, changing economic and social dynamics, advancements in technology and trends towards environmental deterioration. Clearly, a deeper understanding of the challenges and opportunities arising from sustainable infrastructure development is needed. The Bruntland and Rio reports among others have shown a range of interlinked challenges which call for priority attention to cross-sectoral issues such as sustainable cities, energy and water usage. This paper seeks to understand the challenges and opportunities that lie at the nexus of climate change and infrastructure development.

The existence of capacity, financial and institutional limitations in most developing economies makes it difficult to implement both mitigation and adaptation policies relating to climate change. However, it can be argued that it is in the best interests of developing economies to do this. Employing robust mitigation and adaptation strategies will yield an economic growth trajectory that is sustainable in the long-term. The need for developing economies to model their strategies for sustainable infrastructure development cannot be overemphasized. Therefore, the main research

question for this paper is: What are the challenges and opportunities posed by climate change on infrastructure development?

RESEARCH DESIGN

The purpose of this paper is to investigate the fundamental challenges and opportunities arising out of climate change and infrastructure development in developing economies. The main focus is to try and understand the logical problem of how climate change affects the development of infrastructure in developing economies. The previous section dealt with the relevant literature on sustainable infrastructure development. Clearly, there is lack of common ground in the understanding of the challenges and theoretical reasoning applied in explaining the opportunities brought about by climate change to the infrastructure fraternity.

Climate change threatens the sustainability of infrastructure and requires careful consideration in terms of how potential data is sourced and consolidated. A sectoral analysis is therefore used in this enquiry. Why a sectoral analysis? A sectoral analysis studies the size, demographic, pricing, competitive and other economic dimensions of a sector (Davis 1998).

The sectoral analysis method is considered appropriate to review and assess the current condition and future prospects of sustainable infrastructure development in developing economies. This research method is chosen on the understanding that it is more likely to shed light on the challenges and opportunities posed by climate change on infrastructure development. A chain of evidence is created to manage the data collection process and it is maintained throughout the research.

Arguments tracked from the Bruntland Commission Report of 1987 to contemporary debates indicated that the global challenges of sustainable infrastructure development were driven by a broad set of megatrends. This illuminated the gaps in the existing literature. There is need for a deeper understanding of both the challenges and opportunities of sustainable infrastructure development. A sectoral analysis is undertaken to investigate this.

Secondary data sourced from various reports is used. The nexus of climate change and infrastructure development is discussed to show how the challenges and opportunities emanate. Apart from giving a descriptive account of the challenges and opportunities of sustainable infrastructure development, the data is summarized such that it addresses the question of how the infrastructure sector manipulates opportunities to address identified challenges.

The limitation of this paper is its reliance on previously published reports. The cited reports may be subject to potential bias. Such bias may include personal viewpoints, omission of important relevant research, errors in the translation of data from the primary sources and misinterpretation of original source data. The author's power of argument was used in this regard to critique the reports and to highlight any omissions.

Subsequent to a comprehensive data search process to identify the reports cited in the paper, key statements and illustrations were also included. As part of the data analysis process, inferences were made in line with personal intuitive understanding of the data. This process aided the assessment of the quality and relevance of the reports cited.

RESEARCH FINDINGS

The previous section briefly explained how the study was conducted. The extent to which the consequences of climate change need to be considered in the development of requisite infrastructure in developing economies is currently a topical issue in political economics globally. What are the challenges and opportunities posed by climate change on infrastructure development? This sectoral analysis seeks to unpack this.

The nexus of climate change and infrastructure development

Climate change has deep-rooted implications in infrastructure development. The world today faces intense challenges of human-induced global warming. The rise in global temperatures is one of the intrinsic factors of climate change that lead to disasters such as excessive flooding, drought and forest fires, to name but a few. Political and social issues such as economic growth, job creation and education are interconnected with climate change. Over the last few decades, the climate of the planet has, to a great extent, changed. Among other things, such change is ascribable to pollution, GHGs and depletion. The extent to which infrastructure development affects and/or is affected by these issues needs to be fully explored in order to generate appropriate mitigation strategies going forward.

The developmental path that a developing economy chooses will influence the ways in which it copes with both emissions reductions and climatic change impacts. Economies that opt for sustainable developmental paths will avoid being locked in to high carbon growth patterns. They will also minimize negative climatic impacts. The mainstreaming of mitigation and adaptation objectives into policy decisions will assist developing economies to achieve sustainable infrastructure development. However, the ability to do this is dependent on strong institutional structures and whether or not the economy is able to develop a coherent climate change policy framework (Ryan-Collins et al. 2011).

Most developing economies frequently embark on ambitious infrastructure development programmes in an attempt to grow their economies. Economic growth is historically associated with increased GHG emissions. Therefore, there is need for developing economies to break this link if they are to achieve sustainable infrastructure development and meaningful economic growth. There is need for developing economies to avoid using polluting production methods that are used by the developed economies. While it is comprehensible that developing economies have to contend with financial, technological and capacity impediments, the use of low carbon growth paths should not be compromised (Sathaye et al. 2007).

Figure 4.1 hereunder reveal that the infrastructure sector give rise to about 69% of global GHG emissions. As discussed in the literature review, developing economies bear little responsibility for these emissions. Developed economies are the major contributors. Notwithstanding this fact, reducing infrastructure related emissions is compelling. It is prudent that developing economies should steer clear of using high-carbon production methods of infrastructure development. Such a growth trajectory will help them evade the expensive adjustment process that developed economies are now faced with.

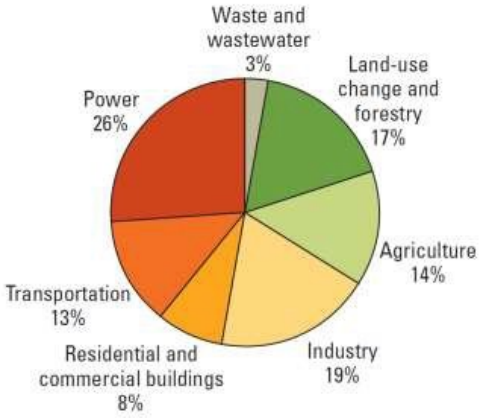


Figure 4.1: Global GHG emissions by sector – 2004 figures (Co2 equivalent) Source: IPCC 2007c

Of the seven sectors shown in Figure 4.1, the residential and commercial buildings sector is considered to have considerable potential for expeditious GHG emissions reductions. The IPCC (2007c) estimated that there are prospects to reduce buildings emissions by 29% from their projected 2020 baseline using cost effective investments. Levine et al. (2007) defined cost effective investments in this context as investments that will ensue in a net saving over the building's lifespan.

The phenomenon of climate change is so indispensable to ignore. Developing economies that try to meet their infrastructure backlogs by investing in high-emissions infrastructure assets risk being locked in to high carbon growth paths for generations. Apart from restraining their economic growth prospects, such ignorance would culminate in disastrous repercussions for the planet. Figures 4.2-3 illustrate some of the negative impacts of climate change on buildings.



Figure 4.2: Typical stranded building



Figure 4.3: Typical effects of flooding in Japan, 2011

Increases in temperatures and the consequent extreme weather patterns affect buildings in one of many ways. Extreme weather results in floods, drought, heat waves, snow, ice and storms. Building location, orientation, foundations, ceiling heights and glazing ratio are not easy to adjust in maintenance cycles and must be comprehensively considered at feasibility stage. This involves employing ingenious design approaches tailored to local conditions. Such design approaches are key to a building's ability to cope with future climate. Failure to cope results in stranded buildings where environmentally unsustainable buildings suffer from unanticipated and premature devaluations and illustrated in Figure 4.2 above.

The search and promotion of building methods that developing economies can go on using with the skills and resources available is imperative. Building methods that have been sustainable over many centuries are now unable to cope with today's needs nor relate adequately to today's available resources. Therefore, new solutions and approaches need to be sort. Along with the appreciation of other areas of professional expertise such as climate scientists, close collaboration is required.

Summary of key challenges

Half of global GHG emissions are associated with the infrastructure sector. The fact that developing economies still have to develop a lot of infrastructure assets to support their economic growth serves as a critical window of opportunity to develop low-carbon stocks of infrastructure. The growth strategies that developing economies in Africa adopt vary considerably, in line with each economy's income bracket. Low income countries (LICs) are slower to adopt low-carbon growth strategies than medium income countries (MICs).

LICs face a number of challenges. First, finance is a major challenge. The implementation of low- carbon growth strategies requires a massive volume of funding, which LICs do not have. While climate-related infrastructure investment is currently being made available through donor funding and carbon markets, it is by far inadequate. According to the World Bank (2012c), Official Development Assistance (ODA – grants and loans) and the clean development mechanism (CDM) for mitigation from 2008 to 2012 was less than $8 billion a year. Donor funding is important in LICs as they suffer from limited resources and struggle to attract private investment.

Second, developing appropriate technologies is a challenge for developing economies, especially LICs. This incorporates technologies for both mitigating GHG emissions and adapting to climate change impacts. At the heart of meeting the challenge of mitigation in the infrastructure sector is technological progress. It will play a key role in reducing the carbon constraint on growth. The delinking of emissions from economic growth requires technology transfer, which can be a complex process than simple transfer of information. A majority of developing economies are characterized with low levels of technical expertise, weak legal frameworks to protect intellectual property rights and the absence of institutions able to promote and coordinate technology transfer (World Bank 2010b).

Third, most developing economies have insufficient capacity to formulate and implement climate change policies. The responsibility to develop mitigation and adaptation policy in the infrastructure sector rests with national government. A challenge exists where national governments have to steer their economies onto low-carbon growth paths while preparing their societies for climate change impacts that are difficult to predict. While action in the infrastructure sector may be urgent, existing capacity barriers and institutional challenges affect progress. According to the World Bank (2010b), capacity constraints exist in line ministries, independent regulators and state-owned enterprises responsible for infrastructure in Africa. Also, a high proportion of construction activities in developing economies take place in the informal sector. This sector is difficult to reach through capacity-building initiatives. Where reforms are successfully passed, the associated laws and regulations are a challenge to enforce.

Summary of major opportunities

While climate change consequences may appear negative, the developmental opportunities for mitigation and adaptation are positive. Taking advantage of such opportunities has the potential to counteract the negative economic and social impacts. The ability of developing economies to harness the opportunities is dependent on a number of factors. These include the economy's stage of development, as well as its capacity to develop and implement appropriate policies. Arising out of the need to make appropriate responses to climate change, some potentially important economic opportunities emerge for developing economies.

First, developing economies can benefit from new sources of finance. A number of market mechanisms have been established to facilitate a transfer of mitigation funding from developed to developing economies. This has the potential to finance green infrastructure development that goes beyond just mitigation. Incentives exist for the private sector to engage in the rollout of research and development for new technologies. This involves developing and disseminating existing technologies using public policy tools. Developing economies that take advantage of the international investment flows and technology transfer will make a sustainable transition to a low-carbon economic growth trajectory. This will benefit from access to diverse, reliable, and affordable, clean renewable energy sources (World Bank 2010a).

Second, the transition to a low carbon economy gives rise to a labour transition to the creation of new green jobs. Such a transition will have a positive effect on sectors such as energy, buildings, transportation and construction materials. The job creation potential in the energy sector is mainly in renewables, while in the building sector, it lies mainly in improving energy efficiency. Transition from the use of private to public vehicles, as well as the creation of green jobs in the design and production of fuel efficient and green fuel vehicles will impact positively on the transportation sector. Emissions reduction, energy efficiency and reducing pollution will help in creating green jobs in the construction materials

sector. In all identified sectors, a coherent policy framework is essential to harness the creation of green jobs (World Bank 2010b).

Third, the existence of synergies in mitigation strategies and development goals is an opportunity for developing economies. The identification and exploitation of synergies between climate change infrastructure investment and development is important. While reducing GHG emissions, a unique opportunity exists for developing economies to create the much needed low carbon infrastructure to support economic growth. In most developing economies, there is still a high demand for electricity, road infrastructure and decentralized forms of energy, with a potential to support green growth. The development of mass transit systems in cities will minimize the use of personal vehicles, which reduces emissions while providing urban dwellers with improved transport options and better air quality. Therefore, it is imperative that climate change infrastructure investment decisions must be informed by a thorough analysis of potential mitigation-adaptation-development synergies in developing economies (World Bank 2012c).

Fourth, given the fact that the climate change phenomenon respects no borders, regional cooperation has the potential to support the transition to a low carbon economy. This opportunity emanates from the fact that regional markets can create a critical mass that attracts entrepreneurs. The main argument here is that mitigation investment is often constrained by the small market size of most low-income countries (LICs). It is suggested that this makes LICs unattractive to investors wishing to introduce new technologies. It is however important to note that complex institutional, political and coordination barriers stifle regional cooperation in most African economies (World Bank 2010b). A majority of economies are reluctant to constrain national sovereignty by entering into regional agreements. Therefore, efforts to advance regional integration must build on existing regional ties and models of regional groupings such as the Southern African Development Community (SADC) and the Economic Community of West African States (ECOWAS). While these regional economic groupings are not always effective, the decisive action taken by ECOWAS in 2016 against Yahya Jammeh's attempts to cling to power in Gambia despite losing an election set a new benchmark for African governance to which SADC and other similar regional groupings need to conform.

CONCLUSION

The purpose of this paper was to investigate the fundamental challenges and opportunities arising out of climate change and infrastructure development in developing economies. Infrastructure development has been shown to play a pivotal role in efforts to reduce GHG emissions and to adapt to the climate changes that are likely to arise going into the 21st century. The development of sustainable infrastructure in developing economies demands the adoption of low carbon growth paths, allied with the development of infrastructure assets that are suited to changing climatic

conditions. This will include changes to construction codes and climate-risk assessments at planning stage.

This study reveals that while climate change repercussions may appear absurd to developing economies, some underlying developmental opportunities also exist. There is clear consensus that developed economies are responsible for most of the causes of climate change. Therefore, a number of international mitigation and adaptation interventions are being mobilized by the developed world to deal with the repercussions in developing economies. Much of the interventions are geared towards investment in the development of sustainable infrastructure assets that will support low carbon growth in developing economies.

While this paper shows that a lot of literature already exists on sustainable infrastructure development, additional evidence of proposed interventions is required. There is need to understand the ability of developing economies to successfully mobilize appropriate implementation strategies for sustainable infrastructure development. Further research into the appropriate strategies for implementing sustainable infrastructure projects would assist developing economies to make appropriate responses to identified challenges and opportunities. Such strategies would need to pay particular attention to the rollout processes for climate resilient infrastructure development.

REFERENCES

Black, J. Hashimzade, N. and Myles, G. (2009) Oxford dictionary of economics. Third ed. Oxford: Oxford university press.

Bhattacharya, A, Romani, M. and Stern, N. (2012). Infrastructure for Development: Meeting the Challenge. Centre for Climate Change Economics and Policy.

Bhattacharya, A, Meltzer, J.P, Oppenheim, J, Qureshi, Z. and Stern, L.N. (2016). Delivering on sustainable infrastructure for better development and better climate. Grantham Research Institute on Climate Change and the Environment.

Burton, I, Diringer, E, Smith, J. (2006) Adaptation to Climate Change: International Policy Options. Pew Center on Global Climate Change.

Chinowsky, P.S, Schweikert, A.E, Strzepek, N. and Strzepek, K. (2015) Road Infrastructure and Climate Change in Vietnam. Sustainability 7, 5452-5470.

CIB & UNEP-IETC (2002) Agenda 21 for Sustainable Construction in Developing Countries. Pretoria: CSIR Building and Construction Technology.

Davy, J. 2006. Assessing public participation strategies in low- income housing: The Mamre Housing project. Master of Public and Development Management, University of Stellenbosch.

Du Plessis, C. (2001) Agenda 21 for Sustainable Construction in Developing Countries – First Discussion Document. CSIR, Pretoria and CIB, Rotterdam.

IPCC (2007b) Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

IPCC (2007c) Climate Change 2007: Mitigation of Climate Change. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Johnston P, Everard M, Santillo D, Robèrt K.H. (2007) Reclaiming the definition of sustainability.

Environmental Science and Pollution Research: 14(1):60-6.

Office for National Statistics (2011). Annual abstract of statistics, Basingstoke, Palgrave Macmillan. Roaf, S, Crichton, D. and Nicol, F. (2009). Adapting Buildings and Cities for Climate Change, A 21st

Century Survival Guide. Elsevier Architectural Press.

Ryan-Collins, L, Ellis, K. and Lemma, A. (2011) Climate Compatible Development in the Infrastructure Sector. Overseas Development Institute.

Sathaye, J, Najam, A, Cocklin, C, Heller T, Lecocq, F, Llanes-Regueiro, J, Pan, J, Petschel-Held G, Rayner, S, Robinson, J, Schaeffer, R, Sokona, Y, Swart, R. and Winkler, H. (2007) Sustainable Development and Mitigation. Intergovernmental Panel on Climate Change.

Ugwu, O.O, and Haupt, T.C. (2005) Key performance indicators and assessment methods for infrastructure sustainability – a South African construction industry perspective. Building and Environment 42, 665-680.

Ugwu, O.O, Kumaraswamy, M.M, Wong, A. and Ng, S.T. (2006) Sustainability appraisal in infrastructure projects (SUSAIP) Part 1. Development of indicators and computational methods. Automation in Construction 15, 239-251.

United Nations (2002) Report of the world summit on sustainable development, Johannesburg and New York.

USAID (2013) Addressing climate change impacts on infrastructure: Preparing for change. Climate Change Resilient Development Task Order.

World Bank (2010a) World Development Report 2010: Development and Climate Change. Washington D.C: World Bank.

World Bank (2010b) Africa's Infrastructure: A Time for Transformation. Washington D.C: The World Bank

World Bank (2012c) Global Financial Development Report 2013: Rethinking the Role of the State in Finance. Washington, DC: The World Bank Group.

World Commission on Environment and Development (1987). Our Common Future. Oxford: Oxford University Press.

CHALLENGES AND REMEDIES OF APPLICATION OF COST PLANNING TECHNIQUES IN CONSTRUCTION PROJECTS IN NIGERIA

Raymond Chike Enenmoh[1] and Nwabueze Michael Anosike[2]
[1]Department of Quantity Surveying, Lagos State Polytechnic, Ikorodu, Nigeria
[2]Department of Building, Federal University of Technology, Owerri, Nigeria

Several literatures specialized for the Built Environment have supported the view that the Construction Industry in Nigeria is currently fraught with challenges of cost overrun and other associated issues. Cost planning techniques was developed in Britain in the distance past to bring about effective cost control in the Industry. The techniques by all reasonable logic is supposed to have found space and application in the activities of the industry in Nigeria with attendant benefits yet the problem persist. Therefore, the paper aims at determining the level of use of these techniques, with a view to bring about improvement to the situation. The study adopted the multistage technique. This basically is purposive and simple random techniques tailored to draw up a 450 sample from a population of 8,000 built environment professionals. A 74% rate was recorded for data administration and retrieval. The respondents were made to rate their views on a 5-point scale. These views were analysed using Likert scale Relative Importance Index (RII). Focus group chart and telephone survey were both used as complementary instrument to draw up data from the field. The validity test centred on researchers and other expert in the field of Academics and industry for validation of the questionnaires. Reliability tests was carried out through pilot study. This was done using a test-re-test method. This test showed a correlation result of 0.79. The findings reveal that the inception activities of the cost planning techniques with a mean of 3.79 ranked highest. Poor remuneration/professional fees of consultants with a mean of 3.81 ranked the highest causal factor. Time overrun with a mean of 3.65 ranked the highest factor on the effect of poor use of identified cost planning techniques. The major recommendation for the legalization and enforcement of the National Building codes is predicated on the findings and analysis.

Keywords: constructions industry, cost planning techniques, Nigeria

[1] raymondchike2000@yahoo.com
[2] nwa_4chi@yahoo.com

Enenmoh, R. C. and Anosike, N. M. (2017) Challenges and remedies of application of cost planning techniques in construction projects in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 380-393.

INTRODUCTION

There is greater urgency now than before to enthrone control of wasteful expenditure in all sectors of Nigerian Economy. The construction Industry as one of the key sectors that is fundamentally pivotal in the trigger of economic development and rescue of recessed economics is essentially a focal point for this control. Construction Industry in Nigeria had been a major source of employment for 70% of labour force in the country, thus it controls the capital flow, as well as labour resources, which has cost implications. Adequate management of these resources is considered an important aspect of project works; it determines to a large extent the overall success of project work. So also, if the resources are adequately harnessed, issues that pertain to cost overrun would not arise which could result to variation and claims. Amusan, (2016).

The assertion above is consistent with the need for proper planning, control and monitoring tools for development of projects in the industry. It is necessary to emphasize here that if efficient cost control tool is employed with appropriate procurement methods for project, the usual anticipated quality performance is assured. It is vital to operate an effective cost control procedure during the design stage of a project to keep the total cost of the scheme within the building client's budget (Seeley, 1996). The above overview of the need for effective cost planning ushers in the problem statement for this study.

Problem statement

Cost planning techniques as established in the past and as a planning instrument, is expected to enhance efficient delivery of construction projects to the clients particularly in time of economic recession, however, these techniques are most times not employed in the traditional delivery of construction projects in Nigeria, the results of the shocking aspect of this challenge is that when client are favourably disposed to allocating enough time for pre-contract services to be adequately carried out, The consultants sometimes refuse to employ this technique leaving the clients with no ultimate option except for losses in value for money.

Recent researches carried out in the study area have not specifically addressed this issues of poor application of cost planning techniques in the traditional procurement of construction project using 2007 RIBA outline of work. Hence the need for this research work as it will address the challenge of poor value for money delivery to client.

Objectives

To achieve this end, the following objectives are set out:

i. To assess the current level of use (procedurally) of cost planning techniques in the traditional delivery of construction projects in Nigeria based on 2007 RIBA outline for work.

ii. To ascertain the causes of poor use of cost planning techniques in the traditional delivery of construction projects in Nigeria based on 2007 RIBA outline for work.

iii. To determine the effects of low level of use of cost planning techniques in the traditional delivery of construction project in Nigeria based on 2007 RIBA outline for work..

iv. To evolve ways of improving the level of use of cost planning techniques in the traditional delivery of construction project based on 2007 RIBA outline for work.

Research Questions

1. What is the current level of use employed in the traditional delivery of construction projects based on 2007 RIBA outline for work?
2. What are the effects of low level of use of cost planning techniques in the traditional delivery of construction projects in Nigeria based on 2007 RIBA outline for work?
3. What are the causes of poor use of cost planning techniques in the traditional delivery of construction projects in Nigeria based on 2007 RIBA outline for work?
4. What are the ways of improving the level of use of cost planning techniques in the traditional delivery of construction projects based on 2007 RIBA outline for work?

Scope of the study

The work specifically centres on building projects both private and public sector developments. Views of built environment professionals were sought for the study, while Lagos state has been chosen as a representative centre. The reason for this choice is predicated on the facts that intense construction activity is currently been undertaken. Lagos happens to be the economic hub of Nigeria due to its natural reliefs, its past status as the former capital city housing some of the head offices and branches of both private and public organizations. The study is basically from the consultant's perspectives and the conceptual frame works for this study is given below as necessary foundation. The study is specifically targeted at construction projects that are traditionally delivered using 2007 RIBA outline for works.

CONCEPTUAL AND THEORETICAL FRAME WORKS

Conceptual framework

Cost planning aims at ascertaining cost before many of the decisions are made relating to the design of a building. It provides a statement of the main issues, identifies the various courses of actions, determine the cost implications of each course and provides a comprehensive economic picture of the whole. The Architect and Quantity Surveyor should be continually questioning whether a specific item of cost is really necessary, whether it is giving value for money or whether there is not a better way of performing the particular function. (Seeley, 1996)

Cost planning is used to ensure that in the early stages of project, the developers knows what the anticipated final cost of the total development may be, including the cost of land, legal issues, demolitions, buildings,

professionals, furniture, connections, financing and management (Ramabodu,2014). Cost planning process involve three process or activities namely; Cost estimating, Cost plan preparation and Cost checking (Ogunseni 2015)

Initial cost Advice (order of magnitude cost). This stage requires the needs to be identified, the broad parameters of a solution are agreed and a decision-in principle is made to proceed on the basis of order magnitude costs (Cunningham, 2015). According to Ashworth as cited in Royal Institute of Chartered Surveyors (2014),

Plan of work for design team operation Outline Plan of Work

Stage	Purpose of work and decisions to be reached	Tasks to be done	People directly involved	Usual terminology
A. Inception	To prepare general outline of requirements and plan future action.	Set up client organisation for briefing. Consider requirements, appoint architect.	All client interests, architect.	Briefing
B. Feasibility	To provide the client with an appraisal and recommendation in order that he may determine the form in which the project is to proceed, ensuring that it is feasible, functionally, technically and financially.	Carry out studies of user require - ments, site conditions, planning design, and cost, etc., as necessary to reach decisions.	Clients' representatives, architects, engineers, and QS according to nature of,project.	
C. Outline proposals	To determine general approach to layout, design and construction in order to obtain authoritative approval of the client on the outline proposals and accom- panying report.	Develop the brief further. Carry out studies on user requirements, technical problems, planning, design and costs, as necessary to reach decisions.	All client interests, architect. engineers, QS and specialists as required.	Sketch plans
D. Scheme design	To complete the brief and decide on particular proposals, including planning arrangement, appearance, constructional method, outline specification, and cost, and to obtain all approvals.	Final development of the brief, full design of the project by architect, preliminary design by engineers, preparation of cost plan and full explanatory report. Submission of proposals for all approvals.	All client interests, architects, engineers, QS and specialists and all statutory and other approving authorities.	
Brief should not be modified after this point				
E. Detair design	To obtain final decision on every matter related to design, specification, construction and cost.	Full design of every part and component of the building by collaboration of all concerned. Complete cost checking of designs.	Architects, QS, engineers and specialists, contractor (if appointed) .	Working drawings
Any further change in location, size, shape, or cost after this time will result in abortive work.				
F. Production information	To prepare production information and make final detailed decisions to carry out work.	Preparation of final production information i.e. drawings, schedules and specifications.	Architects, engineers and specialists, contractor (if appointed).	
G. Bills of quantities	To prepare and complete all information and arrangements for obtaining tender.	Preparation of Bills of Quantities and tender documents.	Architects, QS, contractor (if appointed).	
H. Tender action	Action as recommended in paras. 7 -14 inclusive of 'Selective Tendering'. *	Action as recommended in paras. 7-14 inclusive of 'Selective Tendering' . *	Architects, QS, engineers, contractor, client.	
1. Project planning	Action in accordance with paras. 5 -1 0 inclusive of 'Project Management'. *	Action in accordance with paras. 5 -10 inclusive of 'Project Management'. *	Contractor, sub-contractors.	Site Operations
K. Operations on site	Action in accordance with paras. 11-14 inclusive of 'Project Management'. *	Action in accordance with paras. 11-14 inclusive of 'Project Management'. *	Architects, engineers, contractors, sub-contractors, QS, client.	
l. completion	Action in accordance *with paras.15-18 inclusive of project Management'*	Action in accordance *with paras.15-18 inclusive of project Management'*	Architect, engineers , contractor, QS, client	Site Operation
M Feed-back.	*To analyze the management, construction and performance of the project*	*Analysis of job records. Inspection of completed building. Studied of building in use*	Architect, engineers , contractor, QS, client	Site Operation

Source: Ivor H. Seeley(1996)

Introduction of cost planning techniques, enabled the quantity surveyors to provide more reliable cost advice from the early stages of a project for design appraisal to offer best value and confident for client and project team to proceed with project.

Outline proposal stage (outline cost plan): This stage confirms that the initial cost advice is found and establishes cost target for the selected design situation. It benchmarks the selected situation against similar building types (Cunningham, 2015)

A cost plan determines the physical feasibility of an initiative. This is done by letting life cycle budgets and cost controls to manage the delivery and quality of the initiative's outcome over a set time frame. (Madak, 2016)

Cost checking: This stage involves the process of finalizing the design and production of information and commences following the approval of cost plan.

The Royal Institute of British Architects provided the outline of work for building project delivery. It encompasses duties and responsibilities of built environment professionals and procedural steps to follow in the delivering of building project. It is revised and updated from time to time according to dictates of technological advancement.

Royal Institute of British Architects Outline of work with duties and responsibilities of built environment consultants.

Theory of cost planning

Fundamentally, there are no universally accepted method for cost planning, however concepts have been defined above for the purpose of this study .

According to Seeley (1996)

There is no universal method of cost planning which can be readily applied to every type of building project. buildings have widely varying characteristics, perform a diversity of functions, serve the needs of a variety of building clients, and their erection is subject to a number of different administrative and contractual arrangements. hence, it is not surprising that a wide range of cost planning techniques has been devised to meet the needs of a variety of situations.

In the absence of a universally accepted method for cost planning, the need for further theoretical review has been brought to focus mindful of the fact that this study has a tie with traditional procurement of construction projects based on RIBA outline of work.

This study is modeled on the theory of project management. In general, project management organization can be thought of as a system composed of, but not limited to subsystems such as finance, site operations/implementation, planning, monitoring and control, communication, procurement and the purchasing subsystems. When it relates to construction projects, the organization interrelationship can be more complex. Ubani and Unonuju (2013) noted that a system viewpoint is almost always beneficial in decision making. System approach was defined by Kerzner (2004) as a logical and disciplined process of problem solving. Ubani and Unonuju (2013) then summed up that the system approach forces review of interrelationship of various subsystems; and a dynamic process that integrates all activities into a meaningful total system, systematically assembles and matches the parts of the system into a unified whole, and seek an optimal solution or strategy in solving a problem.

This research explored and considered system approach to mitigating the problem of failed application of cost planning techniques in traditional delivery of construction projects in Nigeria. A proactive system comprising of relevant subsystems developed herein, will not only preempt flaws, but will serve warning signals to the entire project procurement process if properly employed by cost and design consultants of the built environment.

LITERATURE AND EMPIRICAL REVIEWS

Literature review

Both local and international paper reviews have been used to endear deeper perspectives on the issue of application of cost planning techniques for traditional delivery of construction projects using 2007 RIBA work template for reasons of better understanding of the technique by lay stake holders and participants of the industry. The primary essence of application of cost planning technique is to give value for money to the clients of the industry, however in-effective use of this long-established technique has obviously led to loss of confidence on the part of the client. Building cost planning was originally developed within the framework of the traditional arrangement using convetional documentation, tendering and administration processes. With advent of alternative forms of procurement and with more fluid approaches to design state processes and documentation, the need for sound cost planning does not appear to diminish (smith et al, as cited in Adafin, and Wilkinson 2015). One major worry to professionals in the construction industry is the wide gap (deviations) between final account figures, the tender, and the preliminary estimates earlier arrived at, at the pre-contract stage. This has caused a lot of anxiety to clients in going into infrastructural project development (Offei-Nyako, et al, 2016). This situation has necessitated the need for assessment of current level of the use of cost planning techniques in Nigeria for traditional delivery of construction projects based on RIBA work template.

Current level of use of cost planning techniques in Nigeria

Iroegbu et al (2010) opined that project cost planning which is a very important ingredient or technique of project cost management is highly neglected in Nigeria. Automatically, when a cost planning tool is neglected, it then means that such a tool is not recognized and if it is not recognized, one wonders how it could be applied. Akintoye as cited in Iroegbu (2010) disagreed with the assertion that cost planning techniques are to a large extent absent in Nigeria. Typically, it may be, but not to a large extent. As its research proved otherwise, the essential point isolated is that if the established steps and full use of cost planning technique is not employed in project development, the full benefit cannot be derived.

Causes of poor use of cost planning techniques

Opinions of industry experts were sought through focused group charts and telephone survey in (interactive interviews) on level of use of causal factors responsible for low use of cost planning techniques in the traditional delivery of construction projects based on 2007 RIBA outline of works. Poor remuneration/professional fees to Consultants, Lack of knowledge of applicable techniques, No regard for cost planning established standard techniques by clients, Lack of fund by client for cost planning techniques, Lack of adequate time to apply the techniques and Dubious Intent on the part of consultants and sometimes on the part of members of client organizations. There is limited number of current literatures that dealt on these challenges.

Ogunseni as cited in Ayodele & Alabi (2014) discovered that the nonuse of cost control has contributed to the constant building collapse in Lagos state of Nigeria. The cost planning techniques precedes cost controls and by good logic cost planning techniques and cost control approach will definitely have the same effect in a project. Ayodele and Alabi (2014) contributed this fact through the finding of their research by stating that this will drastically reduce the rate of increase of building collapse in Nigeria and will make them ultimately spend less on the projects and produce their projects at shortened time that has been operating.

Effects/ challenges of low use of cost planning techniques

The aggregate value of experts opinion through focused group charts and telephone survey formed the bases for isolating the factors that were later tested and analyzed namely: Cost overrun, Manifestation of many variation works at Construction phase, Under-development of the Nation Economy, Time Overrun, Under-development of the Industry, Under-development of Professional firms on the Industry. Uneven distribution of the budgeted cost amongst the element of the building, Abandonment, Dispute, Increase in cost of tendering and Arbitration Matters.

Existing combating techniques

The aggregate value of expert opinions through interactive interviewing formed the basses for isolating the factors listed below that were later tested and analyzed : Adequate training of members of different professional grouping within the industry on the techniques of cost planning, legalization and enforcement of buildings codes of practice, The carrot and stick approach should be adopted by professional bodies in checkmating the menace, Workshop on benefit on cost planning techniques by the Built Environment, Proper remuneration of Consultants, Regulatory Authorities within the built Environment should certify the procedural stages of the application of cost planning techniques to ensure adequate compliance at pre-contract stages and Monitoring of Projects style of Consultants through intelligence units.

Empirical reviews

In carrying out this review, both locally and internationally applicable researches have been used to endure deeper perspectives on the issue. Iroegbu, Nwafo, Wogu and Ogba (2010) did a qualitative study on cost planning and delivery of construction The study revealed that more time will have to be allocated at the design stage for effective cost planning to take place, the designer may most likely be involved in deeper works, the quantity surveyor persistent challenges in the built environment in areas of ever increasing variation costs, project abandonment, cost and time overrun, wide gap between contract sums and final Accounts figures etc. have created motive for this study in Lagos State. It is consistent to the extent that it has reaffirmed the importance of use of cost planning technique for effective delivery of projects. However, it did not address strongly and in a quantitative manner the causal factors to this persistent poor habit in industry practices. This is where the researcher comes in.

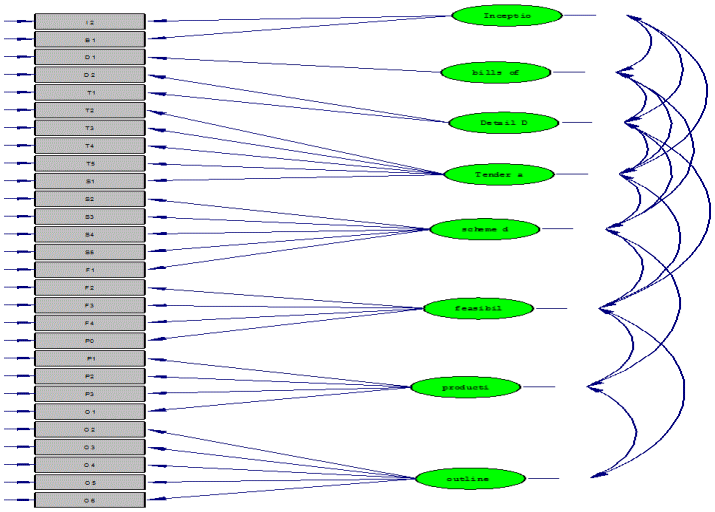
Jackson (2012) conducted a study on contingency for cost control in project management: a case study. The paper addressed issue on the application of cost management techniques as project management techniques for project management of capital works within a major Australian electricity corporation. Historical data were collected from corporations archived files to establish the performance status of completed capital works projects. A survey of the corporation's project staff was also concluded to determine the current usage of cost management techniques. The finding indicates a reluctance to utilize formal cost management procedures on minor projects estimated to cost less than $1 million. Time and fund allocations to proper cost management were isolated as the causes of the reluctance to the usage. The paper concludes that visit of poor budget performance is inevitable if formal cost control is not applied to capital works projects.

RESEARCH DESIGN AND METHODS

The population of the study is made up all built environment professionals in Nigeria which has over 800 members. The study adopted multistage technique. That is, purposive and simple random techniques to draw 450 sample from the population. A 74% response rate was recorded for data administration and retrieval. The respondents were made to rate their views on a 5-point scale. These views were analyzed using Likert scale; Relative importance index (R11) and exploratory factor analysis employing LISREL software version 9.30

Validity and reliability

The researchers and other experts in the field of academics validated the questionnaire. The pilot study carried out to test the reliability of the instrument used. This was done through test-re-test method. The reliability test showed a correlation result of 0.79



ANALYSIS AND RESULTS

Table 1: level of use of cost planning techniques.

S/N	Level of Usage	Mean	Group Mean	Rank (RII)
	Inception			
	Appointment of Architect and other Consultant	3.82	3.79	1
	Briefing by Client	3.72		
	Bills of Quantities			
	7.1 Preparation of Blank Bills of Quantities and Tende			
	Documents	3.68	3.68	2
	Details Design			
	Full design of every part and component of building by	3.65		
	collaboration of all concerned		3.62	3
	Complete cost checking of designs	3.59		
	Tender Action			
	Advertisement, and Invitation to tender	3.49		
	Opening of Tender	3.54		
	Tender Analysis and Report	3.49	3.49	4
	Award of Contract	3.59		
	Preparation of Reconciliation statement	3.33		
	Scheme Design			
	Find development of brief	3.44		
	Fill design of the project by the Architect	3.46		
	Preliminary design by Engineers	3.33	3.44	5
	Preparation of cost plan and full explanatory report	3.49		
	Submission of proposals for all approvals	3.47		
	Feasibility			
	Carrying out studies of user requirement	3.38		
	Carrying out studies of sites conditions	3.34	3.40	6
	Carrying out studies of planning design	3.59		
	Carry out cost studies	3.30		
	Production of Information			
	6.0 Preparation of final production information			
	6.1 Working drawings	3.97	3.20	7
	6.2 Schedules	3.78		
	6.3 Specifications	1.85		
	Outline Proposal			
	Develop brief further	3.28		
	Carrying out studies of user requirement	3.41		
	Carrying out studies of technical problems	3.32	2.79	8
	Carrying out studies of planning	3.32		
	Carrying out studies of design	3.38		
	Carry out studies on cost	3.30		

The findings reveal that inception cost planning techniques i.e. appointment of architect and other consultants ranks highest with a mean of 3.79, The next to the highest in rank is Bills of quantities stage with a mean of 3.86. the third in rank is the detail design stage with a mean of 3.62. Scheme design cost planning activities is the 4th in line with a value of 3.44. This is followed by feasibility stage with a mean of 3.40. Production information stage ranks next with a mean of 3.20 and the last is outline proposal with a mean of 2.79.

Table 2: causes of low use of cost planning techniques.

S/N	Causal Factor	Mean	Rank (RII)
	Poor remunerating/professional fees to Consultant	3.81	1
	Lack of knowledge of applicable techniques	373	2
	No regard for cost planning established standard techniques by clients	3.65	3
	Lack of fund by client for cost planning techniques	3.27	4
	Lack of adequate time to apply the techniques	3.19	5
	Dubious Intent	3.14	6

Table 3: effects of low use of cost planning techniques.

S/N	Effects	Mean	Rank (RII)
	Cost overrun	3.65	1
	Manifestation of many variation works at Construction phase	3.63	2
	Under-development of the Nation Economy	3.59	3
	Time Overrun	3.58	4
	Under-development of the Industry	3.38	5
	Under-development of Professional firms on the Industry	3.27	6
	Uneven distribution of the budgeted cost amongst the element of the building	3.26	7
	Abandonment	3.25	9
	Dispute	3.25	9
	Increase in cost of tendering	3.18	10
	Arbitration Matters	3.05	11

The findings reveal that poor remuneration professional fees to consultants has the highest mean of 3.81 and ranks highest. Lack of knowledge of applicable techniques of cost planning trails directly behind the former with a mean of 3.73, No regard for cost planning established standard techniques by client corner next in position with a mean of 3.65, The next in line is lack of fund by client for cost planning techniques with a mean of 3.27, the second to the last in position is lack of adequate time to apply the techniques with a mean of 3.19 and the last is dubious intent with a mean of 3.14.

The findings reveal that time over run is the highest effect with a mean of 3.65 cost planning challenges. The next in position is manifestation of many variation works at construction phase with a mean value of 3.63. the third in position is underdevelopment of the National economy with a mean of 3.59. the fourth position is occupied by cost overrun with a mean of 3.58. Underdevelopment of the Industry is position with a mean of 3.38, under-development of professional forms of the industry with a mean of 3.27 ranked with a mean of 3.26 is uneven distribution of the budgeted cost amongst the elements of the building the ninth position is occupied by two effects of low level of usage of cost of tendering with a mean of 3.18 recorded the tenth position and the last in the group is arbitration matters with a mean of 3.05

Combating Techniques

Table 4: combating techniques to low use of cost planning techniques.

S/N	Combating Techniques	Mean	Rank (RII)
	Adequate training of members of different professional grouping within the industry on the techniques of cost planning	4.22	1
2.	Enforcement of buildings codes of practice	4.22	1
3.	The carrot and stick approach should be adopted by professional bodies	4.03	3
4.	Workshop on benefit on cost planning techniques by the Build Environment	4.00	4
5.	Proper remuneration of Consultants	3.97	6
6.	Regulatory Authorities within the built Environment should certify the procedural stages of cost planning to ensure adequate compliance at pre-contract stages	3.97	6
7.	Monitoring of Projects style of Consultants through intelligenc units	3.92	8

The findings reveal that enforcement of the building code of practice and adequate training of members of different professional groupings within the industry on the techniques of cost planning respectively have the mean values of 4.22 ranking highest in position the third position is allocated to the point that carrot and stick approach should be adopted by professional bodies in inducing built environment consultants to adopt and enforce cost planning techniques and exercise. The mean value is 4.03; the fourth rank is allocated to the point that workshop on benefit of cost planning techniques in the built environment. The mean value is 4.00, the fifth position is occupied by the view point that regulatory authorities within the built environment should certify the procedure stages of cost planning to ensure adequate compliance at the pre-contract stages and proper remuneration of consultants. The mean is 3.97, the' sixth position goes to monitoring of the practice style of consultants through intelligence units with a mean of 3.92.

DISCUSSION OF RESULTS

The general result of level of usage of cost planning techniques indicates that it is partially enforced. The general cost management practice approach tends towards the traditional method where consultant is appointed and given brief. Focus is generally placed on production of bills of quantities. This result is consistent with the view of most of the authors cited in text.

The result indicates that poor remuneration of consultants/professional is a demoralizing factor towards paying careful attention to this value adding practice in the industry. Lack of adequate knowledge of the cost planning techniques aggravate the challenges further, the next in line is the point that Clients of the Industry are not generally interested in the exercises as most time they are interested more in having their projects completed on time at the cheapest cost ever. This of course means that they cannot even spare extra fund for the technicality. There are not too familiar with or

rather they find it complex and complicated. This is consistent with the views of most of the Authors cited in text.

The results on existing combating techniques suggested by experts in the industry through focused group charts and telephone survey that were tested and analysed showed the following: The major findings that adequate training of members within the industry on the benefits of cost planning techniques and adequate training if members of the different professionals grouping within the industry came topmost in the ranking with a mean value of 4.22. the third in position with a mean 4.03 is that the carrot and stick approach should be adopted by professional bodies of the built environment by inducing consultants to adopt and enforce use of cost planning techniques and exercises. the next in line is the need for built environment to collectively organized workshop on the benefits of the use of cost planning techniques exercise in delivery if projects. This has a mean value of 4.0. the next inline are the needs for proper remuneration of consultants and certification of procedural stages of cost planning techniques by regulatory authorities within the built environment to ensure adequate compliance. These two findings have a mean value of 3.97. The last of the findings indicated the need for monitoring of implementation styles used by consultants in the delivery of construction projects through constitution of intelligence units and disciplinary measures applied where consultants are found to be negligent. This came with a mean value of 3.92. These findings are consistent with Ireogbu et al (2010)

CONCLUSION

The outcome of this exploratory and investigative study was to identify the level of use, causal factors, effects/challenges and combating techniques to the use of cost planning techniques for traditional delivery of construction projects based on RIBA outline of work 2007 as emphasized above is based on inferential deductions that there is an urgent need for implementation of the identified findings so as to alleviate the crushing effects of the non-application of these techniques and by greater implication give value for money to the clients of the industry, rescue the economies of the local, state and nation. Further areas for future studies should be focused on need to increase the sample population that is based on questionnaire distribution, while the additional augmented survey through telephone calls for personal interview should be paid less emphasis. secondly, online survey administration should be employed in the future, and thirdly, in future, the scope of the study should be mapped down to either private sector or public sector

RECOMMENDATIONS

The study recommends that:

- Adequate training of members of different professional grouping within the industry on the techniques of cost planning

- Legalization and enforcement of buildings codes of practice in Nigeria
- The carrot and stick approach should be adopted by professional bodie
- Proper remuneration of Consultants
- Regulatory Authorities within the built Environment should certify the procedural stages of cost planning to ensure adequate compliance at pre-contract stages
- Monitoring of Projects style of Consultants through intelligence units

REFERENCES

Adafin, J., Rotimi, J.O. and Wilkinson, S. (2015). Why Do The Design Stage Elemental Cost Plan And Final Tender Sum Differ In New Zealand?*Journal of Financial Management of Property and Construction*, *20*(2), pp.116-131.

Ayodele, E.O. and Alabi, M.O. (2014). Effect Of Cost Control On Building Projects Delivery In Nigeria. *Civil and Environmental Research*, *6*(2), pp.76-79.

Cunningham, T. (2015). Cost Control During the Pre-Contract Stage of a Building Project–An Introduction

Ireland, L. (2006). Project Management: Past, Present, Future. *Dostupno na: http://www. asapm. org/asapmag/articles/PrezSez7-28-06. pdf [28. lipanj 2014.]*.

Iroegbu, A., Nwafo, K. and WOGU, C. (2010). Application of Project Cost Planning Techniques in the Nigeria Project Cost Management System. The Coconut, 2(1), pp.1-8.

Jackson, G. (2012). Contingency For Cost Control In Project Management: A Case Study. *Construction Economics and Building*, *3*(1), pp.1-12.

Kerzner, H. (2013). *Project Management: A Systems Approach to Planning, Scheduling, And Controlling*. John Wiley & Sons.

Offei-Nyako, K., Ohene Tham, L.C., Bediako, M., Adobor, C.D. and Oduro Asamoah, R. (2016). Deviations Between Contract Sums And Final Accounts: The Case Of Capital Projects In Ghana. *Journal of Construction Engineering*, *2016*.

Ogunsemi, D.R (2015) Value For Money In Construction Project; The Quantity Surveyors,'Quest, Publication Committee; Futa BDC, Akure.

Ramabodu, M.S. (2014). *Procurement Guidelines For Project Success In Cost Planning Of Construction Projects* (Doctoral dissertation, University of the Free State).

Royal institute of chartered surveyors, 2014, `How can building information modeling (BIM) support the new rules of measurement (NRM)`, *Royal institute of chartered surveyors (RICS),* http:/www.isuru.com/site/scripts/download.aspx?type=download&file10=6576

Ubani, E.C. and Ononuju, C.N. (2013). A Study of Failure and Abandonment of Public Sector Driven Civil Engineering Projects in Nigeria: An Empirical Review. *American Journal of Scientific and Industrial Research*, *4*(1), pp.75-82.

CHALLENGES FACING CONSTRUCTION PROFESSIONALS' COMPLIANCE WITH CONTINUING PROFESSIONAL DEVELOPMENT (CPD) IN SOUTH AFRICA

Titus Ebenezer Kwofie[1], Clinton Ohis Aigbavboa[2] and Johannes Siabatho Mpambela[3]

[12,3]Sustainable Human Settlement and Construction Research Centre, Faculty of Engineering and the Built Environment, University of Johannesburg, South Africa

Continuous Professional Development (CPD) has globally been accepted as a veritable approach to acquiring new skills and knowledge as well towards improved performance of professionals in the industry. However, in spite of the numerous effort in CPD developments and regulation by professional bodies in the South African Construction Industry (SACI), the CPD process faces numerous challenges resulting in high incidence of compliance default among professionals. Ironically, identification of these challenges is yet to be subjected to any rigorous research and interrogation. By adopting a quantitative research design and a questionnaire survey, this study sought to delineate the key challenges to CPD compliance among construction professionals in the SACI. A total of sixty (60) questionnaires were distributed to professionals and leaders of professional bodies involved in CPD in South Africa, out of which 34 were received forming a 57% response rate. Data analysis involving the use of one sample t-test revealed *'Strong Work commitments often restrict participation', 'Lack of structured CPD policy within practices', 'Current CPD programme being expensive' and 'Lack of understanding of CPD benefits by professionals'* as the major challenges facing practitioners. The findings from the study are considered vital towards engaging regulators and Stakeholders in CPD adherence in the SACI thus allowing them to chart new agenda, guide decisions, evolve modalities and formulation of strategic framework that will improve compliance of CPD programme aimed at the needs of construction professionals and the industry.

Keywords: CPD challenges, CPD compliance, professional development

[1]teeagk@yahoo.co.uk
[2] caigbavboa@uj.ac.za
[3] joe@shiyaconsulting.co.za

Kwofie, T. E, Aigbavboa, C. O. and Mpambela, J. S. (2017) Challenges facing construction professionals' compliance with continuing professional development (CPD) in South Africa *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 394-409.

INTRODUCTION

Continuing Professional Development (CPD), is defined as systematic maintenance, improvement and broadening of knowledge and skills, and the ongoing development of personal qualities necessary for the execution of professional and technical duties throughout a practitioner's working life (RICS, 2008). From existing definitions in literature, it can be affirmed that, the common denominator amongst the varied definitions is that, CDP is further education by practitioners to maintain their knowledge and skills at a level crucial to affect the needed performance in their work roles in the industry (Olwagen et al., 2015; Vrasidas & Zembylas, 2004; Cervero, 2001). It is further alluded that, CPD is also an effective approach for professionals to build a sense of collective responsibility to society and added value to the capability of the professional through the acquisition of new knowledge (Olwagen et al., 2015; Madter et al., 2012; Wall et al., 2006; Vrasidas & Zembylas 2004). With the construction industry being a continuously evolving industry which is affected by various factors such as construction techniques (i.e. green buildings); materials (i.e. alternative building methods); quality control and legislation (i.e. Health & Safety); changes in the traditional roles of professionals (i.e. Architect being appointed Principal Agent); and high speed evolution in information technology makes CPD an invaluable tool for professionals to keep up to date in these ever changing times. According to Rapkins (1996), almost a third of graduates obtained skills were obsolete seven years after graduation only. Skills obsolescence can be mainly attributed to deficiencies in education and fields of work changes (Olwagen et al., 2015; Madter et al., 2012).

However, in spite of several CPD development by professional bodies and organizations in the South African Constriction Industry (SACI) towards continuous development of professionals, the CDP systems of most professional bodies continue to attract low patronage and low level compliance among professionals in the industry. Likewise, in spite of CPD being regarded as an imperative and important tool for professionals to improve their skills, knowledge and to keep themselves relevant and competitive in the construction industry, many professionals fail to take advantage to develop themselves (Madter et al., 2012; Wall & Ahmed, 2006; Cervero, 2001). The South African Built Environment Council has initiated actions which include development of policies, regulations and incentives on CPD to professionals of the industry (Government Gazette, 2012). Yet, the industry faces high levels of compliance among the key professionals (such as Project Managers, Architects, Structural & Services Engineers, Quantity Surveyors, Contractors and Contracts and Construction Managers). Additionally, the CPD process in the SACI is perceived to be fraught by numerous challenges resulting in high incidence of compliance default among professionals. Ironically, empirical assertiveness through the identification of these challenges is yet to be subjected to any rigorous research and interrogation. Against this background, this study has been initiated with the primary aim to delineate the challenges to CPD

compliance among professionals in the SACI that is crucial to triggering an agenda to engender improvement in CPD compliance in South Africa.

The findings from this study is crucial towards engaging regulators and Stakeholders in CPD in the SACI to chart new agenda, guide decisions, evolve modalities and formulation of strategic framework that will aid compliance of CPD programme aimed at the needs of construction professionals.

LITERATURE REVIEW

The concept of Continuous Professional Development (CPD)

The concept of continuous professional development has received considerable attention in many disciplines, industry and professional practice during the last two decades. Notionally, the fundamental underlining conception is that, CPD is a learning process through which practitioners and professional acquire new and emerging skills, knowledge and competencies that enhance their performance and improve the relevance and competiveness in their work function or role (Madter et al., 2012; Vrasidas & Zembylas, (2004; Alshawi et al., 2006; Starke and Wade, 2005; Thomas-Edward, 1995). However, from extant literature, there is apparent lack of consensus on the definition and thus constitute a major barrier to its wider acceptance and implementation (Friedman and Phillips, 2001). The CII (1986, p. 3) defined CPD as:

'the systematic maintenance, improvement and broadening of knowledge and skill and the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner's working life'.

Schostak (2009) and Friedman et al. (2000) suggested CPD as a means of keeping up-to-date with knowledge, skills and attitudes that are crucial to successful practice of one's profession or way of doing work. From critique of several existing literature, it can be affirmed that, CPD has often been closely associated with continuous cycle of appraisal and revalidation of one's professional skills and competencies that are often linked to performance (cf Madter et al., 2012; Schostak 2009: Alshawi et al., 2006; Wall et al., 2006; CIC, 2008; Guly, 2000)

In practice and reality, the concept of CPD is frequently used in different context referring to different practices and connoting variations in its meaning. With these varying meaning comes with its antecedent different theoretical approaches and assumptions which has often becomes a major source of criticisms (Robinson et al., 2011; Pianta, 2006; Friedman & Phillips, 2001; Eraut, 1994). These developments subsequently limit the understanding of CPD among practitioners and stakeholders (Pianta, 2006; Wall & Ahmed, 2005; Starke & Wade, 2005; Eraut, 1994). Moreover, practitioners are in most cases not clear on what actually counts as CPD as well as sharing opposing opinions as what activities should count as CDP and thus points growing worsening ambiguity over its fundamental rationale and purpose (Friedman & Phillips, 2011; Friedman et al., 2001;

Wall & Ahmed, 2005; Vrasidas & Zembylas, 2004). From these grounded developments of lack of consensus and divided opinions as indicated above, it can be argued that, the concept of CPD is textual and thus generic approach across various professions, disciplines and industry is highly unlikely. In the context of the construction industry, the primal factors in the definition by CII (1986) can be seen to underpin many CPD initiatives of the various professional practices of the professions in the industry.

CPD in the construction industry

The recognition of the need for continuous professional development in the Construction Industry has well been acknowledged in numerous body of literature and other scholarships. From extant literature, CPD in the construction industry identifies the professional themselves, their employer and the professional body as the main tenets for its effective implementation and practice (Friedman and Phillips, 2001; Friedman et al. 2001; RICS, 2008; Foong & Khoo, 2015). In this regard, the construction industry through the various professional bodies have developed and implemented CPD that focus on emerging technology, technique, practice, materials through seminars, annual refresher course training, professional certification and revision of training curriculum through the industry academia collaboration (Robinson et al., 2011; Wall et al., 2006; RICS, 2008; Rehman & Ofori, 2008; Friedman et al. 2001). Through these, the perception of CPD to practitioners have shifted to rather gaining understanding and benefits much against the initial hostile perception among the industry professionals to their various professional bodies.

Friedman and Philips (2001) and Foong & Khoo (2015) revealed that, the construction industry is saturated with numerous CPD programmes from various professional bodies which are often undated to reflect emerging knowledge, practices and skills and thus most of the professional institutions, are largely committed to incorporating CPD into the working lives of their members. However, in reality, the current form of CPD in the construction industry in South Africa and most countries in sub-Saharan Afraica is fraught with confusion and contested by many professional in the industry (SACPCMP, 2009; Rehman & Ofori, 2008 Friedman et al., 2000). In recent times, the focus of many CDP regulatory bodies and professional institutes has been to encourage compliance and recertification. In this light is sternly argued that developing strong compliance to CPD in the industry is regarded as a useful approach and a step necessary to engender the turning out and supply of competent work force and labour in the construction industry. However, it is a common knowledge that, the process is beset with continuous challenges of non-compliance to CPD among various professionals.

The CPD situation in the South African construction industry

In the South African Construction Industry (SACI), policies regarding process, content, renewal and certification have been developed by the Built Environment Council and this is contained in the CPD policy framework of 2007. This policy framework highlighted the recognition of the continued need for regulation of the construction industry to protect public interest;

promotion of professionalism, trust and confidence of the construction professions; support for broader national development priorities, stimulation of competition and an enabling environment, and recognition of commonalities within the construction professions (Government Gazette, 2012). The CBE consists of the South African Council for the Project and Construction Management Professions (SACPMP) which regulates the practice of Construction and Project Management professions, the South African Council for the practice of Quantity Surveying profession (SACQSP) which regulates the Quantity Surveying profession and the South African Council for the Architectural profession (SACAP) which also regulates the practice of Architecture in the country.

The CBE has a key mandate of protecting public interest by making sure that all professionals within the construction profession are well educated and knowledgeable with the latest trends and methods within their field of work. However, numerous studies within the construction industry have pointed to huge CPD inconsistencies and this has been a stumbling block to the efforts of CBE's CPD programmes (Madter et al., 2012). In spite of this, the CBE (SACPCMP, SACQSP, SACAP, etc.) resolved that, CPD compliance is a condition for registration renewal and maintenance. All registered professionals need to renew their registration every five (5) years to maintain their registration in a manner as prescribed by the relevant Council (Government Gazette, 2012). Accordingly, from the various CPD Policies, professionals can earn CPD points and comply, by engaging in voluntary activities (Personal professional development), Taking on furthers studies and attaining certificates of competence or attendance, engaging in research programmes that benefit the profession, teaching and training at tertiary institutions, engage in professional administration and community service, and permanent engagement in professional practice in the construction management sector (Madter et al., 2012; Government Gazette, 2012). By taking part in such activities, points allocation are awarded to the professional involved which counts towards renewal. In spite of these clearly defined CPD activities, compliance has been a major setback in the CBE's efforts of ensuring effective and competent professionals through continuous professional development. Likewise, most registered fail to comply by submitting their CPD details on time, risking their professional status/membership with Councils, which may lead to de-registration and/or being permanently struck of the register of the relevant council, which means a member may no longer practice as a registered professional

The challenges to CPD compliance in the construction industry

It is no denying the obvious fact that CPD globally is fraught by numerous challenges. The general misconception and hostile resistance by particular professionals to CDP continues to dominate as the major challenge to CPD (Foong & Khoo, 2015; Wall & Ahmed, 2005; Alshawi et al., 2006; Cervero, 2001; Friedman & Philips, 2001). Wall & Ahmed (2005) revealed that, accessing formal CPD opportunities, while working full-time in the construction industry continues to be a major challenging undertaking and

thus become very unfriendly. Likewise, it has been posited that, high cost of undertaking CDP by has been a major deterrent to voluntary participation among construction professionals and also these costs further deter some employers who are to assist in their staff developments (Madter et al., 2012; Alshawai et al. 2006; Wall & Ahmed, 2005; Rapkins, 1996).

In the opinion of Holden and Harte (2004) and Sabiechowska and Maisch, (2007), even though the benefits of engaging in CPD is rife and well known, there is seemingly lack of understanding among many construction professionals on the need for CPD given their accumulated knowledge especially from graduate education and thus regard it as complete waste of time. Additionally, many professionals in Construction and other sectors such as Education, Medicine and Journalism have branded some current CPD cycle, process and certification as rather too long which does not suit their organizational working guidelines and conditions (Alshawai et al. 2006; Friedman and Philips, 2001 Friedman et al., 2000; Guly, 2000). Lang et al. (2007) and Rapkins (1996) further opined that, it is often difficult with professionals with strict and difficult schedules and commitment to participate in some CDP programme and thus new approaches must be pursued by the professional institutions.

It has also been well established in existing literature that lack of structured CPD policies and programmes as well as extensive awareness of CPD programmes, procedures and certification among professionals still remains relevant challenges (Madter et al., 2012: Lang et al., 2007; Alshawi et al., 2006; Starke & Wade, 2005; Holden & Harte, 2004; Cervero, 2001; SCOPME, 1996).Against this backdrop of these challenges, it can be strongly argued that, though these challenges can be seen to be general and common, but at the same time, there are likely development that their occurrence may vary from profession to profession and country to country. Hence it is important to subject these known challenges to empirical rigour by profession and country specific. Likewise, gaining understanding and knowledge of the intrinsic contextual challenges facing the compliance of Construction Professional is could be more vital to CPD decisions and policies in South Africa than a whole sale adoption from existing literature.

Table 1.0: Summary of Challenges to CPD Compliance from Literature

S/No	CPD Compliance Challenges	Author Sources				
		1	2	3	4	5
1	Current CPD programmes are expensive	x	x			
2	Current CPD programmes are not user friendly	x			x	
3	Current CPD cycle is too long		x		x	
4	Lack of understanding of CPD benefits by professionals	x		x		
5	Work commitments often restrict participation		x			x
6	Lack of structured CPD policy within practices			x	x	
7	Professionals do not consider CPD important		x			x
8	Lack of CPD awareness by practices, professional council, institutions, etc.	x			x	x

Sources: 1=Wall and Ahmed (2006) 2= Alshawai et al. (2006), 3= Holden & Harte (2004), 4= Madter et al., (2012), 5=Lang et al. (2007)

From a critical synthesis of existing literature on CPD focusing on the SACI, it can be asserted that, notable gaps exist for studies to empirically examine the key challenges to CPD compliance among professionals in the South African context. Likewise, insights into integrated CPD deployment strategies that can bring about improvement in the compliance level and uptake of CPD in the SACI is also lacking. For these notable gaps in knowledge pertaining to the South African context, this study has been initiated with the aim of identifying the critical challenges to CPD compliance among construction professionals in the SACI.

STUDY METHODOLOGY

The study adopted a quantitative research design using structured questionnaire to collect the data in a survey. The choice of this approach was underpinned by the theoretical foundation of its appropriateness in testing prior formulation in a research inquiry (Fellows & Liu, 2008; Creswell, 2009). The questionnaire was developed using the eight (8) identified challenges of CDP compliance summarized in Table 1.0. The adoption of these variables was borne out of the fact, the variables emanate from the three main tenets of CPD agenda (Professional, Employers and Professional Bodies (Friedman and Phillips, 2001; Friedman et al. 2001; RICS, 2008; Foong & Khoo, 2015) and thus this also helps in ensuring theoretical and practical validity in the variables (Creswell, 2009; Field, 2009). The questionnaire was structured into two sections namely A and B.

The section A focused on the background information of respondents which encompassed included their profession, and years of experience in the industry and CPD programmes. The Section B on the other hand related to the examination of the challenges to CDP compliance in the SACI. By adopting a convenient sample of sixty (60) professionals from across the main professions making up the CBE (Architects, Project Managers & Construction Managers, Quantity Surveyors and Engineers) and the leadership of the various professional Institutions active in CPD activities in the construction Industry in South Africa. This was done with the help of the professional bodies so as to offer a fair representation of all the professionals as well as considering their distribution in the entire country. The respondents based on their experience with CPD process and programmes were invited to indicate the extent to which they perceive the variables as being a barrier or challenge to their CPD towards re-registration and development in their professional career based on a five-point Likert rating scale interpreted as: 1 = Strongly Disagree (SD); 2 = Disagree (D); 3 = Neutral (N); 4 = Agree (A); 5 = Strongly Agree (SA). Descriptive statistics were conducted on the background information. By the use of conventional five (5) point likert scale, reliability in the measure, assessment and responses among the respondents were ensured and this can be affirmed in the consistency given in the responses as recorded in Table 3.0 (see Field, 2009).

However, on the main variables, Mean Score analysis and one sample t-test was conducted. The Mean score analysis was used to evaluate to what extent the respondents agree to these variables as being challenges to CPD compliance in the SACI by ranking whereas the one sample t-test was useful in assessing the extent the responses reflect the consensus and potential reflection of the general population (Field, 2009). A total of sixty (60) questionnaires were distributed, out of which 34 were received forming a 57% response rate. The persistent reminders through e-mails and polite Phone calls could be a contributing factor for the relatively high response. By drawing on other studies on construction industry professionals yielding 37% and 55% respectively (cf Ahadzie et al., 2007; Ashiboe-Mensah et al., 2011). In this light, it can be said that, the response rate of 57% yielded can be seen to be adequate to support the statistical analysis (see Field, 2009).

DATA ANALYSIS AND FINDINGS.

Analysis of background information

In Table 2.0, the descriptive statistics on the professions and years of experience of the various respondents in the survey is presented.

Table 2.0: Background information on respondents

Profession	Frequency
Project & Construction Manager	8 (24.0%)
Architect	5 (15.0%)
Quantity Surveyor	10 (29.0%)
Engineer	5 (15.0%)
Professional Bodies Leadership	6 (17.0%)
TOTAL	34 (100.0%)
Years of Experience in industry	Frequency
0-5 Years	8 (24.0%)
6-10 Years	14 (42.0%)
11-15 Years	6 (17.0%)
16 Years and Above	6 (17.0%)
TOTAL	34 (100.0%)

Field Data

From Table 2.0 above, the taxonomy of the professional background of the respondents were: Project & Construction Manager (24%), Architect (15%), Quantity Surveyor (29%), Engineer (15%) and Professional Bodies Leadership (17%). From these results, it can be deduced that, there is a fair representation of all the stakeholders in CPD process and programmes in the SACI and thus the responses are more likely to reflect the practical reality to the situation in South Africa. Furthermore, it is very obvious to state that, over 70% of the respondents have had over 5 years' experience, suggesting that they are likely to have had adequate understanding and exposure to CPD issues in South Africa. This will culminate into a more accurate responses from the respondents, thus giving credence to the results and findings.

Mean scores and one sample t-test analysis- challenges to CDP compliance in South African construction industry

The use of Mean Score and One sample t-test offered the opportunity to rank the variables and determine where the population agreed to a specific challenge to CPD or otherwise. The results of the Mean Scores with the associated standard deviations and standard mean errors and the One Sample t-test with its associated T-values level of significance are summarized in Tables 3.0 and 4.0 respectively. In conducting the analysis, for each of the variables defining the challenges, the null and alternate hypotheses was that, there is an agreement among the respondents on the variable and no agreement on the variables respectively. In this regard, the population mean was fixed at 4.0 which follows the works of Ling (2002) and the significance level was set at 95% in accordance with conventional practice in many research on construction and built environment (Cohen et al., 2001 & 2009; Bliese, 2000).

From Table 3.0, it can be deduced that, four variables had their means greater than 4.0. Thus, based on the likert scale used, a variable is agreed as a challenge to CPD compliance when its mean is 4.0 or more. It can thus be stated that 'Lack of structured CPD policy within practices' emerged as the highest challenge to CPD compliance among professionals in the South African Construction Industry. Additionally, 'Work commitments often restrict participation' also emerged as the 2nd significant challenge whereas 'Current CPD programme are expensive' and 'Lack of understanding of CPD benefits by professionals' were considered as the 3rd and fourth challenges to CPD progress and programs among construction professionals in the South African industry. In contrast, it can be alluded that, the variables 'Current CPD cycle is too long', 'Current CPD programmes are not user friendly', 'Lack of CPD awareness by practices, professional councils, institutions, etc'. and 'Professionals do not consider CPD important' are not major challenge to CPD programmes in the South African context.

Table 3.0: Mean scores ranking the challenges of CPD compliance

Challenges to CDP Compliance	N	Mean	Standard Deviation	Standard Error Mean	Ranking
Lack of structured CPD policy within practices	34	4.4706	.70648	.02116	1st
Work commitments often restrict participation	34	4.4412	.74635	.02800	2nd
Current CPD programme are expensive	34	4.1765	.98629	.18630	3rd
Lack of understanding of CPD benefits by professionals	34	4.0294	.90404	.08504	4th
Current CPD cycle is too long	34	3.9412	.88561	.05188	5th
Current CPD programmes are not user friendly	34	3.7353	.95339	.09905	6th
Lack of CPD awareness by practices, professional councils, institutions, etc.	34	3.2647	1.04349*	.196471	7th
Professionals do not consider CPD important	34	3.1176	1.07226*	.18249	8th

Source: Field Data *Standard Deviations greater than 1.0

It is worth noting that, all the standard deviations of the variables except two were all less than 1.0. With a standard deviation being less than 1.0 suggest that there is little variability data and that there is a sense of a general consistency in agreement among the respondents (see Cohen et al., 2009; Bliese, 2000). Additionally, the standard mean errors associated with all the means of the variables were relatively near to zero. Cohen et al. (2009) intimated that, a small standard mean error in a statistical measure is an indication the sample means are similar to the population mean and thus the sample is more likely to be an accurate reflection of the population. This thus enhance the conclusions and generalizations that can be made from the findings. Contrastingly, it is important to note that the variables *'Lack of CPD awareness by practices, professional councils, institutions, etc'* and *'Professionals do not consider CPD important'* had standard deviations greater than 1.0 even though their respective standard mean errors were perceived to be insignificant. This is an indication that, there might be slight differences in the interpretation and perceptions of these two variables among the categories of respondents. In this light, the results and discussions of the t-test offer a plausible explanation for this.

From the results of the t-test in Table 4.0, it can clearly be noted that, the t-values of all the variables were greater than the conventional cut-off value of 1.960 (Cohen et al., 2009; Field, 2009) except for the *'Professionals do not consider CPD important'* and '*Lack of CPD awareness by practices, professional councils, institutions, etc.*' which t-values less than 1.960. Likewise, the 2-tailed significance values *(p-values)* of all variables were also less than the conventional 0.05 p-value at 95% confidence interval except for 'Professionals do not consider CPD important' and 'Lack of CPD awareness by practices, professional councils, institutions, etc' which had p-values of -1.514 and -.889 respectively and thus greater than 0.05. These two findings about the two variables suggest that, there a divergent views and varying ideology among the respondents regarding these as being significant challenges to CDP compliance among construction professionals in the South African construction industry.

The summary of the results presented in Table 4.0, generally concur with the mean score and affirm that, the respondents generally agreed to '*Lack of structured CPD policy within practices', 'Work commitments often restrict participation', Current CPD programme are expensive'* and *'Lack of understanding of CPD benefits by professionals'* as the most significant challenges to CPD compliance among South African construction professionals. However, it is worth noting that, though the mean score results in Table 3.0 revealed that '*Current CPD cycle is too long'* (3.9412) and *'Current CPD programmes are not user friendly'* (3.7353) revealing scores less than 4.0 suggesting that, respondents do not agree to these as challenges in CPD compliance in the South African context. However, it can be seen that, from the t-test scores, these two challenges were significant as reported by their *t-values* and *p-values* respectively. From this, it can be suggested that, with the two variables being significant (see t-test results),

they cannot be blatantly ignored is addressing the challenges that confront CDP compliance among construction professionals in the South Africa.

Table 4.0: One sample t-test

Challenges to CDP Compliance	Test Value = 3.5					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Current CPD programme are expensive	3.631	33	.001	.67647	.2974	1.0555
Current CPD programmes are not user friendly	1.980	33	.045	.23529	-.1323	.6028
Current CPD cycle is too long	2.905	33	.007	.44118	.1322	.7502
Lack of understanding of CPD benefits by professionals	3.415	33	.002	.52941	.2140	.8448
Work commitments often restrict participation	7.353	33	.000	.94118	.6808	1.2016
Lack of structured CPD policy within practices	8.011	33	.000	.97059	.7241	1.2171
Professionals do not consider CPD important	-1.514	33	.139	-.38235	-.8960	.1313
Lack of CPD awareness by practices, professional councils, institutions, etc.	-.889	33	.380	-.23529	-.7738	.3033

Source: Field Data

DISCUSSIONS OF FINDINGS

From the analysis and results presented in the previous section, it was noted that, *'Lack of structured CPD policy within practices'* emerged as the top most challenge to CPD compliance among south African construction professionals. This generally agree to the suggestions by Holden & Harte (2004) and Madter et al. (2012). This stands to reveal that the global dimension of the issue of lack of structured policies on CPD is real. From this, it can be suggested that, though the CBE in South Africa has made significant strides in formalizing CPD programmes and policies in the construction industry, it stand to reason that the perception among practitioners and other stakeholders of seemingly lack of structured CPD polices within practice should not be overlooked if success is to be chalked in their strides to improve CPD compliance.

According to Wall & Ahmed (200) and Lang et al. (2007) growing commitments to work among professionals has remained a significant challenge to CPD programmes and compliance. Against background, the emergence of *'Work commitments often restrict participation'* as a significant challenge to CPD compliance among South African construction professionals is an agreement to the reality in the global issues with CPD compliance. Generally, construction professionals work under tight unrealistic schedule and excessive pressure coupled with seemingly unimaginable deadlines to meet. In this light, this finding should encourage stakeholders in CPD programmes in the South African industry to learn lessons from strategies evolving in the global setting to addressing this

challenge. It should thus lead to restructuring existing CPD programmes to allow flexibility to practice and parting in them.

Additionally, *'Current CPD programme are expensive'* was perceived to be a significant setback to CPD compliance among professionals. It can be said that this is not surprising given the numerous accounts given in existing literature in construction and other professional fields (see Friedman and Philips, 2001; Wall and Ahmed, 2006; Alshawai et al. 2006). Alshawai et al. (2006) and Wall et al. (2006) revealed that, the operational costs, content maintenance and general maintenance costs of many forms of CPD learning approach, structure and programme including the technology used is very expensive. In reality, most Professional Institutions and Councils tend to pass these cost to participants even though in some cases there is an element of subsidy for professionals. It is thus important to note that, in most situations, in spite of the subsidies offered, the cost appear to be high for especially early career professionals and others who may not be gainfully employed. In this light, it can thus be suggested that, stakeholders in CPD in South African industry should take cognizance of this challenge and take steps to reduce the financial burden of CPDs on practitioners especially young and early career professionals.

The emergence of 'Lack of understanding of CPD benefits by professionals' as a challenge to CPD compliance in South Africa can be interpreted as being strange and in contrast with body of literature. Wall & Ahmed (2006) and Holden and Harte (2004) indicated that lack of understanding on the benefits of CPD was a major challenge at the onset of its introduction in many professional field drawing hostile reception from many professionals. However, they were quick to suggest that, with the understanding of the benefits of CPD programmes over time, this development has dwindled leading to many professionals voluntarily partaking in them. However, a plausible explanation to this development in the SA industry could be attributed to the fact that, most policy framework on CPD in the South African construction industry was developed and introduced in recent times with typical one being that of The South African Council for the Project and Construction Management Professions which was introduced in 2011 and actual implementation started in 2012 (SACPCMP, 2011). This insight should encourage construction industry Councils and Professional Institutions to undertake rigorous education and drive to create awareness of the benefits among professionals of the benefits of CPDs. Likewise drawing on the suggestions by Rehman & Ofori (2008) this awareness could start from the academic training level by introducing this in the curricula of all the built environment courses at the tertiary level. Even though the results suggest that the general awareness level of CPDs among professional is acceptable given its emergence in Table 3,0 as not being a challenge, more efforts should be put in the benefits of CPDs to professionals.

In contrast, it can be said that, though *'Current CPD cycle is too long'* and *'Current CPD programmes are not user friendly'* did not emerge as being a significant challenge to CPD compliance among the construction industry,

they should not be discounted aand overlooked in terms of developing strategies to improving CPD uptake and compliance among professionals. Even though these challenges are well reported in literature (see Wall & Ahmed, 2006; Alshawai et al., 2006; Madter et al., 2012), stakeholders specifically, Professional Institutions and Councils in SACI should continue to pursue agenda and strategies that are aimed at further improving the friendliness of their CPDs as well as the length of time involved. This can in no small way boost the confidence and increase participation especially voluntary participation in CPDs among the professionals.

CONCLUSIONS AND RECOMMENDATIONS

Against the background of limited empirical understanding and knowledge and lack of consensus among various stakeholders and professional institutions on the nature and type of challenges accounting for the low level CPD compliance among construction professionals, the findings emanating from this study has sought to fill the knowledge gap. Through the use of quantitative questionnaire survey design, the study has empirically delineated what constitute the major challenges accounting for low CPD compliance among construction industry professionals in the South Africa construction industry. Through the use of rigorous statistical analysis, '*Lack of structured CPD policy within practices', 'Work commitments often restrict participation', 'Current CPD programme are expensive'* and *'Lack of understanding of CPD benefits by professionals'*, were the most significant challenges to CPD compliance in the industry. Although some of the findings were obvious, the emergence of *'Lack of understanding of CPD benefits by professionals'* as a challenge in the South African context could plausibly justify the uniqueness of the industry compared to the global perspective in regards of systemic, policy, institutional variations. This notwithstanding, it can be implied that, the findings reported in this study offer practical reality and guidance to professional practices in respect of CPD compliance in South African industry. This provide empirical support and further affirm notable apparent challenges facing CPD uptake and compliance in the general construction industry.

Likewise, from a practical and theoretical perspective of the seemingly touted benefits of CPD and its believed potential to enhance performance by improving the skills, knowledge and competencies of professionals, the insight into the challenges of CPD compliance should be useful for CPD decisions, planning, upgrading existing CPD programmes and policies. This could form the justification of the actions by the various construction professional councils in the South Africa construction industry. In a broader perspective, the findings reinforce the practical reality of the challenges facing CDP compliance from a global to the local construction industry and offers the urgent need to addressing these so as to derive the full benefits of CPD to the construction sector by evolving strategies to ameliorating these challenges. Considering that, there is a general consensus among stakeholders and practitioners to influence and improve CPD compliance among professionals in the construction industry in both the global and

South Africa context, the insight provided by this research presents an early opportunity to develop an integrated CPD delivery strategy that can overcome these challenges. In this regard, in an urgent disposition, further research must be pursued based on these findings to identify and evolve bespoke strategies that can nib these challenges among the construction professionals.

LIMITATIONS OF THE STUDY AND FUTURE WORK

The study has limitations which need highlighting. Challenges to CPD uptake and compliance among professionals in various professional domains can be said to be multi-dimensional and multi-faceted and are embedded in several behavioural and cognitive domains. Identifying the challenges to CPD compliance alone will there not be able to automatically address the behavioural and cognitive dimensions. Likewise, the extent and nature of contribution these challenges to CPD uptake and compliance could also not be addressed in this study. However, the findings here are important as far as gaining understanding and knowledge of the key challenges that confronts CPD uptake and compliance among construction professionals in the South Africa Construction Industry. Given that the behavioural and cognitive dimensions of this challenges herein identified and the nature of contribution is crucial, further studies are required in this direction. Also, the findings are limited in its generalization to other Southern African countries even though there lies similarities in institutions, practice and certification in most compared to South Africa.

REFERENCES

Ahadzie D., Proverbs D. and Olomolaiye P. (007. 'Critical success criteria for mass housing building projects in developing countries' International Journal of Project Management, Vol. 26, Iss. 6, pp. 675-687.

Alshawi M., Goulding J. and Faraj I. 2006. Knowledge-Based Learning Environments for Construction, Journal for Education in the Built Environment, 1(1), 51-72

Ashiboe -Mensah, NA., Akuffo, F. and Fugar, F. 2011. Investigating the perceptions of

architects in the Ghanaian building industry with regard to photovoltaic energy technology In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs West Africa Built Environment Research (WABER) Conference, 19 -21 July 2011, Accra, Ghana, 675-682

Bliese, PD. 2000. Within group agreement, non-independence and reliability. In: Klein, K. J. and Kozlowski, S. W. J. (eds.) Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions. San Francisco: Jossey-Bass.

Cervero, RM. 2001. 'Continuing professional education in transition, 1981-2000', International Journal of Lifelong Education, 20:1-2, 16-30.

Construction Industry Council and Construction Skills (CIC) 2008. "Continuing Professional Development," Best Practice Guidance for Professional institutions

Cohen, A., Doveh, E. and Eick, U. 2001. Statistical properties of the rwg(j) index of agreement. Psychological Methods, 6(3), pp.297-310.

Cohen, A., Doveh, E. & Nahum-Shani, I. 2009. Testing agreement for multi-item scales with the indices rwg(j) and ADm(j). Organizational Research Methods, 12(1), pp.148-164.

Construction Industry Council (CII) 1986. CPD information sheets of the professional institution members of the CPD in Construction Group.

Eraut, M. (1994) Developing professional knowledge and competence. London: The Falmer Press

Fellows, R. & Liu, A. 2008. Research Methods for Construction, Blackwell Pubishing, West Sussex.

Field, A. 2009. 'Discovering Statistics Using SPSS for Windows', 3rd edition, London Sage Publications, London.

Foong, SY & Khoo, CH. 2015."Attitude, learning environment and current knowledge enhancement of accounting students in Malaysia", Journal of Accounting in Emerging Economies, Vol. 5 Iss 2 pp. 202 - 221

Friedman, A & Philips, M. 2001. Leaping the CPD hurdle: a study of the barriers and drivers to participation in Continuing Professional Development. Paper presented to the British Educational Research Association Annual Conference, University of Leeds, 13-15 September 2001

Friedman, A., Durkin, C., Davis, K. & Phillips, M. 2000. Continuing Professional Development in the UK: Policies and Programmes, Bristol: PARN.

Friedman, A., Davis, K., & Phillips, M. 2001. Continuing Professional Development in the UK: Attitudes & Experiences of Practitioners, Bristol: PARN

Government Gazette, 2012. Board Notice 75 of 2012, The South African Council for the Construction and Project Management Professions–Continuing Professional Development Policy

Guly, H. 2000. Continuing professional development for doctors in accident and emergency. Journal of Accident and Emergency Medicine 2000, 17, 12-14

Lang, ES, Wyer, PC & Haynes RB. "Knowledge translation: closing the evidence to practice gap" in Ann Emerg Med 2007; 49 (3): 353-366.

Ling, FYY. 2002. Model for Predicting Performance of Architects and Engineers, Journal of Construction Engineering and Management, ASCE, Vol. 128 (5), pp.446-456.

Madter, N, Brookes, NJ., Bower, DA., & Hagan, G. 2012 Exploring project management continuing professional development in engineering construction, Construction Management and Economics, 30:8, 639-651

Olwagen, J., Cumberlege, R., Moss, I. (2015) Continuing Professional Development in the quantity surveying profession- Quantity surveyors' perception, pp1-19

Rapkins, C. 1996. 'Best Practice for Continuing Professional Development: professional bodies facing the challenge' in Woodward, I. (ed.) Continuing Professional Development - Issues in Design and Delivery, London: Cassell, pp. 216 - 225.

Rehman, S, & Ofori, G. 2008. "Developing Construction Professionals of the 21st Century": Renewed Vision for Leadership, pp 279 – 286

RICS 2008. Continuing professional development (CPD) (Accessed on 20/09/2016 via) http://www.rics.org/za/regulation1/compliance1/continuing-professional-development-cpd/

Pianta, RC. 2006. Standardized observation and professional development: A focus on individualized implementation and practices. In M. Zaslow & I. Martinez- Beck (Eds.), Critical issues in early childhood professional development (pp.231–254). Baltimore, MD: Paul H. Brookes Publishing.

Robinson, M, Walker, M, Kinder, K and Haines, B. 2011. Research into the role of CPD leadership in schools. National Foundation for Educational Research (NFER). (Accessed on 20/09/2016 via) www.emie.co.uk/nfer/publications/pdl01/pdl01.pdf

SACPCMP, 2011 Continuing Professional Development Policy, p. 1-25

SACPCMP, 2009 Registration Policies and Guidelines, Code of Conduct for Registered Persons & Recommended Identification of Work, p. 57

Schostak, J. 2009. Effectiveness of Continuing Professional Development: a literature review. London: College of Emergency Medicine

SCOPME (The Standing Committee on Postgraduate Medical and Dental Education) 1999. Strategy for continuing education and professional development for hospital doctors and dentists, London: Department of Health.

Sobiechowska, P., Maisch, M., 2007, "Work-based learning and continuing professional development", Education + Training, Vol. 49 Iss 3 pp. 182 – 192

Starke I. and Wade, W. 2005, Continuing Professional Development: Supporting the Delivery of Quality Healthcare in Annals of Academic Medicine, Singapore 2005; 34: 715.

Thomas-Edward J. 1995. Developing continuing education and training in European universities, Journal of European Industrial Training, 19(4), 11-16

Vrasidas C. and Zembylas M. 2004. Online professional development: lessons from the field, Education and Training, 46(6/7), 326-334

Wall J. and Ahmed V. 2005. Issues in Developing a Blended Learning Initiative to meet Continuing Professional Development Needs of Construction Professionals in Ireland, 21st Annual Conference Association of Researchers in Construction Management

ARCOM. pp 1289–1299, 7-9 September 2005

Wall J., Ahmed, V., Hurst A., Garrecht, H., Luckey A., McNamee F., Kanoglu A. 2006. Evolving a Framework for Technology facilitated CPD for Construction Management A European Initiative, Irish Learning and Teaching Association 7th Annual, 25th and 26th May 2006, Institute of Technology Sligo

CHALLENGES IN THE MANAGEMENT OF HOSTEL ACCOMMODATION IN HIGHER INSTITUTIONS OF LEARNING IN NORTH-WESTERN NIGERIA

A.A Yakub[1] and Z. M. Zaid[2]

[1,2]Department of Estate Management,College of Environmental Studies, Hussaini Adamu Federal Polytechnic, Kazaure, Jigawa State, Nigeria

Hostel accommodation has been a major area of concern with growing student population as a result of increasing interest in higher education in northern Nigeria over the years. This is due to the gradual dissipation of the age-old perception that western education will negate their cultural and religious values as formerly believed by majority of the populace who are predominantly Muslims. This rise in population has led to various challenges in the management of hostel facilities, ranging from overcrowded rooms, to congestion of the hostel's sanitary facilities, which results in an increased pressure on the infrastructure and other social amenities, cutting short their useful life. These in turn rapidly affects the academic environment and in turn pose serious danger to the health of the student in terms of epidemics. Thus, the aim of this paper is to investigate the challenges encountered in the management hostels in north-western Nigeria which was done by identifying the types of hostel units provided, assessing the present situation of infrastructures provided and evaluating the management approach adopted in managing the hostels. Data was sourced through the administration of 30 questionnaires to the students and hostel administrators of each selected institution alongside a face to face discussion/interview. Data collected was subjected to analysis using descriptive statistics and presented in frequency distribution tables. It was found out that most of the hostels in these institutions are overcrowded with students; there is a shortage of facilities, thus increased pressure on available infrastructural facilities and other social amenities and the fact that there is a dearth of professionals in the maintenance of these facilities. Amongst the recommendations proffered include the fact that trained personnel should be engaged in the management of these hostels and their accompanied facilities and the need for Public Private Partnership (PPP) in the provision of additional hostels

Keywords: hostel accommodation, higher institution, management, Nigeria

[1] aayakubam@gmail.com
[2] zaidmusazaid@gmail.com

Yakub, A. A. and Zaid, Z. M. (2017) Challenges in the management of hostel accommodation in higher institutions of learning in north-western Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 410-429.

INTRODUCTION

Generally, shelter is considered to be the next necessity to man after food thus globally seen as an essential resource. In the same vein education is known and accepted, the world over, as the major means by which economic, social, political and technological development could be achieved, thus the need to provide accommodation to the 'learners' as those who are to acquire the knowledge and skills for the sustainability of these developments.

Shelter, otherwise known as accommodation has to do with privacy, personal space and territoriality. Thus, a hostel accommodation is a place of abode for students which might come in the form of a shared room accommodation where students can rent a bed space (usually for short term stay) within a bigger space that provides common areas and communal facilities such as bathrooms, lounge, kitchen etc. This notion of 'hall accommodation' is in line with Ezechukwu's (1999) opinion that hostel is a place where students live and is usually situated within the school premises where students are accommodated in halls. The reason for siting hostels within school premises might not be unconnected with the fact that it could enable students to feel the impact of school environment on the learning activities.

Clark and Meave (1992) see hostel as somewhere people, especially (students) live away from home, can stay and eat fairly cheap. In the same vein, Hornby (2000) see hostel as building in which board and lodging are provided, with the support of the authorities concerned, for students and workmen in training. Meenyinikor and Benjamin (2013) in their study of the types of accommodation for millennium development goals achievement available for sustainability in the University of Port Harcourt, Nigeria and the extent of students' satisfaction with them concluded that campus accommodation is vital for goals achievement hence recommends the provision of the appropriate types and students' involvement in decision making on pertinent issues concerning hostel development.

Hostel accommodation has been a major area of concern with increasing student population as a result of increasing interest in higher institutions of learning over the years. The rise in student in-take in the recent years, most especially in the north, has led to various problematic conditions of hostel accommodation which range from inadequate infrastructure facilities to overcrowding thus the renewed interest in sourcing and researching the best practicable approach towards the enablement of an efficient and conducive academic driven environment.

The federal republic of Nigeria (2004) stated that the goals of higher education include acquisition; development and inculcation of the proper value orientation for individual and societal survival and the development of intellectual capacities to enable the individual understand and appreciate his environment. These goals as far as higher institution is concern cannot be achieved unless students in the higher institution are adequately accommodated and provided with safe drinking water, adequate sanitation,

regular supply of electricity and access to affordable means of transport. It is a fairly common occurrence for these facilities to either be available or found in a state of disrepair. Hostel accommodation is one of the physiological needs that are pre-requisite to the quality of survival of the students in terms of health, academic performance and learning.

The notable problems facing hostel accommodation in Nigeria range from overcrowded rooms to congestion of sanitary facilities, which results in an increased pressure on the infrastructure and other social amenities, cutting short their expected useful life. These in turn rapidly affects the academic environment and in turn pose serious danger to the health of the students in terms of epidemics. Although various studies have been done in this perspective, majority of them dwelled on the challenges encountered by the students rather than looking at the challenges faced by those saddled with the responsibilities of managing these hostel units. Modebelu and Agommuoh (2014) in their study revealed that there were inadequate student's accommodations caused by inadequate number of hostels, inadequate environmental management, and over crowdedness due to increased student enrolment. They also revealed that hostel environmental hazards affect students socially and academically to a great extent in Nigeria.

According to PatMbano, et al. (2012) student hostels provided at many Nigerian universities are not given the desired maintenance attention; as a result, the hostels are in poor states that do not support the living and learning objectives of providing accommodation facilities besides other academic buildings. The deterioration state in the physical conditions of students' hostels on the campuses of some institutions in Nigeria may be blamed for poor academic performance coupled with social problem such as student unrest, poor health poor academic and other negative behavioural patterns that are found in disadvantaged communities (Adamu & Shakantu, 2016; Jolaoso, et al , 2012).

Thus, this study looks at the challenges associated with the management of hostel accommodations in Nigerian tertiary institutions with particular reference to the north-western parts, through identification of the types of hostel units provided; assessment of the availability and present condition of the hostel's infrastructure; evaluation of the problems encountered by students residing in the hostels and identifying the hostels management unit/personnel cum the management approach adopted by each of the five selected institutions.

Finally, it is expected that the findings of this study will be useful to the management as the condition of the facilities will be exposed cum the problems faced by the students which is hoped to, at the long run, lead to improved services.

However the scope of this study will be limited to five higher institutions (Hussaini Adamu Federal Polytechnic Kazaure, Federal College of Education Kano, Kano State Polytechnic, Sa'adatu Rimi College of

Education and Bayero University Kano) due financial and logistics constraint.

REVIEW OF RELATED LITERATURE

Proper accommodation is vital to learning as Ozioko (1997) opined that adequate accommodation is one of the student's personal services that enhance the achievement of educational objective or instruction in an educational institution. Also, Ajayi, Nwosu & Ajani (2015) are of the view that one of the key features that students and their parents are concerned about when enrolling in a university is the availability of student housing as the significance of housing as a major determinant of man's welfare, life sustenance and survival cannot be over emphasized. As a unit of the environment, housing has profound influence on the health, efficiency and social welfare of the community (Omole, 2001).

Olutuah (2003) observed that those who have lived in hostels provided by school will attest to the usefulness of the facilities for students which may include the facts that hostel accommodation facilitates reading habit as staying in the hostel does enhance the desire to read. The distraction will be little and the activities of studious colleague can force the less serious students to read and it is easier to relate with other colleagues when there is difficulty on a subject.

Students in the hostel have greater opportunity to participate in extra-curriculum activities such as sports, games, club and social activities than the students living off-campus who may find themselves indulging in domestic activities once they are at home. Furthermore, since institutions maintain security personnel on campus and do monitor the activities of students, hostel accommodation would tend to provide more security to the student living in the campus, unlike the off-campus student who suffers from all kinds of dangers. Thus, Ukeje et al (1992) and Husen et al (1985) both viewed that housing students on campus is one of the aspect of personnel management, which is a statutory function of schools, therefore not only parents, but also the society at large expects the administration of schools to provide these services to students.

But a lot of problems have been devilling its provision and maintenance as noted by Ndu, Ocho and Okeke (1997) who opined that the problem of students' accommodation started way back in the 70's when the Federal Government took over the existing tertiary institutions and established new ones without giving serious consideration to the implications of such policy decision.

Ezeukwu's (1999) study on the management of student's hostel in Polytechnics in Anambra and Enugu states found out that students live up to four officially in a room meant for two students in the hall of residence in these institutions thus they frequently struggle over bed space and room accessories like pillows, wardrobe, table and chairs, thus concluded that increase in enrolment; insufficient allocation of funds; lack of proper

management, skills on the part of hall supervisors, wardens and porters are the basic causes these problems.

Okoh (2001) noted that lack of adequate hostel accommodation in the tertiary institution have resulted into resell of bed space by students to their frustrated peers by exploiting them unnecessarily. Furthermore, Chukwu (2001) carried out a research on problems of student accommodation in higher educational institutions using University of Nigeria as a case study thereby formulating five research questions with a sample of two hundred first year undergraduate students. He elicited information from the respondents using a 21-item questionnaire which was structured on a 4-point rating scale and finally used a mean score to analyze the collected data. His findings show that there were more students than were originally planned living in a room leading to students struggling over bed spaces and room accessories which might not be unconnected to the increase in students' enrolment and inadequate funding of the educational sector which does not allow the institutions to build more hostels. He also added that students without hostel accommodation are exposed to hazards, poor living environment, lateness to class and lack concentration during lectures.

Onyegiri (2004) conducted a study on managing student hostel accommodation problem in federal and state universities in Enugu State using a descriptive study where he adopted five research questions and five null hypotheses to guide the study. The result of the findings showed that, there existed students' accommodation problem which emanated from unproportionate increase in students' enrolment yearly; inadequate allocation of funds to the Universities by the Federal and State Government for maintenance and construction of hostels, hence students live up to 8 in a room meant for three persons, struggle over bed spaces room accessories and over use hostel facilities thereby forcing many students to live off-campus where they are exposed to all kind of dangers and threat by armed robbers and rapist.

As a result of expansion in student population, accommodation for students in tertiary institution in Nigeria has become a bother for both students and parents as almost all the tertiary institution fails to provide adequate accommodation facility for students. The few accommodations that is provided in tertiary institutions is not well maintained and also below standard, thereby exposing student to frustrated life on campus.

Ubong (2007) also conducted a study on hostel accommodation in tertiary educational institutions in Nigeria using students of Omoku Federal College of Education as case study. In his analysis, he adopted a descriptive design study using five research questions, thus he found that the number of students in the hostel are more than the facilities provided thereby causing considerable stress on facilities including beds and toilets thus concluded that hostel accommodation has not received adequate attention from both the government and the management of the institutions as there are reported cases of inadequate maintenance of the services and infrastructure of hostel accommodation; cases of students taking ill as a result of poor

sanitary condition and limited infrastructures to satisfy the high population of the student admitted on campuses.

He further asserted that in order to relieve the pressure on government finances in the areas of student housing, the older universities should henceforth finance construction of student living accommodation with loans, while government should finance one third of the student accommodation required by the newer universities; the later recommendation should put the newer universities at par with the older ones which have had at least one third of their student accommodation requirements financed by government.

Jennifer (2011) investigated the management of students' hostel accommodation problem in the Federal Colleges of Education South Eastern Nigeria by adopting four research questions and three null hypotheses to guide the study. The research questions were answered using mean and standard deviation while t-test was used to test the hypothesis at 0.05 level of significance. The major findings showed that the student agreed that inadequate of hostel accommodation, overcrowding, location of hostel very far from classroom area, inadequate supply of social amenities, inadequate toilets facilities, poor sanitation and dilapidated hostel building constitute nature of students' hostel accommodation problem in the Federal Colleges of Education.

Also in the same year, Aluko (2011) conducted a study on the assessment of student's housing situation in the University of Lagos. The result of the findings shows that there was student housing problem hence ranging from bad state of the facilities, poor maintenance, and shortage of housing unit to the student population, unavailability of space for future development, shortage of utilities and poor structural condition of the building. The study concluded that as a result of inadequacy of the existing accommodation hostel utilities and services are over utilised as rooms meant to accommodate four (4) students presently has high occupancy ratio of 8-10 people living in a single room.

Yakub, Gimba and Muhammed (2013) in their study of the status and analysis of public conveniences in higher institutions of learning within Kano, Nigeria concluded that although, following the standard, the toilet facilities may be said to be inadequate, but what really makes it look grossly inadequate is the general state of the toilets as there seems to be a generally poor attitude towards maintenance, particularly regular and thorough cleaning and use of disinfectants. This, coupled with irregular public water supply in most of the toilets results into the bad state of the conveniences in these case studies.

Oyegiri (2014) conducted a study on managing hostel accommodation problem in both the Federal and State Universities in Enugu State and concluded that there exists students' accommodation problem hence student live up to eight (8) in a room which is meant to accommodate three (3) persons; they therefore struggle over bed spaces, room accessories etc and over stretch the available hostel facilities. He further opined that the

problem emanated from unaproportionate increase in student yearly intakes coupled with inadequate allocation of funds to the Universities by the federal and state government for maintenance and construction of additional hostels.

Therefore, from the list of studies mentioned above, it is obvious that a lot of researches have been done as regards hostel accommodations in tertiary institutions in Nigeria, but majority of them dwelled on the challenges faced by the students rather than on the part of the hostel administrators with the exception of Gilbert (2011) who conducted a research on the hostel accommodation in federal colleges of education situated in the south-east geo-political zone with the aim of investigating the management of student's hostel accommodation problems in the school. The researcher found out that there are indeed hostel accommodation problems which include inadequate hostel accommodation, overcrowding of student in a room, location of the hostel very far from classroom area, inadequate supply of social amenities, inadequate toilet facilities, poor sanitation, poor communication network, insufficient water supply. The findings thus concluded that the hostels are dilapidated due to lack of maintenance culture on the part of the officials in charge of managing the hostels, poor funding from the government and lack of partnership between the government and private individual/organisation in the ownership and management of student hostel. Therefore, this study is aimed at looking at the challenges faced by the management of these hostels vis a vis the conditions of the available facilities in these campuses.

RESEARCH METHODS

Data was sourced mainly through the use of questionnaires cum interviews and personal observations, where 30 number questionnaires were administered on the students (25 Nos.) and a different set of questions structured to elicit appropriate response with regards to the management of the hostels were administered on the hostel administrators (5Nos.) of each selected institution alongside face to face discussion/interview. A total of 150 respondents were selected from five higher institutions across two states (Kano and Jigawa State) from North West Nigeria.

A detailed survey of all hostel facilities provided in the five higher institutions of learning in the selected case study was carried out where data collected ranged from number of students in a room, provision and condition of mattress/wardrobe/reading table/fan, type of and condition window/door to source of and availability of water supply, alternative electricity supply, response of management to faulty facilities.

Staff of the maintenance sections of the institutions were of great help as the researchers had detailed discussions with them and their response was very useful which dwelled on how quick they respond to maintenance needs of the hostels, the composition of the staff involved in hostel maintenance and problems faced in carrying out maintenance on these hostels. The data is hereby presented in simple narrative form alongside simple statistical

analysis through the use of SPSS thus presentations are made using tables and percentages alongside pictorial representations.

Reliability is the extent to which measurements are repeatable – when different persons perform the measurements, on different occasions, under different conditions, with supposedly alternative instruments which measure the same thing. In sum, reliability is consistency of measurement (Drost, 2011; Bollen, 1989), or stability of measurement over a variety of conditions in which basically the same results should be obtained (Drost, 2011; Nunnally, 1978). In other to ensure utmost reliability in this study the same set of questions were administered to 25 students selected randomly across the five higher institutions and different set of questions were administered on 5 staffs of the hostel management units of the five institutions to ensure consistency of measurement.

Validity "is seen as strength of qualitative research (because) it is used to determine whether the findings are accurate from the standpoint of the researcher, the participant, or the readers of an account" (Creswell & Miller, 2000). The data can be collected and then analysed by a number of different strategies in order to test accuracy of the research conclusions. Some of the strategies used to do this are triangulation, rich, thick description, bias clarification and discrepant information (Creswell, 2003). In order to establish validity for this research, the concept of purposeful selection was used. This allowed for the selection of "participants or sites (or documents or visual material), that would best help the researcher understand the problem and the research questions" (Creswell, 2003) in relation to the central phenomenon. In this case, that central phenomenon deals with aspects of hostel management across some selected higher institutions in north-western Nigeria. In order to achieve validity members of staff of the unit responsible for the management of the hostels in the five selected institutions and the students who reside in the hostels constituted the target respondents that were purposefully selected because they represent the stakeholders that have direct contact with the building. Hence, first-hand information was gotten from them.

RESULT AND DISCUSSION

Maintenance personnel

The survey and interviews conducted revealed that the Physical Planning Unit (consisting of building professionals like architects, quantity surveyors, urban and regional planners, builders e.t.c.) is the department responsible for the management of the students hostels in Bayero University Kano, Hussaini Adamu Federal Polytechnic Kazaure, Kano State Polytechnic, Federal College of Education and Sa'adatu Rimi College of Education Kano.

Table 1: Personnel in Charge of Hostel Management

Personnel	HAFED POLY n(%)	KANO POLY n(%)	FCE KANO n(%)	SRCE KANO n(%)	BUK n(%)
Estate Surveyors & Valuers	0(0)	0(0)	0(0)	0(0)	0(%)
Other building professionals. (Architects., QS, URP, Builders)	5(100)	5(100)	5(100)	5(100)	5(100)
Others	0(0)	0(0)	0(0)	0(0)	0(0)
Total	5(100)	5(100)	5(100)	5(100)	5(100)

Source: Field survey (2017)

Table 2: The Most Fundamental Problem Encountered in the Management of Hostels

Problems	HAFED POLY n (%)	KANO POLY n (%)	FCE KANO n(%)	SRCE KANO n (%)	BUK n(%)
Inadequate hostel accommodation	4(80)	3(60)	0(0)	3(60)	0(0)
Inadequate supply of basic amenities	1(20)	0(0)	0(0)	0(0)	0(0)
Inadequate social amenities	0(0)	0(0)	0(0)	0(0)	4(80)
Poor sanitary condition	0(0)	2(40)	2(40)	0(0)	1(20)
Inadequate toilet facilities	0(0)	0(0)	3(60)	2(40)	0(0)
Total	5(100)	5(100)	5(100)	5(100)	5(100)

Source: Field survey 2017

The research reveals that most of the respondents (maintenance personnel) in Hussaini Adamu Federal Polytechnic representing 80% are of the opinion that the most fundamental problem associated with the management of hostels is inadequate hostel accommodation, while 20% indicated inadequate supply of basic amenities. In Kano State Polytechnic research also revealed that the most fundamental problem encountered in hostel management is inadequate hostel accommodation as indicated by 60% of the respondents, followed by poor sanitary condition as indicated by 40% of the respondents. In Federal College of Education Kano, the most fundamental problem encountered in hostel management is inadequate toilet facilities (60% of total response) followed by poor sanitary condition. However, in Sa'adatu Rimi College of Education the most fundamental problem encountered in the management of hostels is inadequate hostel accommodation with 60% followed by inadequate toilet facilities. In Bayero University Kano the most fundamental problem was revealed to be

inadequate social amenities as indicated by 80% of the respondents, while 20% of the respondents indicated poor sanitary conditions. Therefore, the most fundamental problem associated with the management of hostel accommodation in the study area is inadequate hostel accommodation.

Table 3 shows the schedule of maintenance in the five institutions studied. In Hussaini Adamu Federal Polytechnic research revealed that regular maintenance is carried out on a monthly basis. In Kano State Polytechnic, it was revealed that maintenance is majorly done when the need arises (as indicated by 60% of the total respondents), while the remaining respondents revealed that regular maintenance is done on a quarterly basis. In Federal College of Education Kano and Bayero University Kano, research shows that maintenance is mostly carried out on a monthly basis as indicated by 60% and 80% of the respondents respectively, while 40% and 20% respectively indicated that maintenance is only carried out when the need arises. In Sadatu Rimi College of Education Kano 60% of the respondents indicated that maintenance is only done when the need arises while 40% reavealed that it was done on a yearly routine.

Therefore, the maintenance schedule of most hostels within the study area was revealed to be carried out on monthly schedule.

Table 3: Maintenance schedule of the hostel buildings

Schedule	HAFED POLY n(%)	KANO POLY n(%)	FCE KANO n (%)	SRCE KANO n (%)	BUK n (%)
1-3 weeks	0(0)	0(0)	0(0)	0(0)	0(0)
Monthly	5(100)	0(0)	3(60)	0(0)	4(80)
Quarterly	0(0)	2(40)	0(0)	0(0)	0(0)
Yearly	0(0)	0(0)	2(40)	2(40)	0(0)
When the need arises	0(0)	3(60)	2(40)	3(60)	1(20)
Total	5(100)	5(100)	5(100)	5(100)	5(100)

Source: Field survey 2017

SANITARY CONDITIONS

Toilet facilities

In terms of location, the toilets found in both Bayero University and Federal College of Education's hostels are made of both the sitting and the squatting types which were provided alongside dedicated urinals and wash hand basins; while the sitting type consists of the conventional cistern-flush type with WC. The squatting type consist of a watertight tank to hold the excreta for a certain period before evacuation with pits located offset (not directly below the superstructure) sharing the characteristics of the improved pit latrine with vent pipes. On entering the toilet one steps into a pool of water

which covers the entire corridor of the toilet. The Floor and wall finishes are generally tiles except in few cases where terrazzo was used.

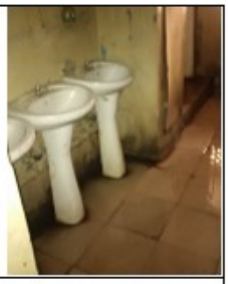
			
Picture of water tanks in front of block Q showing students doing their laundry	Entrance to the toilets depicting a puddle of water on the floor, dirty walls and an unhinged door	The picture shows very dirty squatting type toilet with stained walls from lack of routine cleaning	Wash hand basins with pool of water on the floor

Fig. 1: Showing toilet facilities as well as water source in Block Q, male hostel of Bayero University Kano.

		
unflushed faeces in the WC	A squatting type toilet in poor state	urinal in poor maintenance state

Fig. 2: showing deplorable maintenance state of the toilet facilities in Bayero University, Kano.

In Federal Polytechnic Kazaure however, the toilets on the other hand are entirely the squatting type with a water tanks which have become dysfunctional due to lack of maintenance. Water supply does not get to the toilets. The only provision for pipe born water are two big water tanks located in front of the hostel which are pumped with borehole water on daily basis. This is partly responsible for the deterioration of the toilet facilities, as students have to be subjected to the discomfort of having to fetch water from the tanks before proceeding to the toilet to relieve themselves or take their bath or to clean the toilets.

The condition of the toilet facilities in Federal college of Education Kano is also similar to those found in the state owned institutions. The study reveals that aside from the inconsistent supply of pipe born water to the toilets there is no regular cleaning of the facilities and the attitude of the students who use the facilities without flushing afterwards has also contributed immensely to the deplorable state the toilets are presently in. This is captured in the pictures below.



A squatting type toilet with the wall (tiled half-way) defaced	A squatting type toilet with the water tank	A urinal	A dirty urinal/bath space

Fig. 3: showing deplorable maintenance state of the toilet/sanitary facilities in a hostel at Hussaini Adamu Federal Polytechnic Kazaure.



Urinary in poor state of repairs	Water reservoirs	A sitting type toilet	A squatting type toilet

Fig. 4: showing toilet facilities in Federal College of Education, Kano

While in the case of the state owned institutions viz.. Kano State Polytechnic, Sa'adatu Rimi College of Education and Kano State School of Hygiene were provided with detached general toilets made of pit latrines with pits located directly below the superstructure thus having a steaming effect where squat upon and having only 8% of the entire toilets in these three schools tiled, thus generally finished in cement screed.

Although, 92% of the dedicated urinals and wash hand basins provided in the federal owned institutions are not really functional, thus unused as most of the respondents said it's not part of the culture to urinate while standing. Thus the floor/WC serves as the urinal in most of the conveniences.

The level of maintenance as observed seemed so bad such that it brings discomfort to users as most of them were seen very dirty with even left over faeces producing a staunch foul smell. 72% of the toilets have un-kept environment as the tiles on the walls have changed colours from white to brown, some places milk colours as the cleaners do not border to wash these areas thoroughly and the supervisors do not inspect adequately. In some of the facilities inspected, ants were seen with established homes, implying that the use of disinfectants for cleaning was not effectively and frequently used.



A typical pit toilet with tiled floor



A typical pit toilet with screeded floor



Toilet with cracked surface and sachet water leather littering everywhere

Fig. 5: showing deplorable maintenance state of the toilet facilities in Saadatu Rimi College of Education, Kano

Water Supply

The result (Table 4) also shows that four of the five institutions studied have Tap water as their major source of water supply, with the exception of Hussaini Adamu Federal Polytechnic whose main source of water is Water Tanker. 92% of the respondents in Bayero University and Sa'adatu Rimi College of Education indicated Tap water as their major source of water while 8% indicated Borehole water as the major source of water. In Kano State Polytechnic and Federal College of Education 68% and 64% of the respondents (students) respectively revealed also that their main source of water is Tap water

Table 4: Source of Water

Source Of wate	HAFED POLY n(%)	KANO POLY n (%)	FCE KANO n(%)	SRCE KANO n(%)	BUK n (%)
Tap	7(28)	17(68)	16(64)	23(92)	23(92)
Borehole	0(0)	8(32)	2(8)	2(8)	2(8)
Well	0(0)	0(0)	7(28)	0(0)	0(0)
Water Tanker	18(72)	0(0)	0(0)	0 (0)	0(0)
Total	25(100)	25(100)	25(100)	25(100)	25(100)

Source: Field survey (2017)

Nature of hostel accommodation

Physical inspection revealed that the hostel accommodations within the five institutions studied have basically the same structure. They are typically designed as a long line-up of rooms, each having a definite separating wall from the next room, with a long corridor in front of the rooms. At the far end of the corridor after the last room is usually situated the general toilet/bathroom. In some institutions like Bayero university, next to the toilet/bathroom is the laundry, which has been abandoned as students have opted to do their laundry outside next to the water tanks.



Front view of block Q boys hostel showing clothes hung to dry



Front view of a hostel in Husaini Adamu Federal Poly. Kazaure.

Fig. 6: showing the nature/type of hostels in Bayero University Kano and Hussaini Adamu Federal Polytechnic Kazaure.

Condition of rooms

The information gotten from the Physical Planning Unit of Bayero University revealed that the standard occupancy per room for undergraduates is 4 students to a room, while for postgraduates the occupancy is 2 persons per room. However, analysis of the data gotten from the students shows that 44% of the respondents assert that the number of students in a room range from 5 to 6 persons in a room and 4% assert that the number of students are from 7 to 8 persons per room.

In Kano State Polytechnic, research revealed that most of the students (44%) are of the opinion that the number of students per room is 7 to 8, 32% think it is above 8, while 20% believe it 5 to 6 students per room.

Table 5: Number of Students per Room

Range	HAFED POLY n(%)	KANO POLY n (%)	FCE KANO n(%)	SRCE KANO n (%)	BUK n(%)
1-4	0(0)	1(4)	9(36)	0(0)	13(52)
5-6	0(0)	5(20)	14(56)	5(20)	11(44)
7-8	9(36)	11(44)	2(8)	9(36)	1(4)
Above 8	16(64)	8(32)	0(0)	11(44)	0(0)
Total	25(100)	25(100)	25(100)	25(100)	25(100)

Source: Field survey 2017

In Federal Polytechnic Kazaure however, the hostel rooms have screeded walls and floors, the windows and doors are made of iron frames with glass panes, even though most of the glass have long been broken and yet to be replaced. The walls from the top up to the ceiling are covered in cobwebs. The rooms mostly have an average of 10 to 15 double bunk iron beds arranged side by side with little space for movement in between (a pointer to the fact that the hostel and its facilities have been overpopulated beyond their commissioned capacities).

Fig. 7: showing deplorable maintenance state of the rooms and drainage in a hostel at Hussaini Adamu Federal Polytechnic Kazaure.


Front view of a block of the boys' hostel showing water tanks


Stagnant filth in the corridor of the hostel


The entrance of the hostel showing an exposed iron flush door with no glass panes due to poor maintenance


An overcrowded room showing double bunk beds all covered in mosquito nets due to the broken windows

Fig. 7: showing deplorable maintenance state of the rooms and drainage in a hostel at Hussaini Adamu Federal Polytechnic Kazaure.

Provision and Condition of mattress

All the respondents (students) in Hussaini Adamu Federal Polytechnic revealed that they were provided with mattresses but that the mattresses were in bad condition.

In Kano State Polytechnic, 36% of the respondents (students) revealed that they were provided with mattresses and that the mattresses were in good condition, 32% responded that they were provided with mattresses and that they were in a fairly good condition while 12% also responded that they were provided with mattresses but that the mattresses were in bad condition.

Table 6: Provision and Condition of mattress

Condition	HAFED POLY n(%)	KANO POLY n (%)	FCE KANO n (%)	SRCE KANO n (%)	BUK n(%)
Yes (bad)	25(100)	3(12)	3(12)	6(24)	5(20)
Yes (fair)	0(0)	8(32)	3(12)	1(4)	8(32)
Yes (good)	0(0)	9(36)	9(36)	0(0)	12(48)
Yes (excellent)	0(0)	5(20)	0(0)	0(0)	0(0)
Not provided	0(0)	0(0)	10(40)	10(72)	0(0)
Total	25(100)	25(100)	25(100)	25(100)	25(100)

Source: Field survey 2017

Most of the respondents (40%) in Federal College of Education Kano asserted that they were not provided with mattresses while 36% revealed that they were provided with good mattresses. In Sa'adatu Rimi College of Education, research showed that 72% of the respondents were not provided with mattresses. In Bayero University 80% of the respondents were provided with mattresses in fairly good condition.

Therefore, research shows that most of the students in the study institutions were provided with mattresses, however the mattresses were in bad condition.

Maintenance of facilities

The result in Table 7 revealed that 84%, 52% and 84% of the respondents (students) in Hussaini Adamu Federal Polytechnic, Kano State Polytechnic and Sa'adatu Rimi College of Education responded, "Not prompt" when asked of the response time of the maintenance unit when a fault is reported, while 16%, 48% and 16% indicated it was "Depending on the Nature of Fault" respectively.

Table 7: Maintenance Response to Faulty Facilities

Rating	HAFED POLY n (%)	KANO POLY n (%)	FCE KANO n (%)	SRCE KANO n (%)	BUK n (%)
Prompt Response	0(0)	0(0)	6(24)	0(0)	9(36)
Not Prompt	21(84)	13(52)	12(48)	21(84)	8(32)
Depending on the Nature of Fault	4(16)	12(48)	7(28)	4(16)	8(32)
Total	25(100)	25(100)	25(100)	25(100)	25(100)

Source: Field survey 2017

Table 8: Availability and Condition of Socket Provided

Rating	HAFED POLY n(%)	KANO POLY n (%)	FCE KANO n (%)	SRCE KANO n (%)	BUK n(%)
3-4 (BAD condition)	2(8)	12(46)	18(72)	15(60)	0(0)
3-4 (GOOD condition)	2(8)	10(40)	7(28)	8(32)	1(4)
Above 4 (BAD condition)	11(44)	1(4)	0(0)	2(8)	7(28)
Above 4 (GOOD condition)	10(40)	2(8)	0(0)	0(0)	17(68)
Total	25(100)	25(100)	25(100)	25(100)	25(100)

Source: Field survey 2017

In Federal College of Education Kano most of the respondents (48%) revealed the response was "Not prompt", 28% revealed that it "Depended on Nature of Fault", while 24% revealed the response is "Prompt". In Bayero University Kano 36% of the respondents indicated "Prompt response", 32% indicated "Not prompt", while 32% indicated that it was "Depending on the nature of fault".

Research also revealed that there is availability of sockets in the hostels in all five institutions (see Table 8). However, in Hussaini Adamu Federal Polytechnic 44% of the respondents indicated that the sockets were above 4 in number but in bad condition, 40% indicated the sockets were above 4 but in good condition while 16% revealed that the sockets were 3 to 4 in number in a hostel room. Therefore, research revealed that there were electric sockets in the hostels and their number ranged from 3-4 to above for per hostel room in the study institutions, however the sockets were mostly in bad condition

CONCLUSION

A healthy and comfortable learning environment has immeasurable positive effects on the health, performance and overall wellbeing of students. Hostel accommodation is pivotal to efficient learning because it vests tremendous advantages on students who reside therein, especially when contrasted with students who reside off-campus. The numerous advantages include: nearness to lecture halls which in turn reduces the chances of being late for lectures, nearness to the school library which in turn confers the advantages of having more resources for study and research, absence or reduced public nuisance such as loud music and uncontrolled noise, proximity to lecturers and fellow students which offers the opportunity of having focused group discussions and knowledge sharing, better security for students and their belongings etc. In order for hostels to be kept in a condition where they will continue to serve the initial purposes for which they were built, there has to be proper management and maintenance policy in place as well as the right management personnel.

The decaying and anaesthetic state of student hostels across higher institutions in North West Nigeria elicited this study. There has been noticeable increase in the number of students gaining admissions into these institutions without commensurate increase in the present hostel accommodations thereby leading to overpopulation and overstretching of the hostels and their facilities resulting into the rapid breakdown of the hostels facilities. Findings emanating from interviews, surveys and field inspection point towards the fact that the management of hostel accommodation in tertiary institutions in northern Nigeria are bedevilled with quite a number of challenges vis, poor composition of the staff that constitutes the management/maintenance personnel or department, inadequate hostel accommodation, inadequate toilet facilities, inadequate supply of basic amenities, inadequate water supply, poor maintenance strategy as well as delay in restoration of broken-down facilities.

The findings of this research will aid the authorities of higher institutions across Nigeria in identifying areas of shortfall in the management of their student hostels and where there is a need for reinforcements to ensure the hostels continue to function at peak performance. The findings will also assist the government especially the education sector in identifying institutions that need additional hostel accommodations.

In furtherance to these findings, subsequent studies would need to be conducted to determine the level of involvement of estate surveyors and valuation professionals in the management of our student hostels in Nigeria.

The study thereby advocated that only professionals like facility managers and estate surveyors and valuers that are trained and certified in property and facility management should be tasked with the responsibility of managing hostels. The study recommended timely response to broken-down facilities, it also recommended proper monitoring of students' activities to checkmate those activities that are inimical to the hostels facilities, as well as development of new hostels to cater for the increasing number of students gaining admission into the institutions.

RECOMMENDATIONS

1. The study hereby advocates that only professionals like facility managers and estate surveyors and valuers that are trained and certified in property and facility management should be tasked with the responsibility of managing hostels.
2. The higher institution's authorities can outsource the management and maintenance of their hostels to private estate management firms for enhanced professionalism in the management of their hostels.
3. The school's management should endeavour to promptly respond to repairs and also ensure the constant supply of clean water and electricity as well as other facilities.
4. The schools management should ensure proper monitoring of students activities in the hostels to forestall those activities that are inimical to the hostels facilities.
5. The government should come to the aid of these institutions thus endeavour to build more hostels for students in order to avoid the problem of inadequacy of hostel buildings and overstretching of the facilities.
6. Private investors could also be incorporated in the provision of hostel facilities in these campuses. For example through Build Operate and Transfer (BOT), Sales and Lease Back etc.

REFERENCES

Adeyemi, P. (2008). Search for an ideal handling-over note in student's accommodation. New York: Columbia University Press.

Ajayi, M, A. Nwosu and Y. Ajani (2015). Students' Satisfaction with Hostel Facilities in Federal University of Technology, Akure, Nigeria. European Scientific Journal December 2015.11 (34)

Akpan, P. (2000). Housing conditions and environment quality in Ikot Ekpene, Nigeria. African Journal of Social and Policy Studies.

Akuchie, R. (1998). Classroom organization and management: A 5-point Strategy. Ibadan: Wise Publishers.

Aluko (2011) Assessment of housing situation in university of Lagos. Unpublished seminar paper

Alumanah, U. (2001). Students hostel accommodations problems and Prospects. Nsukka: Optimal Computer Solutions.

Chukwu, J. (2001). Problems of students' hostel accommodation in higher educational institutions: A Case study of the University of Nigeria, Nsukka. In Akubue, A U & Enyi D (eds) Crises and challenges in higher education in developing countries. Ibadan: Wisdom Publishers.

Clark, B. & Meave, G. (eds) (1992). The encyclopaedia of higher education, analytical perspectives. Oxford: Pergamon Press.

Creswell, J. W. (2003). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, California: Sage Publications, Inc.

Creswell, J. W. and Miller, D. L. (2000). "Determining Validity in Qualitative Inquiry." Theory into Practice, 39(3). Quoted in Creswell, John W. 2003. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, California: Sage Publications, Inc.

Daniel, M. (1987). Management of education at a glance. New York: Harper and Row.

Drost, E. (2011). Validity and reliability in social science research. Education Research and Perspectives, Vol.38, No.1. California, Los Angeles.

Ejionueme, L. (2010). Management of student personnel services in Federal and State Universities. Unpublished Ph.D. Thesis, educational Foundations, UNN.

Elechi, E.O. (2008). Student hostel accommodation at the University of Nigeria, Nsukka. Unpublished Seminar Paper, Educational Foundations, UNN.

Ezukwu, O. (1999). Issues in hostel management in the Nigerian tertiary institution. Unpublished M.ED. Project University of Nigeria.

Federal Republic of Nigeria (2004). National policy on education (4th edition) Lagos: NERDC.

Gilbert J. (2011) hostel accommodation problem in federal colleges of education in south-east geo political zones. Unpublished PhD Thesis, educational foundations, UNN

Hornby, A. (2000). Advanced Learners Dictionary of Current English. Oxford: Oxford University Press.

Jennifer, G.F (2011). Management of Students Hostel Accommodation Problems in Federal Colleges of Education in South Eastern Nigeria M. ED thesis, Department of Educational Foundations University of Nigeria

Kalu, U. (1997). Implementation of students services at University of Nigeria, Nsukka. Unpublished 47 Seminar Paper, Educational Foundations, UNN.

Mbot, M. (2000). Management: Industrial financial consultant. Calabar: Urise printers.

Meenyinikor, J. N. D. and O. Benjamin (2013). Managing campus accommodation and extent of achievement of millennium development goals for sustainability in University of Port Harcourt, Nigeria: students' perception. Merit Research Journal of Education and Review. 1(6), 133-138, July 2013

Mgbodile, T. (2007). The dynamics of educational planning. Nsukka: Ephrata Press.

Mgbodile, T. (ed) (2003). Fundamentals in educational administration and planning. Enugu: Management Business Enterprises.

Modebelu, M. N. and Agommuoh, P. C. (2014). Environmental Hazards and Hostel Accommodation Problems: Challenges for University Education in Nigeria. US-China Education Review B, June, Vol. 4, No. 6, pp. 407-413. David Publishing Company located at 240 Nagle Avenue #15C, New York, NY 10034, USA.

Ndu A. Ocho, & Okeke B.S (ed) (1997). Dynamics of educational administration and management: The Nigeria perspective. Awka: Meks Publishers.

Nwachukwu, C. (1998). Management: Theory and practice. Onitsha: Africana – Feb Publishers Ltd.

Ogbonnaya, N. (2010). Principles and applications of educational polices

Omole, F.K (2001). Basic Issues in Housing Development, Femo Bless Publications, Ondo.

Omu, M. (2006) Management of physical facilities and equipment in secondary schools Cross River State. Unpublished Ph.D Thesis, Educational Foundations Ph.D. Thesis, Educational Foundations, UNN.

Onyegiri, P. (2004). Private-public partnership in the provision of students' hostel accommodation in the polytechnics. An Unpublished Masters Project, University of Nigeria.

Ozioko, J. (1997). Environmental psychology. Enugu: Sunny Pat Prints Nigeria.

Pat-Mbano, E., Alaka, I. N. & Okeoma, O., 2012. Examining the Physio and Socio-economic Implications of Non-Residential Policy on Imo State University Students. Canadian Social Science, 8(2), pp. 170-179.

Ubong, N. (2007). Hostel accommodation in tertiary institutions in Nigeria. A case of Federal College of Education Ohoku. An Unpublished M.ED. Project Uyo.

Wechrich, P. (1980). Cost-benefit analysis in management of students' accommodation. Paris: UNESCO International Institute for Educational Planning.

Yakub, A.A, S.D Gimba & S.A. Muhammed (2015) Status and Analysis of Public Conveniences in Higher Institutions of Learning within Kano, Nigeria Global Multidisciplinary Academic Conference GMAC 020, 6-7th April 2015, Langkawi Island, Malaysia

CHALLENGES OF PUBLIC-PRIVATE PARTNERSHIP (PPP) IN URBAN HOUSING IN NIGERIA

Paschal C. Onyemaechi[1]
[1]*Nectar International Business School, Abuja, Nigeria*

Although current public housing strategies in Nigeria place emphasis on partnerships between government agencies and private sector organizations, none of the known studies attempts to understand the challenges of public-private partners (PPP) in housing in urban areas in Nigeria. The aim of this study was to identify and analyse the challenges of PPP in urban housing from the operators of nine PPP housing projects in Nigeria. The data used in this paper were sourced from oral interviews with 27 experts drawn from public and private operators of PPP in housing in Nigeria and analysed using content analysis. Findings reveal that among several issues, the most critical challenges of PPP in urban housing in Nigeria were the lack of sustainable sources of housing finance for private developers and home seekers; poor access to developable land; and low level of compliance with PPP agreements by parties to PPP housing projects. These challenges were also found to be responsible for the poor performance of PPP in meeting the housing needs of a majority of urban residents in Nigeria who have critical housing needs. The paper ends by highlighting the various strategies that can be engaged in addressing these challenges and enhancing the outcomes of PPP in urban housing in Nigeria.

Keywords: public-private partnership, urban area, housing, oral interview, Nigeria

INTRODUCTION

Public-Private Partnerships (PPPs) represent a wide range of collaborative working arrangements involving the states, markets and the civil society organizations in the provision and management of public infrastructure and services (Abd Aziz *et al*. 2007; HABITAT, 2006 and 2011). A study by the UN-HABITAT (2006) reveals that PPP is increasing gaining acceptability in the housing sector across the world. This is because it is a creative and innovative approach to public housing delivery, which helps to solve the problem of public sector budgetary constraint in housing delivery and provides benefit to local economic development as explained by Ismail

[1] Paschaldozie2002@yahoo.com

Onyemaechi, P. C. (2017) Challenges of public-private partnership (PPP) in urban housing in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 430-442.

(2013). Based on these, Ibem *et al*. (2015) observed that PPP in housing has continued to receive research attention from scholars and researchers in the different countries.

The review of literature reveals that the existing studies have shown how PPP had engendered access to housing in countries like Egypt, India, Mexico and the United Kingdom (Payne, 1999), the benefits of PPP and contexts in which PPPs have contributed to urban housing in Malaysia (Ong and Lenard, 2002; Abdul-Aziz and Kassim, 2011), Brazil (Freut, 2005), the Philippines, Turkey and others countries (UN-HABITAT, 2006). In Nigeria, previous studies have examined the role of partners in PPP in housing (Ibem, 2010; Taiwo *et al*., 2014), the extent to which PPPs have contributed to urban housing (Ibem 2011a; 2011b; Adegun and Taiwo 2011; Ibem and Aduwo, 2012), stakeholders awareness of PPP in housing (Oladokun and Aluko 2012,Onyemaechi and Samy,2016), the critical success factors for PPP in housing (Onyemaechi *et al*., 2015) as well as the link between the operational structure and the outcomes of PPP in Housing (Ibem *et al*., 2015). From these studies, it is established that PPP in housing thrives in collaborations between government agencies, private housing developers and community-based organizations (CBOs); and that in the different countries where PPP has been implemented in housing, various degrees of success have been recorded with the attendant challenges.

Although Ukoje and Kanu (2014) and Olofa and Nwosu (2015) have relied on information provided by few government agencies and members of the Real Estate Developers Association of Nigeria (REDAN) in Abuja and Lagos to identify some of the challenges of PPP in housing in Nigeria; their findings cannot be generalized in the context of PPP in housing in this country. This is because the data were not drawn from operators of PPP housing projects in this country. In the light of this, the aim of this study was to assess the challenges of PPP in urban housing in Nigeria. The specific objective was to identify and analyze the challenges experienced in the implementation of PPP housing projects by the operators.

This study posits that as the urban housing need continues to grow, adequate understanding of the challenges of PPP in housing is important in maximizing the benefits of this strategy in addressing the persistent urban housing crisis in Nigeria. This study contributes to knowledge by identifying the key challenges confronting the PPP housing sub-sector in Nigeria; and suggesting measures for addressing these challenges. It is expected that findings of this study would inform policies and practice of PPP in housing in Nigeria and other countries.

LITERATURE REVIEW

The Concept and Practice of PPP in Housing

PPPs are increasingly gaining acceptance as a viable way of circumventing the inadequacies of government-provider approach in infrastructure provision and public service delivery (UN-HABITAT, 2006; Ibem et *al*., 2015). In spite of this, Abdul-Aziz (2012) observed that much of what has

been published on PPPs are more related to their application in infrastructure projects and urban development than in housing; suggesting that PPP in housing has not been adequately researched in comparison to other areas of PPP.

In PPP housing literature, it is observed that whereas some studies have concentrated on the extent to which PPP has been successful in affordable housing in countries such as Australia (Susilawati and Armitage, 2004); India, (Sengupta, 2006); Canada and the USA (Moskalyk, 2008); and South Africa (Suhuza, 2010), other have shown that factors such as strong government support; the availability of competent third-sector organizations for community mobilization (engagement and participation of the immediate environment on the project) and mediatory functions; the presence of a favorable macro-level economic, political and socio-cultural climate; availability of potentials for cost recovery and margin of profit for private-sector partners; and strong control mechanism by government agencies have influenced the outcomes of PPP in housing provision in Malaysia (Ong and Lenard, 2002; Abdul-Aziz and Kassim, 2011; Abdul-Aziz, 2012); Brazil (Freut 2005), the Philippines, Turkey and the USA (UN-HABITAT, 2006).

In Nigeria, the studies by Ibem (2010) and Taiwo *et al*. (2014) have revealed that both the public and private sectors have played diverse roles in PPP in housing. Other studies (Ibem, 2011a; 2011b; Adegun and Taiwo, 2011; Ibem and Aduwo, 2012; Onyemaechi and Samy,2016) have shown that PPPs have thus far provided housing for the middle and high-income people neglecting the low-income earners who have the most precarious housing needs in this country. In addition, the most recent study by Ibem *et al*. (2015) found that there was a link between the operational structure and the outcomes of PPP in housing; while Onyemaechi *et al*. (2015) identified the critical success factors for PPP in housing to include: the availability of committed and competent private developers; strong government commitment and support; the availability of large housing demand market; effective and efficient mortgage system; and access to cheap and long term funds for both developer and subscribers. Indeed, these studies have succeeded in providing a better understanding of the extent to which PPP has succeeded in addressing the housing need and the specific factors that accounted for the outcomes of PPP in housing in aforementioned countries.

Challenges of PPP in Housing

From the review of literature, we also found that in the different countries where PPP in housing has been implemented, operators of PPP in housing are faced with myriad of challenges. For examples, Fruet (2005) found that in Brazil, PPP in housing was faced with the challenges of land use restriction, lack of finance and a supportive legislation and strong policy framework. In India, it was also found that PPP in housing was confronted with the lack appropriate model and ability to regulate the activities of operators in achieving the desired result, while the study by Yuan *et al*. (2012) revealed that PPP in housing was confronted with the challenges of low profits for the private sector participants in PPP in housing; inadequate

legal framework; and unclear responsibility for both the public and private sectors in China. Elsewhere in Canada, Tsenkova and Witwer (2011) identified cumbersome planning approval process and community opposition (planning barriers); non-existent tax incentives, limited and complicated direct subsides (fiscal barriers) and restrictive lending and borrowing practices (financial barriers) as the three key barriers in PPP in housing in that country. Similarly, a study by Abdul-Aziz (2012) noted that the absence of competitive bidding process and corruption were the two key challenges of the PPP housing in Malaysia.

In Nigeria, the existing studies show that the challenges of PPP in housing were: absence of effective institutional framework to direct, regulate, monitor and coordinate the scheme to success; and poor implementation strategies (Abdullahi and Abd Aziz, 2011); inadequate supply of land by government and funding ; high cost of building materials; corruption (Ibem and Aduwo; 2012); inadequate planning, monitoring and supervision; delay and bureaucratic procedures in getting building plan approval from relevant government agencies and relocation, resettlement and compensation of both indigenes and non-indigenes found on the mass housing sites (Awe et al.,2010 ; Ukoje and Kanu, 2014). Others were the lack of skilled work force and inefficient equipment by the operators of PPP in housing (Olofa and Nwosu, 2015).

From the foregoing, it is obvious that in the different countries where PPP has been applied in housing the most common challenges are related to lack of access to land, inadequate funding and; the absence of supportive legislation and policy framework to support the implementation of PPP housing schemes.

RESEARCH METHODS

This paper draws on a larger study conducted to explore the prospects of PPP in urban housing in Nigeria. As stated in the introduction, the aim of this research was to identify and analysed the challenges of PPP in housing from the perspectives of the operators of PPP housing projects in Nigeria. The underlying theory for the study is the new management theory and the enabling strategy. The new management theory posits that there is a need for the private sector to support government and improve efficiency in the provision of public goods and services within the framework of market driven principles. According to the theory, (Yamamoto 2008), there is a need for the private sector to collaborate with the public sector to achieve effectiveness and efficiency. The leading motives is efficiency, effectiveness and equity in the delivery of public services. In this case, the collaboration will improve access to decent housing as basic need of the people. Also, the study finds its fundamentals from the enabling shelter approach as promoted by the United Nations centre for human settlement (Un-Habitat, 2004). The underpinning idea is that the government should act as an enabler. The primary objective is not only to improve efficiency but to improve access to housing and encourage the active participation of the

private sector (commercial and not-for-profit). The study will focus on addressing the following issues: 1. What are the challenges limiting the performance of PPP in housing in Nigeria? 2. Which are the most critical among them? Based on this, the research strategy adopted was qualitative research with data collected through face-to-face oral interviews with purposely selected 27 PPP housing experts in both government and private sector operators of nine PPP housing projects in Nigeria.

It was considered important to select participants in the research from among professionals and experts directly involved in the design, implementation and operation of PPP housing projects across Nigeria. Previous studies on PPP in housing (e.g. Ibem, 2010; and Abdul-Aziz, 2012) adopted similar approach. A preliminary investigation by the researchers reveals that there were 39 PPP housing projects in the six geo-political zones and the FCT-Abuja in Nigeria. Of this number, 25 housing projects have been completed with a majority of them in the Southwest geopolitical zone.

In selecting the PPP housing projects from where the operators were drawn from, one PPP housing project was selected from the Southeast, Southsouth, Northeast, Northcentral and Northeast zones and the Federal Capital Territory (FCT-Abuja). However, three projects were selected from the Southwest geopolitical zone. This translated to nine PPP housing projects from where operators were sampled (See Table 1).

Those interviewed were project managers senior directly involved in the selected PPP housing projects. The human resource department of the organizations involved assisted in the identification of those who fall under this category. Whereas one project manager was purposively selected from each of the private sector developer (PD) in the nine PPP housing projects (P1-P9), two officers comprising Project Managers and their Deputies were selected from the public sector partners (PSP) in each project, making 18 Project Managers from the public sector organizations. In all, 27 Project Managers were interviewed

The interviews were conducted between December 2014 and February 2015 in Nigeria. The interviews were based on pre-determined questions drawn from the interview guide prepared by the researchers. The interviews were based on face-to-face interactions with each of the 27 officials selected. Each interview session took place in the offices of the informants and lasted for about one hour. All the interviews were recorded electronically using a voice recorder with the permission of the interviewees. After each interview session, the recorded interviews were quickly transcribed into word documents and stored as word files in a computer database meant for this research.

The data were analyzed using content analysis, which involved manual coding of the data and identification of the major issues emanating from the interviews. This was complemented with the Nvivo 11 software. Two basic analyses were conducted using the Nvivo 11 software. The first was word frequency search, which was used to identify which words were common in the transcribed data, and result is presented as word cloud. The bolder the

word the more frequent was the occurrence of such words in the interviews; meaning that the more frequently, occurring words are displayed in larger fonts; and vice versa. The second was the text search used to identify recurring theme or phrases that surround the most frequently occurring word(s) in the interviews. The result of text search is displayed as a tree with branches (i.e. word tree) showing the various contexts in which word or phrase are used by the participants in the interviews.

Table 1: List of PPP Housing Projects from where Operators were selected

S/N	Housing Projects	Location	No of Housing units	Public Agency	Private partner
1.	FHA Estate	Owerri, Imo State, (South East zone)	255	Federal Housing Agency(FHA)	Tangent Limited
2.	Diamond Estate	Lagos (South West zone)	500	FHA	Locke International
3.	FHA Estate	Yenogoa, Bayelsa State (South South zone)	246	FHA	Chris Brown Limited
4	FMLHUD Estate	Kaduna State (North West Zone)	98	Federal Ministry of Lands Housing and urban Development (FMLHUD)	Archistrol Nig Ltd
5	North Bank Estate	Benue State (North Central Zone)	140	FHA	Paul B LTD
6	FMLHUD Estate	Adamawa State (North East Zone)	170	FMLHUD	Newturn Key Ltd
7	FMLHUD Estate Kuje	Federal Capital Territory -Abuja	150	FMLHUD	Opinion Engineering
8	Sparklight Estate	Ogun State South-West	200	Ogun Property and Investment Company(OPIC)	Sparklight Property Development Company Ltd
9	Co-operative Home Ownership incentive scheme	Lagos State (South-West)	10,000	Lagos State Ministry of Housing	First World Communities Ltd

FINDINGS

Table 2 shows the direct responses by the 27 officers interviewed on the challenges of PPP in housing in Nigeria. It is evident from the result (Table 2) that a high majority (78%) of the officers interviewed identified the lack of sustainable sources of housing finance for developers and subscribers as one of the major challenges confronting PPP in houisng in Nigeria. This result is supported in Figure 1, which shows that funding was the most occurring word in the responses on the challenges of PPP in housing in Nigeria.

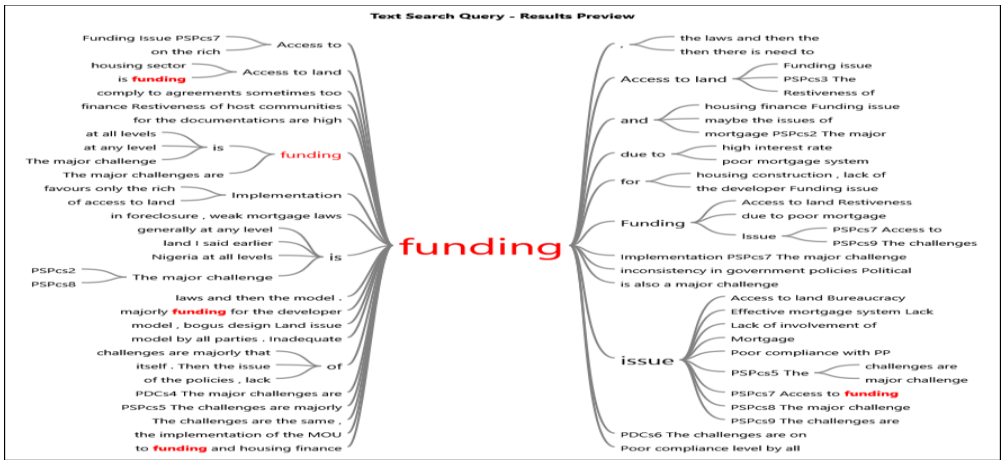


Figure 1: Nvivo Word Tree Description of Funding Challenges of PPP in Housing

Next to funding are difficulties associated with access to land for PPP housing projects (identified by around 30% of the respondents) and the lack of enabling PPP laws (15% of the respondents). Other are low levels of complaince with PPP agreements by the operators; restiveness of host communities where PPP housing projects are located; corruption; inconsistencies in government policies; low capacity of operators to implement projects; the lack of sincerity by government operators of PPP housing; lack of credible private sector partners; cumbersome PPP housing processes and long gestation period of PPP housing projects.

Table 2: Challenges of PPP in Housing in Nigeria

Respondents	Responses	Summary
PD P1	Lack of cheap and long-term funds for housing development through PPP. Poor access to mortgages by the off takers themselves	(i)Lack of cheap and long-term funds for housing development;(ii) Poor access to mortgages by the off takers
PDP2	The human factor, you may call it corruption	(i)Corruption
PDP3	The model being used is not responsive and the designs are not focused to the targeted group	(i)Inappropriate PPP model
PDP4	The high cost of fund for PPP project	(i)Funding
PDP5	Poor access to mortgage to off taker to buy the houses and good funding to developers	(i)Poor access to mortgage to of taker to buy the houses; (ii) Lacl of cheap and long-term funds for housing development
PDP6	Process is complex and not right	(i)Cumbersome PPP housing process
PDP7	Lack of government commitment, lack of sincerity because if government is really sincere	(i)Lack of sincerity by government operators of PPP housing
PDP8	I will say lack of funding to the private developer	(i)Lack of cheap and long-term funds for housing development
PDP9	I think that will be lack of long term funds for the private developer and lack of access to mortgage for the subscribe	(i)Lack of cheap and long-term funds for housing development; (ii) Lack of access to mortgage for the subscribe

Table 2 cont'd: Challenges of PPP in Housing in Nigeria

PSP_{P1}	I think is lack of enforcement of the laws	(i)Poor enforcement of PPP laws
PSP_{P1}	Lack of access to housing development for funds for developers and lack of effective mortgages for the subscribers	(i)Lack of cheap and long-term funds for housing development; (ii) Lack of access to mortgage for the subscribe
PSP_{P2}	We don't implement policies, there is lack of fund and the housing sing units itself are expensive and not affordable to the low-income earners.	(i)Poor implementation of policies (ii)Lack of cheap and long-term funds for housing development;(iii) High cost of PPP housing
PSP_{P2}	The lack of enabling environment, the PPP laws are not strong, the policy implementation is poor and the nature of funding is expensive.	(i)The lack of enabling environment; (ii)Poor implementation of policies; (iii) Lack of efficient PPP laws; (iv) Lack of cheap and long-term funds for housing development
PSP_{P3}	The model being used does not make the housing affordable to the low-income earners	(i)Inappropriate PPP model
PSP_{P3}	I think is that issue of affordability and lack of access to housing finance (mortgages) by subscribers.	(i) Lack of access to housing finance (mortgages) by subscribers; (ii) high cost of PPP housing
PSP_{P4}	Lack of funds for the developer and poor access to land for housing project	(i)Lack of cheap and long-term funds for housing development; (ii) Poor access to land
PSP_{P4}	The issue of delays in completing PPP housing project as scheduled	(i)Long gestation period of PPP housing projects
PSP_{P5}	Delays and bureaucracy, the access to land for housing	(i)Delays and bureaucracy; (ii) Poor access to land for housing
PSP_{P5}	I think the lack of strong PPP legislation and the issue of access to land for building	(i)Lack of strong PPP legislation; (ii) Poor access to developable land
PSP_{P6}	I have told you, access to resource to work with and that is basically the land	(i) Poor access to developable land
PSP_{P6}	That will be lack if mortgage, the lack of funds for private developer and mortgage for the off takers	(i)Poor access to mortgage facilities (ii)Lack of access to cheap and long-term funds for housing development
PSP_{P7}	Inability of government to provide guarantees to the private developers and lack of mortgages too	(i)Lack of access to cheap and long-term funds for housing development
PSP_{P7}	Lack of access to land and greed by the people too	(i)Poor access to developable land (ii) Greed and corruption
PSP_{P8}	Lack of PPP laws, lack of mortgages for buyer and lack of funding for developers	(i)Lack of enabling PPP laws in the housing sector; (ii) Poor access to mortgage facilities; (ii)Lack of access to cheap and long term funds for housing development
PSP_{P8}	I think lack of mortgages in the system and high cost of the housing units produced	(i) Lack of access to mortgage facilities; (ii) High cost of PPP housing
PSP_{P9}	it is usually we don't have a credible private partner	(i) Lack of credible private sector partners
PSP_{P9}	someone will get approval for a PPP project and divert the funds to something else	(i)Corruption

PD= Private Developer; PSP=Public Sector Partner; P1-P9=PPP Housing Projects

The result presented in Table 2 is also supported in Figure 2 showing the word cloud of the different challenges of PPP in housing as identified by the respondents. Examination of Figure 2 shows that lack of funding and access to land are the two most critical challenges of PPP in Housing in Nigeria.

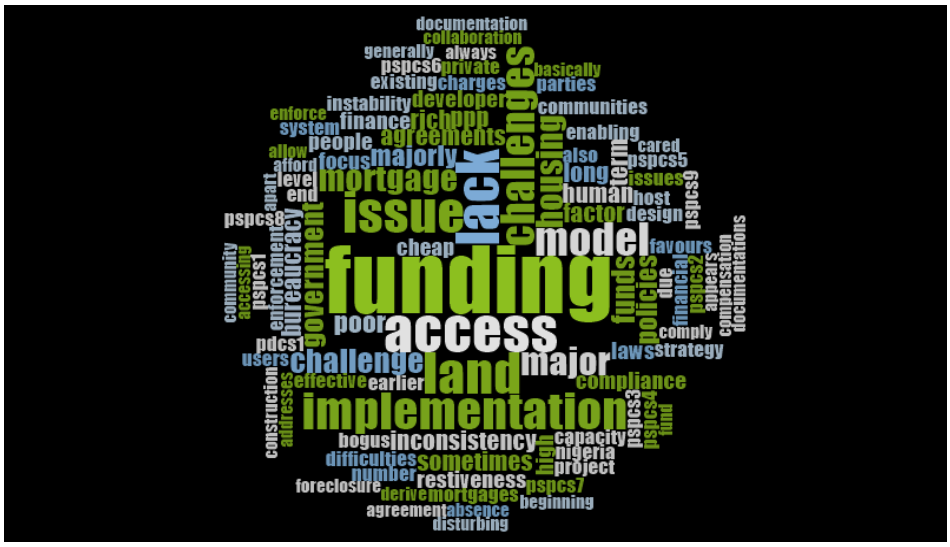


Figure 2: Nvivo Word Cloud of Challenges of PPP in Housing in Nigeria

DISCUSSION

From the result in Figures (1 and 2) and Table 2, it is evident that the challenges of PPP in housing in Nigeria in the order of severity are: (i) the lack of sustainable sources of appropriate housing finance for both private developers and home seekers;(ii) difficulties associated with access to land for PPP housing projects (iii) lack of enabling PPP laws; (iv) low level of compliance with PPP agreements, (v) restiveness of host committees; and (vi) corruption. This implies that the three most critical challenges confronting PPP in housing in Nigeria that need urgent attention are related to access to housing finance for both the developers and home seekers; inadequate access to developable land; and the lack of specific PPP laws in the housing sector.

From the interviews, it was revealed that the challenge of poor access to adequate housing finance for the PPP operators was mainly due to the absence of specialized housing development funds, while the inability of home seekers to secure mortgage facilities was due to the unavailability of such facilities, the cumbersome processes and the unrealistic requirements for accessing the available ones in this country. Consequently, both PPP housing developers and consumers have to rely on the commercial banks for loans and credit facilities with stringent and restrictive conditions similar to what was found in Canada by Tsenkova and Witwer (2011). Notably, the finding on poor access to funding for PPP housing projects corroborates to some extent that by Ibem and Aduwo (2012), Ukoje and Kanu (2014) and Olofa and Nwosu (2015) in Nigeria and Fruet (2005) in Brazil as previously highlighted. Furthermore, the study traced the source of this challenge through the funding framework and investigation reveals that PPP in

housing in Nigeria involves two parties, the public sector (the Government) and the private sector (Developer). The public sector usually initiates the partnership and invites the private sector (Commercial Developer) whose responsibility is to deploy financial resources and expertise to construct the houses. The developer after signing memorandum of understanding (MOU) and developers lease agreement (DLA) which is the document governing the partnership, the developer goes to the commercial banks to source funding for the project and finally borrows at commercial rate . This unsuitable funds which comes at a rate between 24-29% and repayable with 12-18months kills affordability. This is because in price determination, the developers add cost of fund ,land, labour and material to arrive at unit cost of a house. This is then presented to the public sector and both parties agrees on allowable profit margin which is considered and added up before arriving at unit sale prices for the houses (cost of land, material, labour, Fund and allowable profit margin will lead to sale price).

This challenge has been identified as a leading course of poor performance because, majority of urban residents and would be off takers of housing projects in Nigeria are low-income earners and have remote access to mortgage, so they are faced with the same kind of commercial funding for housing acquisition. Hence both developers and home seekers do not have suitable source of funding to achieve the intended goal of government in PPP housing and attempts to bridge the financing gap through commercial lending has not promoted good outcome of PPP in housing.

Furthermore, Public private partnership in Nigeria was not introduced merely to improve the Nigeria housing stock, No. The leading justification for PPP in housing in Nigeria is to collaborate with the private sector and assist the low-income earners and poorer groups achieve housing. This position is in line with the core attributes of new management theory and enabling shelter strategy and this consistent with the findings of previous studies in PPP housing in Nigeria (Adegun and Taiwo, 2011; Olafa and Nwosu,2015; Onyemaechi et al.,2015). Vis-à-vis this objective, PPP is yet to achieve its mandate in housing provision in Nigeria.

In support of previous studies (Fruet, 2005; Ibem and Aduwo, 2012; Ukoje and Kanu 2014; Olofa and Nwosu, 2015) the issue of poor access to land for PPP housing projects was also identified as a barrier in this study. According to those interviewed, the Land Use Act of 1978 as amended in 2004 constitutes a major hindrance to easy access to land for PPP housing projects. This legislation has contributed to the institutionalization of land tenure system that encourages dual ownership of land by the government and indigenous people. As a result, huge compensations are paid to host communities by operators before they can gain access to land acquired by government for PPP housing projects. In some cases, it was reported that some host communities made extra demands from operators and failure to meet such demands resulted to the communities preventing access to project sites. This had led to elongation of the gestation period of PPP housing projects; and thus, constituting a form of community opposition as was reported in Canada (see Tsenkova and Witwer, 2011).

In addition, the lack of enabling PPP laws in the housing sector was also identified as one the key challenegs of PPP in housing in Nigeria. A previous study by Fruet (2005) had also identified this challenge in Brazil. In fact, one of the major gaps in the current operational framework of PPP in housing in Nigeria is the absence of a PPP housing specific policy document. The National Policy on PPP developed by the Infrastructure Concession Regulatory Commission (ICRC) in 2009 and National Housing Policy 2012 only recognized the housing sector as one area PPP can be applied, but made no specific provisions for operators of PPP housing projects. As a result, PPP housing projects identified in Nigeria were implemented based on policies guidelines that are ineffective and inadequate in meeting the current demands and complexities of PPP in housing leading to poor outcomes.

The implication is that for Nigeria to benefit maximally from PPP in housing, the focus must be on affordability to low- income earners and to address this challenge, there is a need to create an enabling environment for PPP in housing to thrive.

This study therefore provides a tool for policy change that will assist government to make appropriate laws or create

appropriate framework that will lead to attainment of the original intention of government in PPP which is to provide houses that are affordable to the low-income earners through partnership with the private sector.

Specifically, the study identified the suitable funding framework needed by both the developers and home seekers to enable government to address the issues of affordability. Also, the study identified the major challenges of PPP in housing in Nigeria and made appropriate recommendations of practical steps to address these challenges.

CONCLUSION AND RECOMMENDATIONS

In this paper, attempt has been made at identifying and analysing the key challenges of PPP in urban housing from the perspectives of operators of PPP housing projects in Nigeria. From the findings, it can be concluded that the three most critical challenges confronting PPP in housing in Nigeria that need urgent attention are related to access to housing finance for both the developers and home seekers; inadequate access to developable land; and the lack of specific PPP laws in the housing sector.

Findings of this study imply that the most critical support needed by the developers to achieve the desired results in PPP in housing is to ensure they have improved access to housing finance for PPP housing projects. To this end, it is recommended that a special PPP housing development fund be established to mobilize funds from multinational finance agencies and international donor agencies, pension and funds to support the implementation of PPP housing programmes. On the issue of access to land, it is recommended that the Land Use Act to be amended to eliminate dual ownership of land and make provisions for the establishment of land banks for PPP housing projects. In view of the absence of PPP in housing specific

laws, this study advocates for a National Policy on PPP in housing to provide comprehensive guidelines for all stages of PPP housing projects at national and states levels in Nigeria. This will help streamline the operational policy framework for the PPP housing sub-sector in this country.

REFERENCES

Abdul-Aziz, A. R. (2012) Control Mechanism exercised in Malaysia housing Public Private Partnership, *"Construction Management and Economics"*, 30 (1), 37-55

Abdul-Aziz, A. R. and Jahn-Kassim, P. S. (2011). Objectives, success and failure factors of housing PPPs in Malaysia: "*Habitat International"*, 35:150-157.

Adegun, O. B. and Taiwo, A. A. (2011) Contribution and Challenges of Private Sectors in Housing in Nigeria: Case Study of Akure, Ondo State. "*Journal of Housing and the built environment"*, 26(4), 457-467.

Awe E. M., Griffith A. and Stephenson, P. (2010). An enquiry into the challenges of skills training in the Nigeria Construction Industry. Conference Proceeding. Third International World of Construction Management Conference. Coventry University, UK. pp. 152 – 159

Fruet, G.M. (2005). The low-income housing cooperatives in Porto Alegre, Brazil: a State/Community Partnership, "*Habitat International"*, 29:300–324

Ibem, E. O. (2010). An Assessment of role of government in public private partnerships in housing delivery in Nigeria. "*Journal of construction in Developing Countries"*, 15(5), 23-48.

Ibem, E. O. (2011a) Public Private Partnership in Housing in Lagos megacity Region Nigeria: "*International Journal of Housing Policy*", 11(2), 133-154.

Ibem, E.O**. (**2011b**).** The Contribution of Public Private Partnerships (PPPs) to Improving Accessibility of Low-Income Earner to Housing in Southern Nigeria. "*Journal of Housing and the Built Environment*" 26 (2), 201-217

Ibem, E. O. and Aduwo, B. E. (2012) Public Private Partnership (PPPs) in Urban Housing in Nigeria: Evidence from Ogun State. "*International Journal of Architecture and Urban Development"* 2(2), 5-14.

Ibem, E.O., Aduwo, B.E. and Alagbe, O.A. (2015). An exploration of the link between the operational structure and outcomes of Public-Private Partnership (PPP) in urban housing in Nigeria. "International Journal of Construction Project Management" 7(2)101-118

Moskalyk, A. (2008). The Role of Public-Private Partnerships in Funding Social Housing in Canada, Canadian Policy Research Networks Research Report, September. Downloaded from www.shscorp.ca (10th September 2012)

Olofa, S. and Nwosu, A. (2015) Investigating the problems associated with Public Private Partnership in the process of housing delivery in Nigeria. "*International Journal of Education and Research"*, 3(1), 133-130

Ong, H. C. and Leonard, D. (2002). Partnership between stakeholders in the provision of access to affordable housing in Malaysia. A paper presented at FIG XXII international congress held at Washington DC USA. April 19-22, 2002.

Onyemaechi, P., Samy, M. and Pollard, D. (2015). An examination of the Critical Success Factors for Public Private Partnership in Housing Projects in Nigeria. "*Journal of sustainable development in Africa*" 17(3),1-20

Onyemaechi, P and Samy, M. (2016) Motives and Motivation for PPP in Housing in Nigeria. "*Mediterranean Journal of Social Sciences"* 7(2),149-157

Payne, G. K. (1999). "*Making common ground. Public-private partnership in land for housing"*. London: Intermediate Technology Publications.

Sengupta, U. (2006) Government intervention in Public private partnership in housing in Kolkata "*Habitat international"*, 30: 448–461.

Susilawati, C., Armitage, L. (2004). Do Public–Private Partnerships facilitate Affordable Housing outcome in Queensland? "*Australian Property Journal"", 184-187*

Suhuza, Y. (2010). *Social Housing in South Africa: Are Public Private Partnerships (PPP) a solution*? Gordon Institute of Business Sciences, University of Pretoria.

Taiwo, A. A., Adeboye, A. B. and Aderonmu, P. A. (2014) Housing Finance "The role of the private sector in Public Private Partnership in Housing delivery for the low-income in Nigeria. "*International Journal of Architecture and Urban Development*" 4(3), 5-10

Tsenkova, S. and Witwer, M. (2011) Bridging the gap. Policy instruments to encourage private sector provision of Affordable Rental Housing in Alberta. "*Canadian Journal of Urban Research"* 20(1), 52-80

UN-HABITAT (2006b). "Public–Private Partnerships in Enabling Shelter Strategies". Nairobi: UN-HABITAT

UN-HABITAT (2011). "Public–Private Partnerships in Housing and Urban Development". Nairobi: UN-HABITAT

Ukoje, J. E. and Kanu, K. U. (2014) Implementation and the Challenges of the Mass Housing Scheme in Abuja, Nigeria. "*America International Journal of Contemporary Research"*, 4(4), 209-218.

Yamamoto K (2008) Has Agencification succeeded in public sector Reform? Realities and Rhetoric in the case of Japan. "*Asian Journal of Political Science"* 16(1) 24-40

Yuan, J., Guang, M., Wang, X., Li, Q. and Sikbniewski, M. (2012) Quantitative SWOT analysis of Public Private Partnership in China based on the perspective of the public sector. "*Journal of Management of Engineering"*, 28 (4), 407-420

CLIENT RELATIONSHIP MANAGEMENT IN ARCHITECTURAL FIRMS IN SOUTHWEST NIGERIA

Adedeji Adebola Adepeju[1], Ezıyı Offıa Ibem[2] and Adedapo Adewunmi Oluwatayo[3]

[1,2,3]Department of Architecture, Covenant University, Ota, Nigeria

This proposed research is premised on the need for the architectural profession to take radical adaptive actions, especially in the management of relationship with clients in order to improve business resilience in uncertain and constantly evolving business environment. Customer Relationship Management (CRM) is a current marketing concept and business strategy of many companies worldwide that enhance their capabilities to maintain long-term relationships with customers in order to ensure organizational resilience. Some studies on the relationship of architectural firms with their clients in Nigeria exist, but they tend to focus on some variables that influence the relationship rather than a comprehensive study. This study intends to fill this gap. Architecture though a relationship-based profession has never adopted conventional marketing. Hence, this study is not about adoption of CRM in the Nigerian architectural industry; rather, CRM is used as a conceptual foothold to understand the Client Relationship Management (CLiREM) techniques and tools engaged by architectural firms in the management of relationships with clients. The study would focus on architectural firms that are registered by the Architects Registration Council of Nigeria (ARCON) entitled to practice in the Federal Republic of Nigeria irrespective of the gender of the Principals. This research aims to investigate the Client Relationship Management (CLiREM) techniques and tools engaged in by architectural firms in southwest Nigeria in order to identify the strategies that contribute mostly to achieving clients' satisfaction and retention. What relationship management techniques and tools engaged by architectural firms (in southwest Nigeria) to manage their relationship with clients contribute most to client retention in spite of influencing factors? The following predictor variables (CLiREM techniques, types of service, client categories, CLiREM tools, influencing factors, perceived service quality, trust, client satisfaction, perceived switching costs, attractiveness of alternatives) and target variable (client retention) will be studied. The mixed method research paradigm will be adopted. A mix of validated questionnaires, non-participant observation guides and interview guides will be administered on architectural firms and their clients. The target population will be accessed using a disproportionate stratified random sampling of 325 licensed Nigerian architectural firms listed by Architects Registration Council of Nigeria (ARCON) and located in southwest Nigeria. Nominal, ordinal and interval data types will be collected during the study. Descriptive, inferential and predictive analyses that will be carried out on the dataset are, cluster analysis, Factor analysis, moderated multiple regression and Multivariate multiple regression. The outcome of this study is also expected to contribute empirical knowledge into the strategic resilience planning efforts of the Nigerian regulatory bodies in Nigeria (ARCON and NIA) thereby informing policy. The results are also expected to inform architectural practice and pedagogy.

Keywords: architecture, Client Relationship Management(CRM) , Client Relationship Management (CLiREM)

[1] dejiadepeju@yahoo.com

[2] ibem.eziyi@covenantuniversity.edu.ng

[3] dapo.oluwatayo@covenantuniversity.edu.ng

Adepeju, A. A., Ibem, E. O. and Oluwatayo, A. A. (2017) Client relationship management in architectural firms in southwest Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 443.

COMPARATIVE ANALYSIS OF INVESTMENT ATTRIBUTES OF COMMERCIAL AND HOTEL PROPERTIES IN SOUTH-WESTERN NIGERIA

Nurudeen Akinsola Bello[1], Adekoyejo Babatunde Jolaoso[2] and Olusegun Olaopin Olanrele[3]

[1]*Department of Estate Management, Faculty of Environmental Sciences, University of Ilorin, PMB 1515, Ilorin, Kwara State, Nigeria*

[2] *Department of Architecture, Faculty of Environmental Studies, Moshood Abiola Polytechnic, Abeokuta, Ogun State Nigeria*

[3]*Department of Estate Management & Valuation, Faculty of Environmental Studies, Moshood Abiola Polytechnic, Abeokuta, Ogun State Nigeria*

Technically, hotel investment especially the accommodation aspect is one of the breeds of real estate investment, but practically, this has been noted to be part of the breed of pure business investment. This empirical work therefore highlighted and compared the attributes of hotel investment and commercial property investment measuring their performance through occupancy rate analysis. From sample of 177 commercial properties and 70 hotel properties in the Central Business Districts (CBD)of Ikeja, Abeokuta, Ibadan, Osogbo, Akure and Ado-Ekiti; data were collected from investment managers of these two investment options in 2015 which was subsequently analysed with descriptive and inferential statistics. The research findings revealed that commercial and hotel properties have similarity in 4 of the qualitative variables (ownership mode, investment financing, renting pattern and renting purpose) and differ in the remaining 8 variables (investment rating, management, state of repair, owners' involvement, source of income, rental review determinants, rental review frequency and outgoings). The study further revealed that commercial property has higher occupancy rate of 0.89 than the hotel property of 0.80, nevertheless, there is no significant difference between the occupancy rates of these investment properties as reflected by the Kolmogorov-Smirnof (K/S) two sample test. Although this seemed to be the first comparative study of direct commercial property and direct hotel property investment attributes in Nigeria, it was recommended that subsequent study should extend to trend analysis of return on these investments. The study is limited to accommodation aspect of hotel investment, but due to its short-term advance payment attribute, hotel rate is more dynamic and can easily change with economic situation than the commercial property.

[1] bello4all007@yahoo.com; bello.na@unilorin.edu.ng

[2] koyejolaoso@yahoo.com

[3] olanrelesegun@yahoo.com

Bello, N. A., Jolaoso, A. B. and Olanrele, O. O. (2017) Comparative analysis of investment attributes of commercial and hotel properties in south-western Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 444-464.

Keywords: CBD, commercial property, hotel property, investment attributes, occupancy rate

INTRODUCTION

Generally, investment in property or real estate can be spread on bare land, residential properties, office buildings, strip stores, shopping centres, industrial properties and diverse realty investments such as hotels and motels, etc, (Sirota, 2004). A commercial property is developments or use of land that entertains business operations, requires huge capital outlay and has significant proportion in the nation's capital and general economy.

There is a new form of distinguishing commercial property at international scene, for instance, the emphasis in Asian real estate market is on Purpose Built Commercial Property (PBCP) and specifically called Purpose Built Office (PBO) in Malaysia.

In Nigeria, Iroham, Oluwunmi, Simon, and Akerele (2014) were of the view that commercial property in urban centers can be categorized into three types; purpose-built office space, converted office space and shopping complex, but Bello (2012) viewed purpose-built commercial property at the perspective of shopping complex, or and office complex. Ozigbo and Ozigbo (2013) specified commercial property as composite of office property and retail property, office property in this context may be single occupancy or multiple occupancy and may be single use, multiple uses or institutional use.

Commercial property is an 'invest-able real estate' presented by Bello (2012) as property occupied for business activities by multiple-tenants, generating stream of income that can be analyzed and thus being source of financial returns to the owner from the rent paid by the occupants. In most cases these properties are found on the high streets of the prime areas of urban centers specifically the CBDs.

For the sake of this study, commercial property has been limited to purpose built commercial complex (shopping or/and office); that are built for business purpose from the onset, used purely as business premises and not wholly owners occupied, located on the prime streets of CBDs of the study areas.

Hotel is simply described as accommodation and hospitality by ILO (2010) and operating businesses that are housed in real estate investment sector (Singh, Schmidgall and Damitio 2011). This however, falls into the first sector under the 5 general umbrella of Hotel, Catering and Tourism industry (HCT) by International Labour Organisation categorization. Hotel itself has two categorizations: real estate and services trade. Where the jobs are located with major concentrations of economic and commercial activities, hotels will follow (Rutherford and O'Fallon, 2007).

A hotel can therefore be defined as a place where tourist stops being the traveler and becomes a guest. It is an establishment that provides lodging paid on a short-term basis and facilities which can range from a basic bed and storage for clothing, to luxury features (Arnaboldi and Spiller, 2011).

Compared to other sectors of the global economy, the HCT industry is one of the fastest growing, accounting for more than one third of the total global services trade (ILO, 2001). Investment pattern in hotel globally indicated that Blackstone has more than US$12 billion in real estate funds, accounting for the largest amount of available capital in the HCT industry (Fresnel and Lausanne, 2009).

The United Nations World Tourism Organization (UNWTO) confirmed that between 70% and 75% of international tourists' expenditure goes to hospitality services on annual basis (Akpabio, 2007). This confirms the strategic importance of the sector to tourism and even the economy. In Europe, around 33 per cent of all transactions regarding hotel properties were the result of private equity fund buyouts and divestment.

Hospitality industry is composed of commercial and non-commercial activities and aspects. George (2001) perceived hospitality as the commercial activities which offer consumers accommodation, menus and drinks when out from home while promoting a welcome, warm friendly experience that benefits travelers.

As part of hospitality industry, hotel in addition to accommodation provision counts a wide range of services including restaurants, casinos, private clubs, managed food service, event planning, tourism related businesses, travel providers, and refers to the relationship process between a guest and a host (Santoro, 2015).

In developing countries and transition economies Nigeria inclusive, 80 per cent of the hotels were under non-equity modes of operation, meaning they were under individual ownership, management contracts, franchises or leases (UNCTAD, 2007). Commercial and hotel properties (despite been housed under real estate category), possess a notable level of similarities and differences that needed to be clearly understood in relation to some attributes, this kind of attributes analysis is still missing in Nigeria.

There is therefore a need to distinguish real estate investment from trading as well as removing the service effect from hotel property performance in terms of its real estate attributes alone. Despite the dearth of quality data, this study aimed at highlighting and comparing investments attributes of these investment options and measures their performance through occupancy rate approach to guide the investors' decision making.

To achieve this aim, this study has been structured into 9 sections; next section reviews the related studies followed by the section that states the research problem. The section after the research problem highlights the commercial and hotel property performance measures, followed by the research design/methods, section next to research design focuses on data collection. Section next to data collection presents the analysis of data

collected followed by the discussion of its results before conclusion and recommendations were made on the study.

LITERATURE REVIEW

Commercial property performance at foreign and local scenes

In Asia continent, Graeme, Kwong and Siu (2009) assessed the significance and performance of the China commercial property market and compared it with six developed and emerging commercial property markets in Asia by analysing the performance of commercial property in China over 1998-2007 for both direct and indirect property. The study found out that China commercial property has significantly enhanced performance and diversification benefits in recent years.

Krystalogianni, Matysiak and Tsolacos (2004) examined the significance of widely used leading indicators of the UK economy for predicting the cyclical pattern of commercial property performance using monthly capital value data for UK industrial offices and retail from the Investment Property Databank (IPD). This work was not on comparative attributes but on prediction of already established secondary data with the scope restricted to commercial property in the United Kingdom.

Colwell, Munneke and Trefzger (1998) applied hedonic model to Chicago office property utilizing 427 observations for the 1986 to 1993 period, the index included building characteristics and many aspects of neighbourhood characteristics as explanatory variables. The results depicted a contrary result to general market belief that there was a nominal expansion in Chicago office transaction prices over the course of the 1980s. This work on hedonic model is limited to office property alone, and a mere personal observation of the authors on building and neighbourhood characteristics but not on attributes of comparative direct investment.

Fisher, Geltner and Webb (1994) examined the alternative price indices in the US commercial property markets. After an empirical look at un-smoothed appraisal based indices, ex-post transaction based indices and un-levered REIT share indices; they concluded that each index method can provide different insights and uses for investors and academics alike. This is restricted to commercial property performance index, but not extended to hotel investment.

In Nigeria, Yakub, Balarabe, Salawu and Gimba (2013) used correlation and time-series analysis to investigate the effect of the review of rent on occupancy ratio of multi-storey commercial properties in Kaduna city between 2006 and 2012. The study discovered that the incessant increase in rent on the properties over the years impacted on the occupation ratio of these buildings by virtue of inverse relationship between the occupancy-status and rents-paid in the buildings, thus, as the occupancy ratio in the buildings continue to decline, the rental value continued to increase. This work has inadequate sample of just three commercial properties in a city and ignored the vital attributes of the investment property.

Bello (2012) analysed the risk and return profile of commercial property in South-western Nigeria with selected stocks market investment between 2000 and 2009; compared the inflation hedging characteristics and diversification potentials of investing in commercial property and selected stock market investment. The study concluded that stock market investment offered attractive higher return when compared with commercial property although with higher risk and there could be diversification benefits in combining commercial property with stocks investment. This work though a local content, but it did not compare the attributes of commercial property with that of hotel investment specifically.

Babajide, Emele, Oni and Durodola (2014) examined the implications of property market forecasts to commercial property valuation in Nigeria and revealed that real estate forecasting is yet to be given full attention by the stakeholders in the Nigerian market. There would not be a better forecasting of commercial property market when the attributes of such investment is not properly understood and analyzed.

Iroham, Olawunmi, Simon and Akerele. (2014) used (ANOVA) coupled with Tukey post-hoc test to assess the trends in rental values of commercial properties between 2006 and 2011 and discovered that the converted office space is mostly predominant while the shopping complex is the most professionally managed property and that the rental values of these properties are significantly different. However, the purpose built office space had the highest trend in rental values resulting to the fastest recoup of investment. The data used for this study was limited to 22 estate surveying firms in Akure, Nigeria and the attributes analysis of the commercial property was not included.

Ogunba, Obiyomi and Dugeri (2014) examined the inflation hedging characteristics of commercial property investments in Ibadan metropolis in Nigeria between 2000 and 2010 and found out that property returns have a poor hedge against actual inflation, a partial hedge against unexpected inflation and almost a complete hedge against expected inflation. This indicated that commercial properties may not offer as much protection against inflation as is usually expected by investors.

In the same direction, Dabara (2014) considered return profile of commercial property investment, but in selected state capitals of South-western Nigeria like Ogunba et al (2014) focusing on actual, expected and unexpected inflation rates for period of 2002 and 2012. Three of the 6 state capitals of the south-western Nigeria were considered, but the work should have been more robust if all the 6 state capitals of the south-western Nigeria were covered.

From all of the above past studies, it would be observed that the focuses are on performance measurement of either direct or indirect commercial property, little emphasis was placed on the investment attributes of direct commercial property specifically.

Hotel Investment performance at foreign and local scenes

A survey of hotel investment literature on the other hand focused on indirect form of investment. Kim and Jang (2012) emphasized the importance of understanding the difference between hotel Real Estate Investment Trust (REIT) and hotel C-corp structures in the lodging industry by comparing the risk-return characteristics and performance of real estate investment trust (REIT) hotel companies (hotel REITs) with C-corporation hotel companies (Hotel C-corps).

This was achieved by estimating 2 asset pricing models (single-factor and three-factor) for each portfolio and using Wald test statistics to test their differences. The result indicated little significant difference of hotel REITs risk-return characteristics and performance than hotel C-corps, but no significant difference in market risk-return characteristics and performance. Although, the findings of the work can be used by portfolio managers to construct a diversified portfolio and render hotel investors' decisions between the two organizational structures less complicated, the limitation of the work is that 30% of the total variation in the hotel firms' return still remains unexplained by the adopted pricing models.

In an attempt to estimate the cost of equity capital for lodging industry, Madanoglu and Olsen (2005) observed that traditional models like CAPM or the Fama-French three factor model are not adequate to estimate the cost of lodging firms' equity because the models do not properly measure the intangible attributes relevant to the lodging industry.

In a related study, Kim, Mattila and Gu (2002) examined the return and risk relationship of hotel REITs and factors affecting the systematic risk or beta of the hotel companies with adoption of single asset capital asset pricing model (CAPM). They also compared the performance of hotel REITs with other market portfolios and other REITs sub sectors.

Pan, Wu and Song (2012) investigated the usefulness of search query volume data in forecasting demand for hotel rooms and identified the best econometric forecasting model. The research findings indicated that the three ARMAX models used consistently outperformed their ARMA counterparts, validating the value of search volume data in facilitating the accurate prediction of demand for hotel rooms. Although this work validate the value of search query volume data in predicting hotel room demand, the first of its kind in the field of tourism and hospitality research, which could be used to predict various types of tourist consumption and activities, such as hotel occupancy, spending, and event attendance, but the work's weakness is that it focused on only one tourist city with five specific tourist-related queries it would have been better to focus on other aspects of tourist consumption and on more destinations, using a larger number of queries to increase accuracy of the work, furthermore, it is restricted to forecast of hotel investment.

Santoro (2015) verified the correlation between performance and its determinants in the context of the Piedmont hotel industry, through valuating a sample of 112 hotels of Piedmont. The study investigated

whether variables as stars rating, dimension and added services provided are correlated to performance, measured by revenue per available room (Rev Par), a performance metric typical of the hotel industry. The noted weakness of this work is that it relied only on secondary data from "World Economic Impact Report" by the World Travel and Tourism Council (WTTC, 2014) integrated with data collected on web platforms such as Booking, Expedia, etc.

Barsky and Labagh (1992) attributed performance indication such as price, location, cleanliness, reputation, personal service, and appealing image as parameter that travellers use to evaluate the quality of the hotel. In the hotel industry, in particular, competition is based on the "total value" offered with the services, so it is necessary to evaluate the various dimension of the value. Hence, hotel industry performance can be measured using occupancy performance, such as average occupancy rate (Sun and Lu, 2005), operating revenues, average production value per employee and other indicators.

Other aspects of hotel investment performance such as cancellation, overbooking, unsold rooms and reduced patronage are among the germane issues in hotel investment. Overbooking decision for instance is one of important and complicated decision-makings, which is related directly to the occupancy rate and yield of hotel revenue management. It is necessary for a hotel manager to observe cancellation pattern in the history to make a reliable decision.

In the wake of the above, Phumchusri and Maneesophon (2014) developed overbooking models to determine the optimal number of overbooking for hotels having one and two different types of rooms, using mathematical modelling to find the optimal solutions of overbooking for stochastic cancellation that can assist hotel manager to make practical decision. The findings proved that for hotels with only one type of room, there exists a closed form solution to guarantee the optimal number of overbooking, depending on the cost of walking customers to other hotels, the cost of unsold rooms and cancellation distribution observed in the past.

This is one of the first articles in the hotel industry that considered the marginal cost for each room unsold caused by no shows and the marginal cost for each walking guest in a comprehensive perspective. This is however restricted to hotel performance indicator only; it does not extend to other breeds of direct property investment.

As a local content, Sanni (2009) examined the contributions of the hospitality industry (represented by Hotels and Restaurants) to the Nigerian economy (represented by the Gross Domestic Products (GDP) from 1980 – 2006, using simple regression analysis. The findings of the research indicated that a positive correlation existed between the hospitality industry and the Nigerian economy through the GDP. This study also focused on investment performance of hotel not on its attributes.

In other related work, Oparanma and Gabriel (2012) determined the problems associated with hospitality industry failures in Port Harcourt and

concluded that success in the hospitality industry may very well depend on the degree to which each owner understand his strengths and weaknesses and how such is sensitive to all the people within its environment. However, understanding the attributes of hotel investment would assume to indicate its strengths and weaknesses to investors in a better way.

Durodola, Oloyede, Ayedun and Olawunmi (2014) established the operational effectiveness of hotel facilities in South-Western Nigeria via customers' perception as an alternative way of measuring performance of hotel facilities. In addition to physical assessment of hotel facilities and system operations, data were collected from hotel's customers and analysed. The study discovered disparity between the assessment of the engineers who are employed to maintain the facilities and the customers who pay for the facilities. The weakness of this indigenous work is that it did not find out the linkage among quantity, quality and operational sturdiness. Furthermore, the study was restricted to operative effectiveness of hotel facilities but not hotel accommodation specifically.

From all of the above, it would be observed that the focuses of most of these studies are like the ones observed in commercial property i.e. on performance measurement of hotel investment, little emphasis was placed on the investment attributes of direct hotel investment.

Comparing short-letting with long-letting, the comparative analysis of hotel investments and timeshare undertaken by Powaga and Powaga (2008) using Grand Chateaux hotel in Las Vegas to find out that the timeshare investment alternative yielded high benefits against the hotels, making the timeshare resort a better investment than the hotel operation and therefore preferred by developers in Las Vegas and that timeshare have immunity to economic performance. Although, this is the most related work to this research, both investments are a breed of short-let, a very short term compared to the tenancy attribute of commercial property, there is therefore a need for comparing short-letting with long-letting.

However, in order to extend the attributes analysis beyond qualitative view, the analysis shall involve the occupancy rate at quantitative view as previously documented by Sun and Lu (2005) among other studies.

PROBLEM STATEMENT / RESEARCH QUESTION

Sequel to the crash in the global capital market in 2008, Nigerian investors like their international counterparts have been noted to have renewed confidence in investing in direct commercial property and other real estate asset classes due to their perceived sustained investment performance and investment opportunities.

The growing importance of the commercial property investment and hotel investment in real estate industry has therefore been attracting investors' attention but this has been studied at a far distance of understanding. Irrespective of the growing importance of these two investment vehicles, the

basic understanding of their attributes and comparison are still insufficient in the literature, this is a notable gap that cannot be overlooked.

Despite the fact that hotel investment is operating business that are housed in real estate investment sector, major emphasis in the older literature of real estate are on long stay accommodation, little emphasis was on a short stay in the form of short let and lodging. Except for REITs indirect real estate attributes and the trading aspect of hotel and hospitality, direct commercial property remains in its infancy stage while no emphasis was on direct hotel aspect of short stay accommodation investment.

With the exception of restricted investments performance, no literature on REITs actually compares the investment attributes of commercial property with hotel property. Furthermore, available literature on hotel and hospitality has either addressed the REIT hotel investment solely, or focused on comparing specific hotel REIT with the REIT market generally, or compare hotel REIT with other REIT sub sector or compare hotel REIT with the general stock market (Kim, Mattila and Gu, 2002; Jackson, 2009 and Kim and Jang, 2012).

The focus of such past literature on hotel investment included Jackson (2009}; Kim et al, (2002) and Gu and Kim (2003) which focused on performance of hotel REITs and hotel C-corps; Kim, Ham and Moon (2012) which focused on the hotel ranking by qualitative approach; Lu, Berchoux, Marek and Brendan (2015) which looked at quality of service and customer satisfaction of the hotels while Pimpao, Correia, Duque and Zorrinho (2014) examined the effectiveness of hotel branding, the cost of lodging company equity was also investigated by Madanoglu and Olsen (2005) and Lee and Upneja (2008).

But these have not much been replicated in the directly owned individual hotel companies, most especially in Nigeria. In the same vein, there are literature on the performance of commercial property (Colwell et al 1998, Krystalogianni et al 2004, Alcock, Glascock and Steiner 2012, Bello 2012, Iroham et al 2014 among others). These previous studies on commercial property addressed direct or indirect commercial property differently.

No work seemed to have specifically compared the attributes of direct hotel property with that of commercial property especially in Nigeria; therefore, there is a need for empirical analysis of the in-depth attributes of commercial asset as well as hotel investment of local content to be added to the existing body of knowledge. This is with the aim of providing investment information to the investors for making viable property investment options.

COMMERCIAL AND HOTEL PROPERTY PERFORMANCE MEASURES

Performance measures widely used in the hotel aspect of the hospitality industry in the literature include: Total available rooms, average occupancy, Revenue per Available Room (RevPAR), Average Daily Rate (ADR), while that used in commercial property in the literature include: Total available

space, average occupancy, Revenue Per Available Space (RevPAS) and the rate of return.

Total available (rooms/space) represent the number of rooms/space available multiplied by the number of days in the report period. This measures the capacity and rate of occupation in commercial property and hotels system. Average occupancy measures the utilization of capacity and represents total paid rooms or space occupied divided by total available rooms/space. Revenue per available room/space, or RevPAR/RevPAS, measures performance yield and represents total room/space revenues divided by total available rooms/space.

Namasivayam, Miao and Zhao (2007) and Blanco, Oehmichen and Frood (2011) focused on RevPAR as a performance metric in the hotel industry, which is calculated by dividing a hotel's total guest room (total available space) revenue by the room count and the number of days in the period being measured. RevPAR/RevPAS provides insight into how well a hotel or commercial property is utilizing its room/space inventory.

Average daily rate measure room/space pricing and is represented as total room/space revenues divided by the total number of paid rooms occupied by hotel guests or total number of paid space occupied by tenants. Room revenues of hotel is calculated as the number of rooms × room rate × number of days in a week × number of weeks sold, with two weeks reserved for maintenance purposes) × occupancy rates (75 per cent — the number of rooms or quantity of space rented out of the available rooms/ total space).

The average occupancy rate/vacancy rate yardstick seemed to fit for the performance of hotel and commercial property investment ranges from 0 to 1 (in decimal) or 0 to 100 (in percent). The closer the vacancy rate is to 0, the better the level of economic vitality of a commercial property area (Udoekanem, Ighalo and Nuhu, 2015) as well as hotel investment. The higher the occupied space to stock of office space ratio and the available rooms to the paid rooms, the lower the vacancy rate and conversely.

It is widely believed that there are distinct factors that underlie the investment attributes of industry specific attributes of hotel as well as commercial property investment to provide the investors with practical information that they can use in making investment decisions. Therefore, this study analysezed the two investment options, in term of their common attributes and occupancy rate of investment object.

RESEARCH DESIGN AND METHODS

The scope of this study is limited to the commercial property and hotel property within the South-western Geo-political zone of Nigeria; in particular state capital of Lagos, Ogun, Oyo, Osun, Ondo and Ekiti States represented as Ikeja, Abeokuta, Ibadan, Osogbo, Akure and Ado-Ekiti respectively

These cities have some common economic, social-cultural and political features, emanated from the same old region of Nigeria and shared common

regional characteristics. Due to limitations attached to total coverage, not all the commercial properties and hotels in the study areas were covered, but the ones for pure investment purpose in the high street of the CBD noted with high value were covered.

Land value yardstick was used as common variable for the two investments, hence, high streets of the CBD of each city expected to have similar land value. Generally, hotel investment as earlier pointed out is made up of accommodation and hospitality (ILO, 2010), the focus of this work will be limited to accommodation aspect of hotel properties and total let-able space of commercial properties.

It will not be on hotel and commercial property performance measurement but general attributes extended to occupancy rate analysis. In addition, since vacancy rate (a measure of the quantum of un-utilized space in the commercial property market and hotel sub-industry) is an important indicator of the level of economic vitality of a commercial area as well as hotel investment attributes, the vacancy rates of the two real estate investments means were mainly examined.

According to Nigerian Tourism Development Corporation (NTDC) in collaboration with Standard Organization of Nigeria (SON) 2001, over 70% of the total hotel stock in Nigeria meets standard set for national classifying and grading of Hotels and other Serviced accommodation in Nigeria, and majority of them are located in these capital cities. Moreover, they are to be compared with the commercial property which majority of them are as well located in the capital cities.

DATA COLLECTION

Primary data was collected with the use of structured questionnaire and complemented with interview session. The target population are the commercial and hotel properties at high streets in the CBD in each state capital of the study area, however, data were collected from the property managers of the sampled commercial and hotel properties.

The high streets were first identified, followed by determination of number of purpose-built commercial and hotel properties on each high street. Neighbourhood and high streets of equivalent land value were selected and the sample size was selected from the total available commercial and hotel properties located therein.

Total of 886 (497, 66, 148, 72, 55, 48) and 354 (132, 38, 77, 42, 36, 29) commercial and hotel properties respectively were enumerated and this made up the sample frame for the study from where (30%) representing 266 (149, 20, 44, 22, 17, 14) and 106 (40, 11, 23, 13, 11, 9) were taken through random sampling technique to represent the sample size for commercial property and hotel property respectively.

Total of 177 and 70 questionnaires were successfully retrieved for commercial property and hotel investments respectively for the analysis. Data on the attributes of investment analysis were collected on 12

qualitative variables; description of the investment property, ownership, source of investment financing, management responsibility of investment property, owner's level of involvement on investment activities, state of repairs, renting pattern, purpose of renting by the occupants, sources of income generation, determinants of rental review, frequency of rental review and percentage of total income as outgoing on investment.

By quantitative means, data on occupancy rate were collected through the ratio of total occupied units/space to total available units/spaces approach. Data on patronage as means of investment performance was collected as average occupancy rate for hotel and net space occupied by commercial property. Records of hotel room sales and total space occupied on commercial property for the year 2015 (January to December) was utilized.

The collected data on qualitative variables were analysed with frequency tables and percentage distribution while data on quantitative variable was analyzed using frequency/percentages tables and two sample test Kolmogorov-Smirnof (K/S)

ANALYSIS AND RESULTS

The qualitative data are analysed with frequency and percentage tables. The detailed analysis is presented as Table 1 having all the 12 stated qualitative variables for the study. Investment description and categorization was basically done as star for hotel and purpose built for commercial property.

Starting from description, majority (44.63%) of commercial properties has combination of offices and shopping complexes while 45.71% of the sampled hotel properties are 3-star rating. The ownership of commercial property as well as hotel property reflected that most of these investment properties are privately and individually owned as evidenced by 70.62% and 68.57% responses respectively.

Source of investment financing reflected that both investments exhibit private equity source as the major source of investment financing (72.32% and 50%) while commercial properties are managed by the estate agents on behalf of their owners (63.28%), majority of hotel owners (65.71%) managed their investment property by themselves.

Hotel investment commanded very good state of repair as indicated with 65.71% responses whereas commercial property had a fair state of repair (41.81%) as affirmed by the respondents. Owners are fully involved in the investment management of hotel (67.14%) but owners of commercial property are not involved in the investment management of commercial property (50.28%).

The renting pattern indicated that both investment properties are in favour of short term or long term advance payment of rent since a long term payment in advance for commercial property (89.27%) was observed while a short term payment in advance for hotel property was indicated with 87.14% response rate. The renting by the occupants indicated the purpose

of renting of commercial property as well of hotel property is majorly for business endeavour, this is represented by 51.41% and 60.00% response respectively.

Table 1: Analysis of qualitative data on investment attributes.

	COMMERCIAL PROPERTY			HOTEL PROPERTY			
Main Variables	Sub-variables	Frequency (177)	%	Sub-variables	Frequency (70)	%	Remarks
Description of Investment Property	Shopping complex	47	26.55	3 star	32	45.71	D
	Office complex	51	28.81	4 star	22	31.43	D
	Shopping/office complex	79	44.63	5 star	16	22.86	D
Ownership	Private/ individual	125	70.62	Private/ individual	48	68.57	S
	Family	19	10.73	Family	6	08.57	S
	Corporate	26	14.70	Corporate	12	17.14	S
	Government	7	03.95	Government	4	05.71	S
Source of Investment financing	Leverage	31	17.51	Leverage	28	40.00	S
	Private equity	128	72.32	Private equity	35	50.00	S
	Equity capital	15	08.75	Equity capital	4	05.71	S
	Combined private/equity	3	01.69	Combined private/equity	3	04.29	S
Management responsibility of the investment property	Agent	112	63.28	Agent	1	01.43	D
	Owner	12	06.78	Owner	46	65.71	D
	Agent/owner	43	24.29	Agent/owner	7	10.00	D
	Corporate in-house	10	05.65	Corporate in-house	16	22.86	D
State of repairs	Very good	47	26.55	Very good	46	65.71	D
	Good	51	28.81	Good	14	20.00	D
	Fair	74	41.81	Fair	8	11.43	D
	Poor	5	02.82	Poor	2	02.86	D
Owner's involvement in investment activities	Full involvement	22	12.42	Full involvement	47	67.14	D
	Partial-involvement	66	37.29	Partial-involvement	13	18.57	D
	Non-involvement	89	50.28	Non-involvement	10	14.29	D
Renting pattern	Long term Payment in advance	158	89.27	Long term Payment in advance	-	-	S
	Short term Payment in advance	2	01.13	Short term Payment in advance	61	87.14	S
	Long term Payment in arrears	15	08.47	Long term Payment in arrears	1	01.43	S
	Short term Payment in arrears	2	01.13	Short term Payment in arrears	8	11.43	S
Purpose of renting by the occupants	Business	91	51.41	Business lodging	42	60.00	S
	Services rendering	68	38.41	Tourist lodging	11	15.71	S
	Govt./non profit	9	05.08	Official lodging	10	14.29	S
	Others	9	05.08	Transit	7	10.00	S
Source of income generation	Rental only	173	97.74	Rental only	2	02.86	D
	Rental and diverse trading & services	4	02.26	Rental and diverse trading & services	68	97.14	D
Determinants of rental review	State of economy	46	25.99	State of economy	34	48.57	D
	State of property market	110	62.15	State of property market	2	02.86	D
	Services & goodwill of investment property	21	11.86	Services & goodwill of invest. property	34	48.57	D
	Regulatory directives	-	-	Regulatory directives	-	-	D
Frequency of rental review	Biennially	76	42.94	Biennially	2	02.86	D
	Annually	-	-	Annually	5	07.14	D
	Monthly	-	-	Monthly	-	-	D
	Occasionally	40	22.60	Occasionally	42	60.00	D
	Not-specified	61	34.46	Not-specified	21	30.00	D
Average % of total income as outgoing o investment	Taxes, management fee, income void, insurance, interest on capital, repairs, levies/dues, etc	14.5%	14.5	Taxes, management fee income void, insurance, interest on capital, repairs, levies/dues, etc	31.6%		D

Source: Authors' Field Survey (2015) *S = Similarity, *D= Discrepancy

Source of income to the owners is another attribute of diverse between commercial property and hotel property, while the income of commercial property investors is mainly from rent collected on the property (97.74%), hotel investment has a diverse source of income in addition to the usual room sales/ room rentals (97.14%).

What determined rental review of commercial property is basically the state of property market as indicated by 62.15% response from the respondents, but combinations of state of economy and services and goodwill of hotel property determines the rental review of hotel property (97.14%). The average percentage of total income as outgoing on investment for commercial property was put as 14.5% less than hotel property's 31.6%.

Lastly, rental review frequency showed that while commercial property rent is mostly reviewed biennially (42.94%), review of hotel rents are done occasionally (60.00%).

The quantitative findings on occupancy rate as the performance rate of commercial and hotel investment through space occupation approach is presented in Table 2. Total of 138,165 m^2 are available from all the sampled commercial properties from the whole study area. Ikeja has the highest of 103,950, while Ado Ekiti has the least of 2880m^2.

However, 129,268.01m^2 of the total available space was occupied in the study area as at the time of this study. Commercial property in Ikeja has highest average occupied space of 1050m2, while Ado Ekiti has lowest average space of 288m^2. The hotel property has total of 2111 available rooms for renting in the whole study area, but average of 1720 rooms of the total available rooms were financially occupied during the year of this study. Ikeja has the highest number of hotel rooms represented as 910 while Akure has the lowest, represented as 154. Furthermore, Ikeja has highest number of occupied rooms of 801 and Akure has lowest rental rooms of 129. The findings further showed that Ikeja has highest average rooms per hotel (35) than other state capitals.

Table 2: Commercial property and hotel in south-western Nigeria space and rooms availability (2015)

State Capital	TNCP	SCP	TAS(M^2)	TOS(M^2)	AS(M^2)	TNH	SHT	TAR	NOR	AR/H
IKEJA	497	99	103950	98752.50	1050	132	26	910	801	35
ABEOKUTA	66	13	6006	5345.34	462	38	8	216	175	27
IBADAN	148	30	15960	14523.60	532	77	15	465	330	31
OSOGBO	72	14	5684	5001.92	406	42	8	192	142	24
AKURE	55	11	3685	3427.05	335	36	7	154	129	22
ADO-EKITI	48	10	2880	2217.60	288	29	6	174	143	29
TOTAL	886	177	138165	129268.01	3073	354	70	2111	1720	168

*TNCP: Total number of commercial properties; SCP: Sampled commercial properties; TAS (M^2): Total available space per meter square; Total occupied space per meter square; AS (M^2): Average space per meter square; TNH: Total number of hotels; SHT: Sample hotels; TAR: Total available rooms; NOR: Number of occupied rooms; AR/H: Average room per hotel.

Source: Authors' Field Survey (2015)

From analysis in table 3, the occupancy and vacancy rate for the two compared investment properties were derived. The commercial properties as well as hotel property occupancy rates were the highest in Ikeja with 0.95

and 0.88 respectively. Ado Ekiti has the least occupancy rate in commercial property 0.77, but not the least in hotel property occupancy rate, Ibadan has the least occupancy rate of 0.71. On the average, the occupancy rate of the whole study area is 0.89 for commercial property and 0.80 for hotel property.

This indicated that commercial property has the higher calculated occupancy rate than the hotel property at the study area during the period of this study.

Table 3: Occupancy and vacancy rate of commercial property and hotel investment in South-western Nigeria.

State Capital	CPOR	CPVR	HTOR	HTVR
IKEJA	0.95	0.05	0.88	0.12
ABEOKUTA	0.89	0.11	0.81	0.19
IBADAN	0.91	0.09	0.71	0.29
OSOGBO	0.88	0.12	0.74	0.26
AKURE	0.93	0.07	0.84	0.16
ADO-EKITI	0.77	0.23	0.82	0.18
TOTAL	5.33	0.67	4.80	1.20
AVERAGE	0.89	0.11	0.80	0.20

*CPOR: Commercial property occupancy rate; CPVR: Commercial property vacancy rate; HTOR: Hotel occupancy rate; HTVR: Hotel vacancy rate.

Source: Authors' Field Survey (2015)

Unlike the calculated interpretation that the occupancy rate of commercial property is higher than that of hotel property, the two samples Kolmogorov-Smirnof test (O'Connor and Kleyner 2012) ran on both investments indicated that there is no significant difference in these occupancy rates; since the calculated value of 0.114 is lesser than the theoretical/table value of 0.563 at alpha level of 0.5 and at degree of freedom of 5. The calculated value is attached as appendix 1.

DISCUSSION OF RESULTS

The finance of commercial property and hotel investment in Nigeria is by private equity unlike in the advanced nations where it is majorly by equity capital. High response on investment equity in both types of investment confirmed the initial findings of UNCTAD (2007) that documented 80% of equity as capital equity and 20% for private equity in developed countries against 33% to 67% for developing countries.

Performance of hotel was measured in term of the consumer's satisfaction in the accommodation quality and value for money while such was measured by commercial property occupants in terms of business and services feasibility and viability. The level of owner's involvement in the investment indicated that commercial property owners have little or no involvement in the investment activities operated on the property, but hotel investment business like-attributes requires the owner to be more involved directly or indirectly in the activities of the investment.

Provision of accommodation with advance receipt of renting charge is applicable to both investments, but the hotel investment requires a short

stay renting (like a day or some days) while commercial property requires a long stay renting such as tenancy and leasing. The focus of enterprise has diverse income from hotel, but income from commercial property is limited to rental income.

The foreign currency exchange rate problem faced by Nigeria due to turbulent economic situation witnessed in 2015 was an advantage to the hotel investors than commercial property investors because with short term advance rental payment, it is easy for the hotel investors to easily adjust their rental rate to reflect the dollar rate, opportunity that eluded the commercial property investors.

Data on sales transaction of hotel investment is relatively scarce as compared to commercial property which has few sales transactions documentation. The interview session with most of the managers of commercial and hotel properties revealed that commercial property and hotel property have interchange of activities; while commercial property receive the day activities of occupants, hotel property receive the night activities of the occupants this is because the purpose of patronage of commercial property is for business and office activities during the day time, while the purpose of patronage of hotel is purely lodging mostly at night.

Commercial property exhibit long stay average of 2-10 years of its occupants, but short stay exhibit short stay of average of 3 days of its occupants. Hotel investment has high level of operating maintenance management and requires more facilities management than commercial property concern.

Unlike the commercial property, change of ownership was not well noted for hotel investment as it rarely comes to the property market for sale transaction. It also has cultural and religious sentimental as hotel investment is perceived as promoting immorality and social misbehaviour.

Lastly, 4 of the qualitative variables (ownership mode, investment financing, renting pattern and renting purpose) displayed attributes similarity between the two investments while there are attributes discrepancies in the remaining 8 (investment rating, management, state of repair, owners' involvement, source of income, rental review determinants, rental review frequency and outgoings), meaning that while similarity was noted in the quantitative analysis of the investments, discrepancies exist in qualitative analysis of the investment options.

CONCLUSION AND RECOMMENDATIONS

This work was not extended to trading aspect of hotel investment and return performance of both investment means, it only attempted to lay foundation for other works to improve on through qualitative variable coupled with occupancy rate approach; therefore, it is recommended that subsequent works can extend this work to trend analysis of risk-return as previously documented in US by Kim and Jang.

At the expiration of annual rent/lease of commercial property there is tendency for some sitting tenants to vacate or surrender their tenancy, creating more vacancy and already vacancy may be filled with new occupiers, thereby distorting the established occupancy rate, rate and rent are dynamic.

In addition, this occupancy rate was established in year 2015, the preceding years' occupancy rate (trend) was not ascertained, neither were the succeeding years occupancy rates predicted. Although both investments require advance payment, but unlike the rent fixed for the period on commercial property which may not be easily change until proper renewal notice is served, hotel rate is more dynamic and can easily change with situation in economy, though this may have attendant effect on demand.

Investors in hotels and commercial property as well as occupiers are both interested in the performance of their investment and money; hence their commitment to effective performance. This can be perceived as a function of satisfaction in accommodation quality and value for money at perspective of hotel customers but as a function of business and services feasibility and viability on the part of commercial occupants' point of view.

Commercial as well as hotel property returns deemed to be dynamic with the economy, but that of hotel is deemed to be more than commercial property especially due to the volume of its transactions over year. In summary, during unstable and turbulent economic situation like one recently experienced in Nigeria, short stay duration ensures easy adaptation to variation brought by change in economy more than the long stay due to long term financial commitment by the occupier.

REFERENCES

Akpabio, I 2007. Hospitality industry in Nigeria: Prospects and challenges in developing tourism", *African Hospitality and Tourism,* 11(3), 23-26.

Alcock, J., Glascock, J. & Steiner, E. 2012. Manipulation in U.S. REIT Investment Performance Evaluation: Empirical Evidence Springer Science+Business Media, *LLC Journal of Real Estate Finan Econ* 47, 434–465 Published online: 17 May 2012

Arnaboldi, M. & SPILLER, N. 2011. Actor-network theory and stakeholder collaboration: The case of Cultural Districts, *Tourism Management,* 32(3), 2011, 641-654.

Oparanma, A.O. & Gabriel, J.M.O. 2012. Causes of Failures in Hospitality Industry in Port Harcourt, Nigeria, *International Journal of Asian Social Science,* 2(5), 583-586.

Babajide S.O., Emele, C.R. Oni A.O & Durodola D.O. 2014. Implication of property market forecast on valuation of commercial properties in Lagos state. Paper presented at the 7th IRERS Conference, Malaysia May 29 & 30

Barsky, J. & Labagh, R.1992. A strategy for customer satisfaction, The Cornell Hotel and Restaurant *Administration Quarterly*, 35(3), 32–40.

Bello, N.A. 2012. Comparative Analysis of Commercial Property and Stock-market Investments in Nigeria"

World Academy of Science, Engineering and Technology WASET Issue 70 Lucerne October. www.waset.org&*International Journal of Social, Management Economics and Business Engineering 6(10),* 414-422.

Blanco, A. C., Oehmichen, A. & Frood, S. 2011 European hotel development – Focus on budget hotels, *Journal of Retail & Leisure Property*, 9(5), 373–379.

Colwell, P.F., Munneke, H.J., & Trefzger, J.W. 1998. Chicago's office market: price indices, location and time. *Real Estate Economics*, *26*, 83–106.

CORGEL, J.B. 2008. Private Equity Investment in Public Hotel Companies: Recent Past, Long-Term Future, *Cornell Hospitality Report*, 8(10), 12-18

Dabara, D.I. 2014. *Inflation hedging potential of commercial real estate investments in selected state capitals of South-western Nigeria*, being an M Sc thesis submitted to Department of Estate Management, Faculty of Environmental Design and Management, ObafemiAwolowo University, Ile-Ife, Nigeria.

Durodola, O.D., Oloyede, S.A., Ayedun, A.C., And Oluwunmi, A.O. 2014. Assessment of Operational Effectiveness of Hotel Facilities in South-Western Nigeria: Customers' Perspective'

Fisher, J.D., Geltner, D., & Webb, R.B. 1994. Value indices of commercial real estate: a comparison of index construction methods' *The Journal of Real Estate Finance and Economics*, *9*, 137–164.

Fresnel, F. & Lausanne, E.H. 2009. Quick note on private equity groups‖ at the General Assembly of the EFFAT Hotel Restaurant Catering Tourism Sector, 24 and 25 March 2009.

George R. 2001. *Marketing South African Tourism and Hospitality*. Cape Town. South Africa: Oxford University Press

Graeme N., Kwong W.C. And Siu K.W. 2009. The significance of Chinese commercial property in an Asian property portfolio' *Journal of Property Investment & Finance* 27 (2),102 – 119

Gu, Z. And Kim, H. 2003. An examination of the determinants of hotel REITs unsystematic risk, *Journal of Hospitality & Tourism Research,* 27(2), 166-184

Kim, H., Sunny Ham, S. And Moon, H. 2012. The impact of hotel property size in determining the importance of electronic distribution channels, *Journal of Hospitality and Tourism Technology*, 3 (3), 226 – 237

International Labour Organisation (ILO) 2001. *Human resources development, employment and globalization in the hotel, catering and tourism sector,* report for discussion at the Tripartite Meeting on Human Resources Development, Employment and Globalization in the Hotel, Catering and Tourism Sector, 2–6 April 2001, Sectoral Activities Programme (Geneva, 2001), p. 5.

International Labour Organisation (ILO) 2010. *Development and Challenges in The Hospitality and Tourism Sector, Sectoral Activities Programme*, Issues Paper for Discussion at The Global Dialogue Forum for The Hotels, Catering, Tourism Sector held in Geneva, 23-24 November

Iroham, C. O, Oluwunmi, A. O., Simon, R. F, & Akerele, B. A.2014. Assessing the trend in rental values of commercial properties along Oyemekun Road, Akure, Nigeria Covenant *Journal of Research in the Built Environment (CJRBE) 1(1) (Maiden Edition), January.*

Jackson, L.A. 2009. Lodging REIT performance and comparison with other equity REIT returns *International Journal of Hospitality & Tourism Administration, 10(4), 296-325*

Kim, H., Mattila, A.S. And Gu, Z. 2002. Performance of hotel real estate investment trusts: a comparative analysis of Jesen indexes*, International Journal of Hospitality Management,21(1),85-97*

Kim, J. & Jang, S.S.2012. Comparative analyses of hotel REITs: examining risk-return and performance

Characteristics, International *Journal of Contemporary Hospitality Management* 24(4), 594-613.

Kim, H. & Mattila, A.S. 2002. Hotel real estate investment trusts' risk features and beta determinants', *Journal of Hospitality &Tourism Research*, 26(2), 138-54.

Krystalogianni A, Matysiak G. &Tsolacos S. 2004. Forecasting UK Commercial Real Estate Cycle Phase with Leading Indicators: A Probit Approach *Applied Economics*

Lee, S. & Upneja, A. 2008. Is capital asset pricing model (CAPM) the best way to estimate the cost of equity for the lodging industry, *International Journal of Contemporary Hospital Management,* 20(2), 172-185.

Madanoglu, M. & Olsen, M.D. 2005. Toward a resolution of the cost of equity conundrum in the lodging industry: a conceptual framework, *International Journal of Hospitality Management* 24(4), 493-515

Namasivayam, K., Miao, L. & Zhao, X. 2007. An investigation of the relationships between compensation practices and firm performance in the US hotel industry, *International Journal of Hospitality Management*, 26(3), 574-587.

O'connor, P.D.T & Kleyner, A 2012. *Practical reliability engineering*, John Wiley & Sons Ltd Fifth edition.

Ogunba, O. A., Obiyomi O. O. & Dugeri T. 2014.*The Inflation Hedging Potentials Of Commercial Property Investments in Ibadan, Nigeria.* Being a paper presented at International Real Estate Research Symposium held at INSPEN, Selangor, Malaysia between 28 and 29th April

Oparanma, A.O., & Gabriel, J.M.O.2012. Causes of Failures in Hospitality Industry in Port Harcourt, Nigeria, *International Journal of Asian Social Science*, 2(5), 583-586.

Ozigbo, I. & Ozigbo, C.A. 2013. Professionalization of our facility management function as the basis for the optimization of public infrastructure in Nigeria nation. *The Estate Surveyor & Valuer, Journal of Nigerian Institution of Estate Surveyors and Valuers* 38(1), jan-jun,21-28

Pan, B., Wu, D.C. & Song, H 2012. Forecasting hotel room demand using search engine data, *Journal of Hospitality and Tourism Technology,* 3(3),196 - 210

Phumchusri, N. & Maneesophon, P. 2014. Optimal overbooking decision for hotel rooms revenue management, *Journal of Hospitality and Tourism Technology*, 5(3), 261 - 277

Pimpao, P, Correia, A., Duque, J., & Zorrinho, J.C. 2014. Exploring effects of hotel chain loyalty program, *International Journal of Culture, Tourism and Hospitality Research,* 8(4), 375 - 387

Powaga, A. & Powaga, L.2008. An economic analysis of a timeshare ownership *Journal of Retail and Leisure Property* 7(1), 69 – 83. doi: 10.1057/Palgrave.Rlp.5100082

Rutherford D.G.& O'fallon M.J. 2007. Hotel Management and Operations' John Wiley & Sons, Inc. Canada 4th edition.

Sanni M.R.2009.The Influence of the Economy on Hospitality Industry in Nigeria'. *Ethiopian Journal of Environmental Studies and Management* 2(1), 12-18

Santoro, G. 2015. Evaluating Performance in the Hotel Industry: An Empirical Analysis of Piedmont. *Journal of Investment and Management,* Special Issue: Attractiveness and Governance of Tourist Destinations. 4(1), 17-22. doi: 10.11648/j.jim.s.2015040101.13

Singh A. J., Schmidgall R. S. & Damitio, J. W. 2011. Evaluating hotel feasibility studies: lender perspective *Int. J. Built Environment and Asset Management, 1(1), 74-93*

Sirota, D 2004. *Essentials of Real Estate Investment,*.7th ed. Chicago: Dearborn Financial Publishing, Inc

Sun, S. & Lu, W. 2005. Evaluating the performance of the Taiwanese hotel industry using a weight slacks-based measure, *Asia-Pacific Journal of Operational Research*, 22(4), 487–512.

Udoekanem, N.B. Ighalo, J.I, & Nuhu, M.B. 2015. Office Rental Dynamics in Minna, Nigeria' *Sri Lankan Journal of Real Estate Journal of the Department of Estate Management and Valuation University of Sri Jayewardenepura pp.16-30*

UNCTAD (2007): *FDI in Tourism: The Development Dimension*, UNCTAD Current Studies on FDI and Development No. 4, New York and Geneva, p. 35.

Yakub, A.A, Balarabe S, Salawu A.O & Gimba S.D 2013. Effects of trends in annual rents on occupancy ratio in multi-storey commercial properties in Kaduna metropolis, Nigeria *In:* Laryea, S. and Agyepong, S. (Eds) *Procs 5th West Africa Built Environment Research (WABER) Conference,* 12-14 August 2013, Accra, Ghana, 465-474

APPENDIX 1: THE CALCULATED VALUE FOR KOLMOGOROF SMIRNOF TEST

Observed proportion for commercial property: 0.95 0.89 0.91 0.88 0.93 0.77

5.33 5.33 5.33 5.33 5.33 5.33

Observed proportion for hotel property: 0.88 0.81 0.71 0.74 0.84 0.82

4.80 4.80 4.80 4.80 4.80 4.80

Observed cumulative for commercial property: 0.95 1.84 2.75 3.63 4.56 5.33

5.33 5.33 5.33 5.33 5.33 5.33

Observed cumulative for hotel property: 0.88 1.69 2.40 3.14 3.98 4.80

4.80 4.80 4.80 4.80 4.80 4.80

Difference between observed cumulative: 0.07 0.15 0.35 0.49 **0.58** 0.53

5.07 5.07 5.07 5.07 **5.07** 5.07

0.58 = **0.114**

5.07

COMPARATIVE STUDY OF CAUSES OF VARIATIONS IN PUBLIC BUILDING PROJECTS IN TANZANIA AND UGANDA

Yusuph B. Mhando[1], Ramadhan S. Mlinga[2] and Henry M. Alinaitwe[3]

[1]*School of the Built Environment, Department of Construction Economics and Management, Makerere University, Kampala, Uganda*

[2]*Department of Structural and Construction Engineering, College of Engineering and Technology, University of Dar es Salaam, Dar es Salaam, Tanzania*

[3]*School of the Built Environment, College of Engineering, Design, Art and Technology, Makerere University, Kampala, Uganda*

Detrimental variations in public building projects often have led to cost overruns, time overruns, project abandonment, rework, disruption and conflicts. Consequently, these have led to non-fulfilment of project objectives. This study was carried out to identify, evaluate and compare the most significant causes of detrimental variations in public building projects in Tanzania and Uganda. This could help in monitoring the trends of non-beneficial variations and safeguarding the anticipated value for money in such building projects. Pertinent literature was reviewed coupled with structured questionnaire administered to professionals to elicit relevant information with regard to causes of detrimental variations. Statistical analysis was used to analyse and synthesize data collected from questionnaires. Subsequently, the most significant causes of detrimental variation variables were ranked according to their importance and occurrence. The agreement among respondents in rating the factors of variations was found to be significant. The results suggest the top four highly ranked factors of detrimental variations in both countries as change of plans or scope by owners, design discrepancies by consultants, misinterpretation of contract documents by the contractors and weather conditions. These factors significantly contribute detrimental effect to construction projects performance and pose great risk to construction industry prosperity. Finding concludes that owner is the major source of detrimental variations in building projects and suggested that in order to avoid such scenario, owner should have adequate planning and resources before initiating a construction project. More importantly, project management teams must possess enough integrity, knowledge and skills to deal with the day-to-day management challenges of construction changes.

Keywords: causes, detrimental variations, public building projects, Tanzania, Uganda

[1]ybmhando@gmail.com
[2]mlingars@yahoo.co.uk
[3]alinaitwe_h@cedat.mak.ac.ug

Mhando, Y. B., Mlinga, R. S. and Alinaitwe, H. M. (2017) Comparative study of causes of variations in public building projects in Tanzania and Uganda *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 465-478.

INTRODUCTION

Detrimental variations are variations which pessimistically impact the project resulting into scenarios such as cost overruns, time overruns, project abandonment, rework, disruption and conflicts. Detrimental variations are among the challenges faced in the course of executing construction projects. Non-beneficial variations in construction have resulted into complexity with the consequence of negative impacts on project performance. Regardless of the similarities and dereferences of the results, various studies (Sunday, 2010; Babatunde, 2013; Memon et al., 2014) have identified causes and effects of variations that need to be controlled as part of project's risks management process.

Arain and Pheng (2005) affirm that a detrimental variation is one that negatively impacts various aspects of the project performance. Moghaddam (2012) argues that the cost of rework in a construction project can be as high as 10 to 15 percent of the original contract value. The projects handled by consultant reveal that the total initial contract sum was 11,490,077.17 United States Dollar (USD) and the final cost was 14,396,353.67 USD, representing an approximate cost overruns of 25.29 percent (Sunday, 2010). Likewise, the research carried out on projects indicates an increase in the duration of the projects from 178 months to 226.5 months, representing an average of 27.25 percent time overruns (Moghaddam, 2012). This implies that, adverse effects resulting from detrimental variations inflict substantial adjustment to the contract sum and duration of the project. Traditionally, there is always a 15 percent price variation ceiling allowed for in contracts. However, due to a number of reasons many public building projects normally exceed this ceiling making projects very costly and in turn leading to delays in implementation. Arain and Pheng (2005) argue that an increment in the project cost and an extended completion time are the two main effects observed for non-beneficial changes.

In their study, Ndihokubwayo and Haupt (2009) found that variation orders were not realistically priced resulting in an increased construction costs. Relatively, Mohammad et al. (2010) managed to outline few causes of variations in Malaysia which inevitably fuel the need to look comparatively the experience of variation characteristics in other countries. The objective of this research was to identify and evaluate the major causes of detrimental variations in public building projects in Tanzania and compare them with those from Uganda by using a questionnaire survey. Relative to their geographical locations in East Africa (EA), the economies of both countries most depend on agriculture and almost have similar characteristics and investment in the construction sector. The other objective was to recommend based on the study findings so that effort in future research can focus on mitigating detrimental variations to improve performance of construction in countries with similar economies.

LITERATURE REVIEW

The Concept of Variations in Construction

Basically, there is no single definition of what constitutes a variation. Entrusty Group (2008) defines variation as a change, modification, alteration, revision or amendment to the original intent of the contract and / or its works. It may involve the alteration of kind or standard of any materials to be used in the works (Nachatar et al., 2010). Hao et al. (2008) insist that there is a very limited research work addressing the change management issues specifically within the construction project management context. The nature of variations is usually defined by variation clauses in the conditions of contract (Babatunde, 2013). However, variations involve not only changes in the work or matters relating to the work in accordance with the conditions of the contract but also changes in the working conditions.

Presumably, there are many reasons for the occurrence of variations and their subsequent effects. For instance, most public building projects are liable to variations that might be caused by change of mind in the part of the owner, consultant or any unforeseen scope of the project raised by one of the project participants. Likewise, the engineers' or architects' review of the design may bring about changes to improve or optimize the design and the operation of the project (Babatunde, 2013). However, most construction projects especially in developing countries, usually suffer from cost and time overruns due to variations in project plans. Arain and Pheng (2005) found types of variations as beneficial variations and non-beneficial (detrimental) variations, the latter being the main focus of this research work. The terms non-beneficial and detrimental have been used interchangeably in this research. Beneficial variations are those variations which positively impact the project in terms of cost, time and quality. Conversely, non-beneficial variations are variations which negatively impact the project resulting into scenarios such as cost overruns, time overruns, project abandonment, rework, disruption and conflicts.

Causes of Detrimental Variations

Keane et al. (2010) argue that the causes of variations could originate from client, consultant, contractor and non-party-related causes. Non-beneficial variations of project scope, political factor, wrong estimate and faulty design may cause abandonment of construction project, resulting in wastage of government resources (Olusegun and Michael, 2011). Greenwood and Shaglouf (1997) assert that variations cause both delays and increased costs of construction projects. In fact, there are many reasons why detrimental variations occur in construction projects. They may be due to change of plans or scope by owner, owner's financial problem, fraudulent and kickback practices, change in specifications and hindrance in prompt decision making. Moreover, design discrepancies by consultants, differing site or subsurface conditions, poor procurement process and conflicts between contract documents may lead to deleterious variations. Likewise, defective workmanship, unavailability of materials and equipment, weather

conditions and many other factors may necessitate detrimental variations that lead to scenarios such as cost overruns, time overruns, project abandonment, rework, disruption and conflicts with the consequence of project failure.

Although there is a provision of variation clauses in contracts for the betterment of the construction project, this does not necessarily stop the occurrence of non-beneficial variations in the process of executing such project. The involvement of different actors with different perception and cognition makes the construction industry more complex and unique. This complexity gives rise mostly to unwanted situation like detrimental variations that inflict substantial adjustment to the contract sum and duration of the project. The causes of non-beneficial variations have been identified in other countries such as Ghana, Sri Lanka, Kenya and Yemen (Asamaoh and Offei-Nyako, 2013; Oloo et al., 2014; Halwatura and Ranasinghe, 2013; Lokhande and Ahmed, 2015). However, the findings have demonstrated similarities and differences on the causes of detrimental variations due to differences in methodologies and locations used for the studies.

Apparently, scenarios such as dubious payments by procurement entities to contactors due to non-contractual payments; repetition of work items, premature payment of preliminary items; unjustified variation orders; overpayments due to wrong assumptions; and paying for non-existing works are the relevant sources of detrimental variations in public building projects. Impliedly, construction work processes might have many unpredictable non-beneficial changes such that their minimization is indispensable for fulfilling project objectives. More importantly, project management teams must possess enough integrity, knowledge and skills to deal with the day-to-day management challenges of construction changes.

RESEARCH METHODOLOGY

Research design

The research is descriptive, designed to use literature review and questionnaire survey to obtain views from architects, engineers, quantity surveyors and procurement officers with regard to causes of detrimental variations in public building projects. Ying (2009) argues that there are five common research strategies in the social sciences: surveys, experiments, histories, epidemiologic research and case studies. However, the adoption of the appropriate research design depends on the logic that links the data collected and data analysis to yield results that give answers to the main research questions being investigated. Fellows and Liu (2008) stipulate that surveys operate on the basis of statistical sampling; only extremely rarely are full population surveys possible, practical or desirable. Furthermore, the principles of statistical sampling – to secure a representative sample – are employed for economy and speed. Evidently, interview approach is time-consuming, inconsistency and expensive in terms of cost as compared to questionnaire survey. Alshenqeeti (2014) reveals that interviews are time-

consuming with regard to both data collection and analysis because they need to be transcribed, coded and possibly translated.

Population and sample size

The population of the study comprises of engineers, architects, quantity surveyors, procurement and supplies officers registered by Engineers Registration Board (ERB), Architects and Quantity Surveyors Registration Board (AQRB) and, Professionals and Technicians Board (PSPTB) of Tanzania respectively. Likewise, the study comprises of practicing professionals registered by Uganda Engineers Registration Board (ERB), Surveyors' Registration Board (SRBU), Architects Registration Board (ARB) and the Institute of Procurement Professionals (IPPU). A sample size of 183 participants was estimated comprising of 36 architects, 90 engineers, 42 quantity surveyors and 15 procurement officers from Tanzania (TZ). Relatively, a sample size of 52 participants was estimated comprising of 9 architects, 24 engineers, 14 quantity surveyors and 5 procurement officers from Uganda (UG). Telephone call and Short Message System (SMS) reminders were used to remind respondents to fill the questionnaire form. Table 1 illustrates that 143 and 34 valid responses from TZ and UG were received from the respondents constituting 78 percent and 65 percent of responses respectively which is considered adequate for data analysis compared with the norm of 20 percent to 30 percent for most questionnaire survey in the construction industry.

Sampling technique

A non-probability judgment sampling was used due the nature of respondents to be involved in the study. Lists of clients, consultants and contractors were established through respective regulatory boards' offices and websites, where the participants for the study were selected using purposive (judgement) sampling to collect data needed for the in-depth 'what', 'why' and 'how' answers on the research questions being investigated. Palinkas et al. (2015) insist that judgement sampling is a useful technique widely used in research for the identification and selection of information-rich cases for the most effective use of limited resources. According to Tongco (2007) judgement sampling technique is a deliberate choice of an informant due to the qualities that the informant possesses. Judgement sampling defines a process where researcher use own judgement to select a group of people who knows about the problem. This type of sampling technique is convenience and cost effective (Rahi, 2017).

Data collection techniques

Literature review and questionnaires were adopted for data collection in this study. Pertinent literature review was carried out to establish facts on the subject matter under investigation. Journal papers and other relevant sources were used to get useful information. Questionnaire form was divided into two main sections. Section one required respondents to give their general information, and section two required them to rate the causes of detrimental variation variables using five-point Likert scale viz-a-viz: strongly disagree = 1; disagree = 2; neutral = 3; agree = 4 and strongly agree = 5. In total, 25 variables identified from literature as major causes of non-

beneficial variations were included in the questionnaire for rating. Likert Scale Rating System (LSRS) has been used successfully by many researchers such as (Mohammad et al., 2010) and (Memon et al., 2014) in their studies.

Data analysis

Data were carefully analysed statistically using Statistical Package for Social Sciences (SPSS) version 17 to draw inferences. Rank of causes of non-beneficial variations in public building projects was assessed based on the arithmetic average or mean value computed by adding up all the raw scores and dividing by the number of scores as illustrated in Equation 1.

$$Mean(\bar{X}) = \frac{\Sigma X_i}{n} = \frac{X_1 + X_2 + ... + X_n}{n} \quad \text{(Equation1)}$$

Where $\bar{X}$ = Symbol for mean (pronounced as X bar)

Σ = Symbol for summation

X_i = Value of the *i*th item X, i = 1, 2, …, n

n = Total number of items or scores.

Table 1: Questionnaire survey response rate

Registration Board(s) TZ/UG	Category of Participants	Questionnaires Sent		No. of Response		Response Rate (percent)	
		TZ	UG	TZ	UG	TZ	UG
AQRB/ARB	Architects	36	9	12	3	33	33
ERB	Engineers	90	24	84	23	93	96
AQRB/ ISU	Quantity surveyors	42	14	35	7	83	50
PSPTB/ IPPU	Procurement officers	15	5	12	1	80	20
	Total	183	52	143	34	78	65

Source: Field Survey Data (2016)

RESULTS AND DISCUSSION

Reliability Testing

Reliability testing of the questionnaire was carried out to determine whether the questionnaire was capable of yielding similar scores if the respondents used it twice. Cronbach alpha is used to estimate the proportion of variance that is systematic or consistent in a set of test scores. It can range from 00.0 to 1.00 with all values between 00.0 and 1.00 also being possible. Zadeh et al. (2014) affirm that the Cronbach's alpha coefficient value is usually computed from the following formula:

$$Alpha = \frac{NC}{V + (N-1) * C} \quad \text{(Equation 2)}$$

Where N = the number of items, V = the average variance and C = the average inter-item covariance. The determined Cronbach's alpha coefficient value for all rated 25 items of the questionnaire was 0.86. From Table 2, it

can be concluded that the determined alpha coefficient value substantiate that the items form a scale that has reasonable internal consistency reliability. Impliedly, the survey instrument used was reliable and acceptable and that an agreement exists between construction industry practitioners in rating the factors of detrimental variations accordingly.

Table 2: Cronbach's alpha internal consistency values

Cronbach's alpha	Internal Consistency
$\alpha = 0.9$	Excellent (High-Stakes testing)
$0.7 = \alpha < 0.9$	Good (Low-Stakes testing)
$0.6 = \alpha < 0.7$	Acceptable
$0.5 = \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Source: Manerikar and Manerikar (2015)

Demographics survey of respondents

Table 3 presents the detailed features of the respondents including type of organisation, professional background, gender, education and work experience in the construction industry. In fact, about 79 (55 percent) of the respondents in Tanzania were from clients. This has made the study worthwhile because the study was on public building projects. However, about 31 (91 percent) of the respondents in Uganda were from contractors. All respondents have considerable years of experience which have made them able to understand the field problems and give reliable feedback in the survey which was considered trustworthy.

Table 3: Demographics survey of respondents

		Professional Background									
Distribution of the respondents according to:		Architect		Engineer		Quantity Surveyor		Procurement Officer		Total	
		TZ	UG	TZ	UG	TZ	UG	TZ	UG	TZ	UG
Type of organization	Government	1	0	58	1	9	0	11	1	79	2
	Consultant	10	0	10	1	18	0	1	0	39	1
	Contractor	1	3	16	21	8	7	0	0	25	31
Total		12	3	84	23	35	7	12	1	143	34
Education level	Undergraduate	10	1	67	17	28	7	5	0	110	25
	Masters Degree	2	2	16	6	7	0	7	1	32	9
	Doctoral degree	0	0	1	0	0	0	0	0	1	0
Total		12	3	84	23	35	7	12	1	143	34
Gender	Male	10	3	76	23	24	6	9	1	119	33
	Female	2	0	8	0	11	1	3	0	24	1
Total		12	3	84	23	35	7	12	1	143	34
Work experiences	0-5 Years	5	0	21	4	13	2	4	0	43	6
	6-10 Years	3	3	21	10	9	4	4	0	37	17
	11-15 Years	1	0	11	5	7	1	1	0	20	6
	16-20 Years	1	0	10	2	2	0	3	1	16	3
	21-25 Years	0	0	9	0	0	0	0	0	9	0
	> 25 Years	2	0	12	2	4	0	0	0	18	2
Total		12	3	84	23	35	7	12	1	143	34

Source: Field Survey Data (2016)

Client-related causes

Results in Table 3 show that change of plans or scope (Mean = 4.17) was ranked first in Tanzania, whereas in Uganda, change of plans or scope (Mean = 3.77) and change of specifications (Mean = 3.77) were ranked first as well. Evidently, change of plans or scope is the most predominant cause of detrimental variations in public building projects in both countries. Impliedly, there was no much interaction between the design team and client to ensure that client's requirements are clarified and communicated effectively to reduce non-compliance with client's requirements. Sunday (2010) affirms that change of plans or scope by clients is a factor that contributes mostly to the causes of variations in the construction of Iran and Seychelles respectively. Client's financial problem was ranked second in both countries. This may imply that, due to various reasons most clients fail to release funds on time with the consequence of cost and time overruns in projects. Memon et al. (2014) found that client's financial problem is the common factor of variations in the Malaysian construction projects. The rest ranked factors were also identified in other countries such as hindrance in prompt decision making (Sunday, 2010) in the Seychelles construction industry and inadequate project objectives (Asamaoh and Offei-Nyako, 2013) in Ghana. However, the lowest ranked causes of variations are fraudulent and kickback practices (Mean = 3.05) and inadequate project objectives (Mean = 2.97) in Tanzania and Uganda respectively.

Consultant-related causes

Results in Table 3 demonstrate that design discrepancies (Mean = 4.07) and inadequate working drawings (Mean = 4.35) were ranked first and second respectively in Tanzania. In the case of Uganda, differing site conditions (Mean = 4.00) and change in design or specifications (Mean = 3.79) were ranked first and second respectively. The inconsistency in design can be caused by various factors including the inability of the design team to accommodate the project requirements from the client and other stakeholders. The ranking of inadequate working drawings somehow is in agreement with the views of Sunday (2010) that ranked inadequate working drawings in the first position. Ndihokubwayo and Haupt (2009) claim that 18 percent out of 47 percent of the variations related to consultants was contributed by lack of detailed drawings. In fact, lack of detailed drawings can be caused by several factors including consultant's lack of judgement and experience in design. The rest ranked factors were also identified in other countries such as differing site conditions (Mohammad et al., 2010) in Malaysia; non-compliant design with government regulations, lack of coordination and conflicts between contract documents (Halwatura and Ranasinghe, 2013) in Sri Lanka; lack of judgment and experience (Oloo et al, 2014) in Kenya. However, the least ranked causes of detrimental variations are non-compliance design with government regulations (Mean = 3.13) and lack of coordination (Mean = 3.15) in Tanzania and Uganda respectively.

Contractor-related causes

The analysis results in Table 3 indicate that misinterpretation of contract documents (mean = 3.60) was ranked first in Tanzania. Relatively, misinterpretation of contract documents (Mean = 2.97) was also ranked first in Uganda. This may imply that architects or consultants have big role to play in preparing unambiguous contract documents for the projects. Asamaoh and Offei-Nyako (2013) argue that in order to convey a complete concept of the project design, the working drawings must be clear and concise. A delay due to misunderstanding in one of the contracts would cause disruptions in other contracts schedule (Lokhande and Ahmed, 2015). Some of the rest ranked factors were also identified in other countries such as lack of strategic planning (Zadeh et al., 2014) in Canada; lack of judgment and experience (Oloo et al, 2014) in Kenya; unavailability of materials and equipment (Halwatura and Ranasinghe, 2013) in Sri Lanka. Nevertheless, the lowest ranked causes of variations are unavailability of materials and equipment (Mean = 3.29) and defective workmanship (Mean = 2.68) in Tanzania and Uganda respectively.

External factor-related causes

Table 4: Ranking the causes of detrimental variations

	N = 143 TANZANIA		N = 34 UGANDA	
Causes of detrimental variations	Mean	Rank	Mean	Rank
Client-related causes				
Change of plans or scope	4.17	1	3.77	1
Client 's financial problems	3.91	2	3.74	2
Change in specifications	3.87	3	3.77	1
Hindrance in prompt decision making	3.61	4	3.65	3
Inadequate project objectives	3.23	5	2.97	5
Fraudulent and kickback practices	3.05	6	3.21	4
Consultant-related causes				
Design discrepancies	4.07	1	3.59	4
Inadequate working drawings	4.04	2	3.59	4
Differing site conditions	4.01	3	4.00	1
Change in design/specifications	3.92	4	3.79	2
Conflicts between contract documents	3.55	5	3.41	5
Lack of coordination	3.45	6	3.15	7
Poor procurement process	3.24	7	3.47	4
Lack of judgment and experience	3.20	8	3.62	3
Non-compliant design with government regulations	3.13	9	3.27	6
Contractor-related causes				
Misinterpretation of contract documents	3.60	1	2.97	1
Lack of strategic planning	3.57	2	2.74	3
Lack of judgment and experience	3.53	3	2.74	3
Defective workmanship	3.40	4	2.67	4
Contractor's financial difficulties	3.35	5	2.88	2
Unavailability of materials and equipment	3.29	6	2.74	3
External-related causes				
Weather conditions	4.01	1	4.03	1
Change in economic conditions	3.92	2	3.91	2
Change in government regulations	3.44	3	3.44	3
Socio-cultural factors	3.29	4	3.27	4

Table 3 indicates weather conditions factor was considered as the major cause of non-beneficial variation and ranked first from all respondents in both countries. Impliedly, varying weather conditions may cause time variation that may adversely affect the project progress, leading to delays. It is argued that changing weather conditions such as rain, snow, wind, and adverse temperature conditions have serious negative impact on productivity resulting into delays in construction and variations in the schedule (Lokhande and Ahmed, 2015). Furthermore, weather changes are the cause of detrimental variations that is not directly related to the project participants (Mohammad et al., 2010). Change in economic conditions and change in government regulations were ranked second and third respectively in both countries. These causes of detrimental variations were also observed by (Halwatura and Ranasinghe, 2013) in Sri Lanka. Overall, socio-cultural factors were considered the lowest cause of variations in both countries and ranked fourth. Asamaoh and Offei-Nyako (2013) reveal that in the Ghanaian construction industry socio-cultural factor is one of the causes of non- beneficial variation with less impact. However, most construction industries in developing countries are characterized by both local and foreign firms where by professionals with different socio-cultural backgrounds work together and encounter a number of problems due to different perceptions and language barriers. This situation may cause lack of coordination and communication between professionals leading to reworks and delays.

One sample t-test analysis

One sample t-test was carried out using SPSS version 17 to test for the significance of the ratings. The test value was set as 3 because the rating scale ranges from 1 to 5 with 3 being a neutral position. Result in Table 5 shows that in Tanzania about 92 percent of the causes of non-beneficial variation variables demonstrated significant values less than 0.05. Impliedly, the differences in means were statistically significant at the 0.05 confidence level. However, about 8 percent of the variables demonstrated significant values higher than 0.05 suggesting that the differences in means were statistically not significant at the 0.05 confidence level. In the case of Uganda, about 56 percent of the causes of detrimental variation variables demonstrated significant values less than 0.05. Impliedly, the differences in means were statistically significant at the 0.05 confidence level. Nevertheless, about 44 percent of the causes of detrimental variation variables demonstrated significant values higher than 0.05 signifying that the differences in means were statistically not significant at the 0.05 confidence level. The t values in both countries demonstrated that the rating of the factors was significant since they are above or below zero. Relatively, the 95 percent interval of difference ($\rho = 0.05$) shows that all rated factors have both the upper and lower limits above or below zero meaning that they were practically significant.

Table 5: One sample t-test for attributes of detrimental variations

Causes of Detrimental Variations	TANZANIA N = 143 df = 142 Test value = 3 t	Sig.	UGANDA N = 34 df = 33 Test value = 3 t	Sig.
Client related causes				
Change of plans or scope	15.0	0.00	4.26	0.00
Change in specifications	9.05	0.00	4.83	0.00
Client 's financial problems	8.78	0.00	4.96	0.00
Hindrance in prompt decision making	6.19	0.00	3.97	0.00
Inadequate project objectives	2.39	0.02	-0.17	0.87
Fraudulent and kickback practices	0.49	0.63	1.13	0.27
Consultant related causes				
Design discrepancies	15.6	0.00	4.18	0.00
Differing site conditions	14.0	0.00	5.92	0.00
Change in design/specifications	10.9	0.00	5.26	0.00
Inadequate working drawings	11.6	0.00	3.37	0.02
Lack of coordination	5.69	0.00	0.93	0.36
Conflicts between contract documents	6.58	0.00	3.07	0.04
Non-compliant design with government regulations	1.50	0.14	1.47	0.15
Lack of judgment and experience	2.08	0.04	2.99	0.05
Poor procurement process	2.46	0.02	2.61	0.01
Contractor related causes				
Lack of judgment and experience	2.08	0.04	-1.04	0.31
Lack of strategic planning	6.14	0.00	-1.33	0.19
Misinterpretation of contract documents	6.12	0.00	-0.14	0.89
Defective workmanship	4.05	0.00	-1.54	0.13
Unavailability of materials and equipment	3.01	0.00	-1.16	0.26
Contractor's financial difficulties	3.05	0.00	-0.53	0.60
External factors related causes				
Weather conditions	15.2	0.00	4.93	0.00
Change in economic conditions	10.5	0.00	5.51	0.00
Socio-cultural factors	3.79	0.00	1.51	0.14
Change in government regulations	4.77	0.00	2.77	0.01

CONCLUSIONS AND RECOMMDATIONS

The study concludes that public building projects in both countries of Tanzanian and Uganda have suffered because of detrimental variations. The study shows the existence of the causes of detrimental variations that put construction projects at great risk of poor performance. The identified critical causes in both countries were: change of scope and specifications, design discrepancies, differing site conditions, misinterpretation of contract documents, financial problem, poor strategic planning and weather conditions. Result of the t-test demonstrates that the agreement among respondents in rating the causes of detrimental variations was significant.

Based on the study findings, it is therefore recommended that adequate planning, adequate resources, team work spirit among project parties, use

of proper procurement procedures, proper feasibility study, sufficient time for design, inclusive design and proper change control mechanisms should be the focus of project parties to minimise detrimental variations in public building projects. More importantly, project management team must possess enough integrity, knowledge and skills to deal with the day-to-day management challenges of construction changes.

LIMITATIONS

Whilst the findings are significant for construction performance improvement, the research design is not without flaws. Future research should employ a large number of participants. Both quantitative and qualitative methods should be used to maximize the strengths and minimize the limitations of each technique.

CONTRIBUTIONS

Overall, results of this study provide insights on the potential causes of detrimental variations in public building projects across construction sectors of Tanzania and Uganda respectively, involving more stakeholders such as clients, consultants, contractors in additional to the practicing professionals. Moreover, the study extends and builds upon previous researchers' works such Hao et al. (2008) who acknowledge that there is a very limited research work addressing the change management issues specifically within the construction project management context.

FUTURE RESEARCH

Findings of this study could be used as input for future studies. Specifically, further research could focus on developing effective mitigation measures to alleviate non-beneficial variations in public building projects.

ACKNOWLEDGEMENT

The authors wish to gratefully acknowledge, with thanks, the Arusha Technical College of Tanzania and Makerere University of Kampala Uganda for providing the required necessary resources that made this research possible. The authors also acknowledge all participants and institutions for providing data needed for the study.

REFERENCES

Alshenqeeti, H. (2014). Interviewing as a Data Collection Method: A Critical Review. English Linguistics Research, 3(1), pp. 39-45.

Arain, F. M., and Pheng, L. S. (2005). The Potential Effects of Variation Orders on Institutional Building Projects. Facilities, 23, (11/12), pp. 496-510.

Asamaoh, R. O., and Offei-Nyako, K. (2013). Variation Determinants in Building Construction: Ghanaian Professionals' Perspective. Journal of Construction Engineering and Project Management, 3(4), pp. 20-25.

Babatunde, S. O. (2013). Quantitative Assessment of Cost and Time Implication of Susceptibility of Building Elements to Variation in Nigeria. International Journal of Sustainable Construction Engineering and Technology, 4(2), pp. 93-103.

Entrusty Group. (2008). What Constitute Variations and How to Evaluate Them? Master Builders Journal, 4, pp. 82-92.

Fellows, R. and Liu, A. (2008). *Research Methods for Construction*, (3rd ed.), United Kingdom: Blackwell Publishing Ltd.

Greenwood, D. J., and Shaglouf, A. A. (1997). Comparison Between and Planned and Actual Durations in Medium Sized Building Projects. In: Stephenson, P. (Ed.), Proceedings 13th Annual ARCOM Conference,15-17 September 1997, Cambridge, UK. Association of Researchers in Construction Management, 1, pp. 233-41.

Halwatura, R. U., and Ranasinghe, N. P. (2013). Causes of Variation Orders in Road Construction Projects in Sri Lanka. ISRN Construction Engineering, 2013, pp.1-7.

Hao, Q., Shen, W., Neelamkavil, J., and Thomas, R. (2008). Change Management in Construction Projects. CIB W78 International Conference on Information Technology in Construction, Santiago, Chile.

Keane, P., Sertyesilisik, B. and Ross, A. D. (2010). Variations and Change Orders on Construction Projects. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 2(2), pp. 89-96.

Lokhande, M. A., and Ahmed, F. S. Y. (2015). Assessing Consequences of Change Request Impact in Construction Industry of Yemen: An Explorative Likert Scale Based Survey Design. Journal of Management, 5(5), pp. 141-147.

Manerikar, V., and Manerikar, S. (2015). Cronbach's alpha. A Peer Reviewed Research Journal – aWEshkar, XIX (1), pp. 117-119.

Memon, A. H., Rahman, I. A., and Hasan, M. F. A. (2014). Significant Causes and Effects of Variation Orders in Construction Projects. Research Journal of Applied Sciences, Engineering and Technology, 2(21), pp. 4494-4502.

Moghaddam, A. G. (2012). Change Management and Change Process Model for the Iranian Construction Industry. International Journal of Management Business Research, 2(2), pp. 85- 94.

Mohammad, N., Ani, A. I. C., Rakmat, R. A. O. K., and Yusof, M. A. (2010). Investigation on the Causes of Variation Orders in the Construction of Building Project: A Study in the State of Selangor, Malaysia. Journal of Building Performance, 1(1), pp. 73-82.

Nachatar, S. S., Hussin, A. A., and Omran, A. (2010). Variations in Government Contract in Malaysia. Journal of Information Management, 2, pp. 40-53.

Ndihokubwayo, R., and Haupt, T. (2009). Variation Orders on Construction Projects: Value Adding or Waste? International Journal of Construction Project Management, 1(2), pp. 1-17.

Oloo, D. D., Munala, G., and Githae, W. (2014). Factors Contributing to Variation Orders: A Survey of Civil Engineering Construction Projects in Kenya. International Journal of Social Sciences and Entrepreneurship, 1(13), pp. 425-437.

Olusegun, A. E., and Michael, A. O. (2011). Abandonment of Construction Projects in Nigeria: Causes and Effects. Journal of Emerging Trends in Economics and Management Sciences, 2(2), pp. 142-145.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., and Hoagwood, K. (2015). Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. Adm Policy Ment Health, 42(5), pp. 533-44.

Rahi, S. (2017). Research Design and Methods: A Systematic Review of Research Paradigms, Sampling Issues and Instruments Development. International Journal of Economics and Management Sciences, 6(2), pp. 1-5.

Sunday, O. A. (2010). Impact of Variation Orders on Public Construction Projects. In: Egbu, C. (Ed.) Proceedings 26th Annual ARCOM Conference, 6-8 September, Association of Researchers in Construction Management, Leeds, pp. 101-110.

Tongco, D. C. (2007). Purposive Sampling as a Tool for Informant Selection. A Journal of Plants, People and Applied Research, 5, pp. 147-158.

Yin, R. K. (2009). *Case Study Research: Design and Methods*. 4th ed. London: SAGE Publications.

Zadeh, M. T., Dehghan, R., Ruwanpura, J. Y., and Jergeas, G. (2014). Factors Influencing Design Changes in Oil and Gas Projects. International Journal of Construction Engineering and Management, 3(4), pp. 117-133.

COMPARISON BETWEEN CONSTRUCTION PROJECTS COST OVERRUN IN PUBLIC AND PRIVATE SECTORS OF LAGOS STATE, NIGERIA

Emmanuel O. Fatoye[1] and Nwabueze M. Anosike[2]
[1]Department of Quantity Surveying, Lagos State Polytechnic, Ikorodu, Lagos, Nigeria.
[2]Department of Building, Federal University of Technology, Owerri, Nigeria.

Despite proven importance of cost as a driving force of project success, construction projects in both government and private sectors may have been failing to achieve their objectives within budgeted cost. Hence, the research is aimed at making comparison between construction projects cost overrun in public and private sectors of Lagos State, Nigeria with a view to enhancing both sectors' effective project delivery. The objectives are to compare the level of occurrences and percentages of cost overruns between public and private sectors' construction projects, identify the causes of cost overruns in public and private sectors' construction and evaluate the degree of agreement/disagreement between any two groups of construction industry participants regarding the ranking of important causes of cost overruns. Using a well-structured 1-5 Likert Scale, a total of 130 questionnaires were administered to sampled respondents, out of which 92 were duly completed and returned, representing 70.77% response rate used for the analysis. Stratified multi-stage sampling technique was adopted to select respondents in study area. Statistical tools were utilized to analyse the data obtained. The result of the study revealed that frequency of occurrence of cost overrun ranges from 69.39% in public sector to 90.70% in the private sector while percentage of cost overrun ranges between 19.14% in public sector and 19.63% in the private sector indicating that cost overrun is more pronounced in private sector projects than in the public sector. The most important cause of cost overrun in both sectors is additional work to project'. A well-defined project scope from inception to completion is recommended for both sectors in order to reduce additional work and consequently, cost overrun.

Keywords: construction, cost overrun, Nigeria, private sector, projects, public sector

INTRODUCTION

The construction industry is a dynamic sector and an important player in the development of any nation (Memon, Rahman and Azis, 2012). According

[1] emmanfatoye@yahoo.com
[2] nwa_4chi@yahoo.com

Fatoye, E. O. and Anosike, N. M. (2017) Comparison between construction projects cost overrun in public and private sectors of Lagos State, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 479-493.

to Okoye et al. (2016), construction sector has the potentials for contributing to the improvement and growth of national economy and facilitate quick recovery from national economic recession. The Nigerian building and construction industry has contributed between 2.88% in 2010 and 4.30 % in 2016 to the Nigerian GDP (National Bureau of Statistics, 2015; 2016; RTC Advisory Services Ltd, 2016). Global economy is based on both public and private sectors and it appears that available literature on cost overrun were based on either of the sectors, this study therefore focuses on comparing cost overruns in both sectors in the Nigerian construction industry. Various researchers (Mahamid & Amund, 2012; Nyamoki, 2012; Jain & Singh, 2012; Subramani, et al., 2014) have defined cost overrun as the excess of actual cost over budget or the difference between the actual construction cost on completion of work and original estimated costs, with all costs calculated in constant prices. For the purpose of this paper, cost overrun is defined as the difference between final account sum at project completion and original contract award sum at the signing of the contract. According to Dube and Danescu (2011), the public sector consists of governments and all publicly controlled or publicly funded agencies, enterprises, and other entities that deliver public programs, goods, or services. The private sector is the part of the economy and businesses that are not owned or operated by the government but run by individuals and companies (Halvorsen, et al., 2005). The research is aimed at making comparison between construction projects cost overrun in public and private sectors of Lagos State, Nigeria with a view to enhancing both sectors' effective project delivery. The objectives are to compare the level of occurrences of cost overruns between public and private sectors' construction projects, compare the percentage of cost overruns between public and private sectors' construction projects as well as to identify the causes of cost overruns in public and private sectors' construction. The study will be of value to the construction industry participants in all areas of financial management and control of construction projects. It will act as diagnostic tools in curbing menace of cost overrun through cost-related policy formulation and implementation.

LITERATURE REVIEW

Despite the impressive performance of the construction industry, Dantata (2007) observed that it faces a significant number of challenges including cost overruns. The principles of chaotic theory, developed by Edward Lorenz in 1961, are applicable to the built environment, with particular reference to cost overrun. One of the key characteristics of this theory is summarised as *sensitive dependence on initial conditions*, otherwise known as the butterfly effect which is a situation where small change in a system causes major and unpredictable consequence which could either be positive or negative (Olaniran, et al., 2015; 2017) According to Frear (2011), chaos theory establishes that within a predictable project work, a parameter could react to small changes and create variations of significant consequences both in time and cost. This is true of construction industry where small alteration can give rise to strikingly great consequences (Olaniran, et al.,

2017).For instance, a small omission / error in design or addition to work which may be perceived as insignificant and that can be overlooked at the point when the event occurred may have a cumulative and long-term effects on other activities across the entire project, especially where there is a high degree of reciprocal interdependence, which are difficult to predict. Kiiras (n. d.) opined that these changes can arise from internal source (from project owner) or external source (beyond the influence of the owner). Consequent solution may need high levels of rework at later stage that will contribute to an escalation of project costs. (Olaniran, et al., 2017). Unless these changes are predefined at inception and effectively managed, they can lead to either challenged or impaired project (Holgeid & Thompson, 2013) with its attendant underperformance or total failure.

Considering the causes of cost overrun, the study of Amoa-Abban (2014) on government building construction projects in Ghana, additional works tops the list of contributing factors to cost overrun (Azis, et al., 2013) pointed out that contractors' site management is the most significant contributor to cost overruns in Malaysia. This is followed by information and communication, project management and contract administration, labour related factors, materials and machinery and external factors. The study of road construction projects in Palestine by Mahamid and Amund (2012) indicated that 100% of the projects suffer cost deviation from 39% to 98% with an average of 14.6% between estimated and actual cost. Results of the perceptions of contractors on factors affecting cost overruns on building projects in Palestine indicated the top five factors as fluctuation in the currency exchange rate, project financing, contract management, level of competition, and cost of materials (Mahamid, 2014). Slow decision making, poor schedule management and poor cost estimation were identified as the major causes of cost overrun in dam construction project in Rwanda (Gasasira and Mbabazi, 2016).

Brunes and Lind (2014) observed that overruns in infrastructure projects in Sweden, occurred in the planning stages up to the final design and are related to design changes because of technical and administrative problems. The analysis of 58 Australian transportation infrastructural projects revealed that rework during construction as a result of design changes; errors and omission are the major contributors of overruns in projects (Love, et al., 2014). In the survey of 74 road projects awarded in the West Bank-Palestine over the years 2007-2010 by Mahamid (2013), 100% of the projects suffered from cost overrun with an average of 16.73% ranging from -20.33 to 56.01%. A correlation between project size and cost deviation was also observed. Bekr (2015) observed that schedule delay, frequent design changes, changes and additional works at owner request, were ranked as the most important causes of cost overrun in Jordan construction projects. The results of the study of Ameh, Soyingbe and Odusami (2016) on telecommunication projects in Nigeria identified and ranked the prevailing causes of cost overruns in order of importance as lack of contractors' experience in telecommunication projects, high cost of imported materials, fluctuations in material prices, frequent design changes due to inadequate

site and environmental information. Kasimu (2012) also in Nigeria identified market condition, lack of experience in contracts works, insufficient time (for pre-tender stage), material price fluctuation and political situation as the major significant factors for cost overruns in those projects.

PROBLEM STATEMENT

Despite the construction industry's contributions to the national development, the construction industry, has been regarded as one facing chronic problems and poor performance leading to failure in achieving effective cost performance (Olawale and Sun, 2010; Memon, Rahman and Azis, 2012). For the construction industry to fully fulfil its role towards national development, therefore, construction cost then becomes a fundamental consideration especially in a bid to forestall cost overrun in both public and private sectors of the industry. The available literature has dealt with issues relating to various causes of cost overrun generally. Since global economy is based on both public and private sectors and majority of the work of past researchers were based on either of the sectors, this study therefore focuses on comparing the cost overruns in both public and private sectors' construction projects in the Nigerian construction industry. The spread of the study is on both building and civil engineering projects with the assumption that its outcome will be beneficial to both types of projects.

RESEARCH DESIGN AND METHODS

The study made use of cross-sectional design and adopts a quantitative research method with a multi-stage sampling technique. Lagos State (the study area) was stratified into three on the basis of senatorial districts having a total of 20 local governments. They are Lagos Central (5 local governments), Lagos West (5 local governments) and Lagos East (10 local governments). Three local governments were selected from each stratum (senatorial district) based on their commercial/economic status, concentration of professionals and good representation of the population. The population of construction industry professionals in the State is 520 making up of architects (236), builders (38), civil/structural engineers (80), mechanical/electrical (109) and quantity surveyors (57). Out of this population, 50 were randomly sampled from the selected local governments in Lagos Central and 40 from Lagos West and Lagos East respectively. These make a total of 130 sample size representing 25% of the population.

The questionnaires were distributed in the senatorial districts by simple random technique. Out of the 130 questionnaires administered, a total of 92 were duly completed and returned, representing approximately 70.77% response rate, for the analysis. The questionnaire was designed to seek respondents' opinion on level of importance of the listed factors causing cost overruns on a 1-5 Likert-type scale from 1 for not important to 5 for extremely important. The causes were assessed for their relative importance index using the mean item score (MIS) method.

$$MIS = \frac{\sum_{i=1}^{5} (s_i \times f_1)}{N}$$

where,

i = response category (scaling) index

= 1, 2, 3, 4, and 5 for not -, slightly -, moderately -, very – and extremely important respectively;

s_i = score assigned to each factor by the respondents and ranges from 1 to 5;

f_i = frequency of responses to each rating (1 - 5) for each factor.

N = total number of responses concerning that factor

These causes were identified through the review of available relevant literature from different countries that have been associated with construction cost overrun. The first five ranked factors that resulted in cost overrun in each of the literature were selected for consideration. These were then reshuffled to eliminate same/repeated factors before coming up with the major factors that were considered for this study. The percentage of overrun is calculated from the data obtained from past completed projects using the formula:

$$\% \text{ Cost overrun} = \frac{\text{Final Account Sum - Original Contract Award Sum}}{\text{Original Contract Award Amount}} \times 100$$

In order to determine the most important causes, the "weighted average" of the mean item scores for each of the causes from each group was evaluated. The mean scores were ranked with high mean scores assigned high ranks and vice versa. These ranking made it possible to cross-compare the relative importance of the causes as perceived by the three groups of construction industry participants (the clients, consultants and contractors' organisations). The study made use of Statistical Package for Social Sciences (SPSS, Version 20) computer statistical programme.

DATA COLLECTION

Primary data were obtained through questionnaires administered on construction industry professionals, i.e. architects, builders, civil/structural engineers, mechanical/electrical engineers and quantity surveyors working within clients' (project owners) organisations, consultancy firms and constructing organisations. Secondary data were sourced from textbooks, journals, research works, conference/seminar papers got from libraries, research centres, Internets, etc. There are also archival data on cost details such as initial contract sum and final account sum of most recently completed construction projects by the public sector (Ministry of Works &

Structures and Ministry of Housing in Lagos State respectively) and those by the private sector collected from clients, consultants and contractors through questionnaires. Some of the buildings used in the data collection for both public and private sector projects range from shopping mall, primary and secondary school classroom blocks and administrative buildings, hospital buildings to office complex projects, and of which, their contract sums were in millions of Nigeria Naira currency.

Reliability test is carried out to check the stability and consistency of the data by using Cronbach's alpha (α) method that is widely adopted. According to Wong and Cheung (2005); Shanmugapriya and Subramanian (2013), reliability of data is considered to be at low level when Cronbach's alpha is less than 0.3 which means the data is not reliable and cannot be adopted. Reliability is at high level and deemed sufficient for analysis when Cronbach's alpha is more than 0.7. A Cronbach's alpha (α) coefficient analysis was carried out and the result in Table 1 shows an alpha of 0.966 for 54 items (indicating 96.6% reliability). This is above the recommended threshold value of 0.7, confirming the reliability of the measures. Content validity was carried out based on a thorough review of related literature and cross-examination of contents by an academic researcher and three PhD students. Their comments and consequent adjustments of the contents of the questionnaire confirmed they had content validity.

Table 1: Reliability Statistics Test for Causes of Cost Overrun

Cronbach's Alpha (α)	Cronbach's Alpha Based on Standardized Items	N of Items
0.966	0.966	54

ANALYSIS AND RESULTS

The demographic characteristics of the respondents are explained, empirically, using data collected from the survey are as shown in Tables 2. About 50% percent were either B.Sc. or HND holders, 45.7% were M.Sc. holders, 2.2% were PhD holders, and 2.2% was ND holders. Those who were professionally qualified, not lower than corporate membership in their respective fields were about 85.8%. Respondents with over ten years of working experience in the construction industry were about 89.2%. Organisations with over ten years of working experience in the construction industry were about 80.4%. The professionals were employed in clients' organisation (N = 30), consultancy firms (N = 34), and contracting firms (N = 28). These findings were indications that the respondents were knowledgeable enough about the study matter and, by inference, high level of reliability of their response.

Levels of occurrences and percentages of cost overrun in public and private sectors were compared as indicated in Table 3. About 69.39% of the total number of executed projects in the public sector experienced cost overrun as against 90.70% in the private sector. There was an average of 19.14% cost

overrun ranging from 1.19% to 81.82% in the public sector compared with an average of 19.63% cost overrun ranging from 2.34% to 156.42% in the private sector. Projects that were completed at the exact initial contract sum were 22.45% of the total number in the public sector and 6.98% in the private sector. Those that were completed with savings (at prices less than the initial contract sum) ranging from -4.30% to -0.14% of initial contract sum were 8.16% in the public sector. Similarly, in the private sector, percentage of project that was completed with a saving (-37.50% of initial contract sum) was 2.33%.

Table 2: Respondents' Demographic and Organisational Characteristics

S/N	Demographic Characteristics	Frequency	Percentage	Total %
1	Profession (N = 92)			
	Architecture	33	35.87	
	Civil/Structural Engineering	15	16.30	
	Mechanical/Electrical Engineering	20	21.74	
	Building	10	10.87	
	Quantity Surveying	14	15.22	100.0
2	Academic Qualification (N = 92)			
	ND	2	2.20	
	HND	34	37.00	
	B.Sc.	12	13.00	
	M. Sc.	42	45.70	
	PhD	2	2.20	100.1*
3	Professional Qualification (N = 92)			
	Graduate/Probationer	13	14.10	
	Corporate member	45	48.90	
	Fellow	6	5.40	
	Government Registered	29	31.50	99.9*
4	Experience in the construction industry (Years) (N = 92)			
	≤10	10	10.90	
	11-20	46	50.00	
	21-30	25	27.20	
	> 30	11	12.00	100.1*
5	Nature of respondents' organisation (N = 92)			
	Client	30	32.60	
	Consultancy	34	37.00	
	Contracting	28	30.40	100.0
6	Owner of project involved in by respondents (N = 92)			
	Private	43	46.70	
	Public (Government)	49	53.30	100.0

Note: *Did not add up to 100% due to rounding error.

A hypothesis was set up to test if there is significant difference in the mean values of percentages of cost overrun, that is, 19.14% and 19.63%, in the public and private sectors' projects respectively. To do this, an Independent 2-Sample t-test was carried out and the result is presented in Table 4 which indicates a p-value (.933 > .05) at 95% alpha level. Since p-value (.933) is greater than .05 for mean values of percentage of cost overrun in the public and private sectors, the result is not significant at the 5% level, implying

that Ho will be accepted. Thus, there is sufficient evidence to conclude that there is no significant difference in the mean values of percentages of cost overrun in the public and private sectors projects. This is an indication that both sectors are plagued with cost overrun without any significant difference in their percentages.

Table 3: Comparison of the Levels of Occurrences and Percentages of Cost Overrun between Public and Private Sector Projects

Level of Overrur	Public Sector Projects No. of Occurrences	Level of Occurrences	Range of % of overrun	Private Sector Projects No. of Occurrence	Level of Occurrence	Range of % o overrun
Savings	4	8.16	-4.30-0.14	1	2.33	-37.50
Zero Overrun	11	22.45	0.00	3	6.98	0.00
Positive Overrur	34	69.39	1.19-81.82	39	90.70	2.34-156.41
Total	49	100.00		43	100.01*	
Occurrence/ Average % of Overrun		69.39	19.14		90.70	19.63

Note: *Did not add up to 100% due to rounding error

Table 4: Comparison of Mean Values of Percentage of Cost Overrun between Public and Private Sector Projects

Client Type		N	Mean	t-score	df	Sig. (2-tailed) [p value]	95% Confidence Interval of the Difference		Remark
							Lower	Upper	
% of cost overrun	Private	43	19.6333	.085	90	.933	-10.98841	11.96680	Not Significant
	Public	49	19.1431						

In Table 5, the overall weighted average of the top twenty causes of cost overrun in both public and private sector projects revealed that additional work to the project with an overall mean of 4.130 is the most important cause of cost overrun in both sectors. It is equally ranked first by the respective sector. This is followed by poor project management and contract administration (4.033). This was equally ranked second by the private sector but sixth in the public sector. Inflation and high interest rates on the cost of construction materials came third in the rank (3.989) but fifth and third in public and private sector respectively. This was followed by incomplete design information when estimating (3.967) and lack of detailed and well-defined design brief (3.935).

A hypothesis was set up to test if there is significant difference between two independent groups (i.e. public versus private) on the mean of the causes of cost overrun. An Independent 2-Sample t-test was carried out to determine the significant difference in the group (public versus private) mean for each cause of cost overrun. The result in Table 5 reveals that p-value is greater than 0.05 for 19 out of the first 20 ranked causes of cost overrun in the public and private sectors.

This shows that the result of these 19 causes is not significant at the 5% level, implying that H_o cannot be rejected. Thus, there is sufficient evidence to conclude that there is no significant difference (or there is significant

degree of agreement) between the mean values of both public and private sectors.

A hypothesis was set up to test the level of agreement / disagreement between any two groups of construction industry participants regarding their ranking of important causes of cost overruns in the public and private sector.

H_0: There is no agreement between any two groups of construction industry participants regarding their ranking of important causes of cost overruns in the public and private sector.

H_1: There is agreement between any two groups of construction industry participants regarding their ranking of important causes of cost overruns in the public and private sector.

Table 5: Comparison of Mean Values of the Causes of Cost Overrun between Public and Private Sector

Causes of Cost Overrun	Overall average (N=92)		Public Sector (N=49)		Private Sector (N=43)		Sig. (2-tailed	Remarks
	Mean	R	Mean	R	Mean	R		
Additional work to the project	4.130	1	4.184	1	4.070	1	0.623	NS
Poor project management and contract administration	4.033	2	4.020*	6	4.047	2	0.894	NS
Inflation and high interest rates on the cost of construction materials	3.989	3	4.020	5	3.954	4	0.758	NS
Incomplete design information when estimating	3.967	4	4.000	7	3.930	5	0.729	NS
Lack of detailed and well-defined design brief	3.935	5	4.061	2	3.791	12	0.202	NS
Fluctuation/ Price escalations of materials, labour and equipment	3.924	6	4.020	4	3.814	10	0.344	NS
Delay payment and cash flow difficulties faced	3.913	7	4.020	3	3.791	11	0.337	NS
Rise in foreign exchange rate (for imported	3.880	8	3.980	9	3.767	14	0.356	NS
Poor financial resources management	3.880	9	3.959	11	3.791	13	0.433	NS
Design changes	3.880	10	4.000	8	3.744	15	0.230	NS
Fraudulent practices and kickbacks	3.870	11	3.857	14	3.884	6	0.907	NS
Poor site management and supervision	3.870	12	3.714	19	4.047	3	0.049	S
Inaccurate or poor estimation of original cost	3.848	13	3.878	12	3.814	9	0.798	NS
Lack of contractors' experience in relevant	3.826	14	3.980	10	3.651	19	0.131	NS
Rework during construction as a result of design changes, errors and omission	3.794	15	3.837	15	3.744	16	0.663	NS
Use of inefficient contractors	3.739	16	3.857	13	3.605	20	0.354	NS
Financial difficulties of owners	3.728	17	3.776	16	3.674	18	0.674	NS
Poor schedule planning & management	3.728	18	3.612	19	3.861	7	0.186	NS
Poor monitoring and inefficient cost control systems	3.717	19	3.755	17	3.674	17	0.729	NS
Change orders	3.707	20	3.592	20	3.837	8	0.222	NS

Note: * Equal mean scores of the individual factors ranked according to the number of respondents scoring 5 and 4 respectively; F-stat = test statistic; p-value = probability that the null hypothesis is true; significant at $p<0.05$; NS = Not significant; N = Significant

To ascertain this for the public sector, Kendall tau rank correlation coefficient analysis was carried out. The result in Table 6 shows the computation of a Kendall tau rank correlation coefficient (r) (analysis) and the decision rule of rejection of null hypothesis for the ranking of causes of cost overrun as perceived by different groups. The p-values (0.604; 0.795; 0.650) > 0.05 indicate that the agreements between groups are not significant. This implies acceptance of null hypothesis (H_0) and rejection of alternative hypothesis (H_1). Thus, there is sufficient evidence to conclude that there are no relationships, meaning there are no agreements between two groups of construction industry participants i.e. clients and consultants, clients and contractors, as well as consultants and contractors in their ranking of important causes of cost overrun in public sector projects.

Table 6: Test of Agreement on Ranking of Important Causes of Cost Overruns in the Public Sector

Construction Industry Participants	Test Statistic	p-value	Accept H_0?	Remark
Clients and Consultants	0.084	0.604 > 0.05	Yes	Not significant
Clients and Contractors	-0.042	0.795 > 0.05	Yes	Not significant
Consultants and Contractors	-0.074	0.650 > 0.05	Yes	Not significant

Note: Kendall tau-b Test Statistic = Correlation coefficient; p-value = Probability that the null hypothesis is true; Significant at p<0.05 (2-tailed).

Similarly, in the private sector, the p-values (0.243; 0.119; 0.060) > 0.05 indicate that the agreements between groups are not significant (Table 7). This implies acceptance of null hypothesis (H_0) and rejection of alternative hypothesis (H_1). Thus, there is sufficient evidence to conclude that there are no relationships, meaning there are no agreements between two groups of construction industry participants i.e. clients and consultants, clients and contractors, as well as consultants and contractors in their ranking of important causes of cost overrun in private sector projects.

Table 7: Test of Agreement on Ranking of Important Causes of Cost Overruns in the Private Sector

Construction Industry Participants	Test statistic	p-value	Accept H_0?	Remark
Clients and Consultants	0.189	0.243 > 0.05	No	Not significant
Clients and Contractors	0.253	0.119 > 0.05	No	Not significant
Consultants and Contractors	0.305	0.060 > 0.05	No	Not significant

Note: Kendall tau-b Test Statistic = Correlation coefficient; p-value = Probability that the null hypothesis is true; Significant at p < 0.05 (2-tailed).

DISCUSSION OF RESULTS

One of the findings of this study is that frequency of occurrence of cost overrun ranges from 69.39% in public sector to 90.70% in the private sector while percentage of cost overrun ranges between 19.14% in public sector and 19.63% in the private sector. Frequency of occurrence is similar to that of Malaysia with 92% but the percentage of overrun is higher than the Malaysian situation with an average of 5-10% (Memon, Rahman and Azis, 2012). This range of percentage of cost overrun is an upward experience from 14%reported in Nigeria by Omoregie and Radford (2006) and 17.34% stated by Aibinu and Jagboro (2002) also in Nigeria. It is much higher than

the 12% contingency allowance recommended by Bello and Odusami (2012) to cater for variations (or additional work) on contract delivery. It is almost at the upper limit of 15-20% contingency allowance suggested by Aibinu and Jagboro (2002). This implies there had been no improvement in the cost control of construction cost. It was also evident from the finding of this research that occurrence and percentage of cost overrun, though high, is more in the private sector than the public sector. The reason could be that most of the government projects are awarded based on non-fluctuating (firm price) contracts, which were better managed and financially controlled. The funds are tax payers' money that must be spent judiciously and well accounted for. Besides, in this era of global economic recession, public funds are very scarce in the midst of many competitive needs and must be expended for the stakeholders to have value for their money. The finding also agrees with the assertion of Flyvbjerg, Holm and Buhl (2004) that the often-seen claim that public ownership is problematic and private ownership is effective in curbing cost overrun is a generalization. It disproves that of Subramani, Sruthi and Kavitha(2014) that government owned projects are the least cost effective. According to the former, the type and level of accountability by the practitioners appear to matter more in cost overrun than types of ownership.

The finding of this research also shows that additional work to the project is the most important cause of cost overrun in public and private sector respectively. This was also rated as the most important cause in the work of Choudhry, Nasir and Gabriel(2012) in Pakistan and Amoa-Abban (2014) in Ghana. Decision by clients to increase the scope of any ongoing contract will change the contract cost and invariably leads to cost overrun unless there is a trade-off of any part of the project without compromising the quality. The observed disagreements between two groups of construction industry participants in the ranking of causes of cost overrun in both sectors could be that there was bias in the ranking; each of the groups ranked the causes that are directly related to them very low and ranked others high in order to absolve themselves of responsibility for cost overrun. Similar observation was made by Omoregie and Radford (2006).

CONCLUSION AND RECOMMENDATIONS

Cost overrun is still a severe problem faced by both public and private sectors in construction industry. Both the frequency occurrence and percentage of cost overrun is lower in the public sector than in the private sector, though without statistical significant difference in their percentages. The lower percentage is a pointer to better financial management and control in the public sector. This higher level of financial probity, no doubt, will create a higher level of confidence in the public sector by construction industry stakeholders than for the private sector. The ranking of the important causes of cost overrun in both public and private sectors should be a guide in the resources management of construction projects.

The percentages of 19.14% and 19.63% cost overrun in public and private sector respectively as observed in this study are higher than 14% and 17.34% reported in previous studies for Nigeria. The contingency allowance of 12% and 15-20% respectively recommended by previous researchers to accommodate variations (or additional work) on contract delivery will be inadequate in the light of the findings of this study. This is a serious warning of danger to cost managers and other stakeholders in the Nigerian construction industry especially in this era of economic recession. This makes the improvement of the management of financial resources, in both public and private sectors, inevitable.

Cost overrun, from whichever sector and for whatever reason, could lead to additional financial burden on the clients in form of claims by the contractor. This can lead to delayed payments by clients and cash flow difficulties on the part of contractors and consequent reduction in his work force. It could further lead to liquidation of contractors, project abandonment and client's inability to use the facility and get value for money. It has negative multiplying effects on the socio-economic life of construction workers in the form of possible retrenchment and on the prospects of the construction industry as a whole. These effects, if allowed to continue unabated, could hinder the growth of the construction industry and its contribution to the Gross Domestic Product (GDP) of the nation.

It is therefore recommended that for any project, there must be a well-defined scope from inception and every aspect of design including all possible changes should be completed and estimated at pre-contract stage before going to tender in order to avoid change orders and variations that are likely to occur at post-contract stage. There must also be more efficient financial management through resource planning and control. Construction industry employers should provide relevant training programmes in reputable organizations for their technical and managerial personnel. Government should put in place strong monetary policies and implementation to fight inflation and high interest rates so as to stabilise or reduce cost of construction materials. These will consequently reduce cost overrun in construction projects to a minimum, if not eliminate them completely.

The findings of this paper reveal that though cost overrun in the public sector is lower than that of the public sector, it is higher than those in the previous study. These findings, therefore, have practical implication on both sectors to have an urgent re-think on their cost control measures for improved cost performance in order for clients to get value for money.

This study is limited to Lagos State, Nigeria. Similar studies can be conducted in other parts of country and beyond Nigeria in order to compare the outcome of the research.

REFERENCES

Aibinu, A. A. & Jagboro, G. O., 2002. The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management,* Volume 20, pp. 593-599.

Ameh, O. J., Soyingbe, A. A. & Odusami, K. T., 2010. Significant factors causing cost overruns in telecommunication projects in Nigeria. *Journal of Construction in Developing Countries,* 15(2), pp. 49-67.

Amoa-Abban, K. & Allotey, S., 2014. Cost overruns in building construction projects: a case study of a government of Ghana project in Accra. *Developing Country Studies,* 4(24), pp. 54-65.

Azis, A. A. A., Memon, A. H., Rahman, I. A. & Abd. Karim, A. T., 2013. Controlling cost overrun factors in construction projects in Malaysia. *Research Journal of Applied Sciences, Engineering and Technology,* 5(8), pp. 2621-2629.

Bekr, G. A., 2015. Identifying Factors Leading to Cost Overrun in Construction Projects in Jordan. *Journal of Construction Engineering, Technology and Management,* 5(3), pp. 25-33.

Bello, W. A. & Odusami, K. T., 2012. *The effectiveness of construction contingency in contract delivery in Nigeria.* Las Vegas. Nevada USA, RICS, pp. 1627-1636.

Brunes, F. & Lind, H., 2014. *Explaining cost overruns in infrastructural projects: A new framework with applications to Sweden,* Stockholm, Sweden: Department of Real Estate and Construction Management, Royal Institute of Technology.

Choudhry, R. M., Nasir, A. R. & Gabriel, H. F., 2012. *Cost and time overruns in highway projects in Paskistan,* Pakistan: Centenary Celebration (1912-2012).

Dantata, S., 2007. *General overview of the construction industry,* Massachusetts: Massachusetts Institute of Technology.

Dube, S. & Danescu, D., 2011. *Supplemental Guidance: Public Sector Definition,* Altamonte Springs, Fla., USA.: The Institute of Internal Auditors.

Flyvbjerg, B., Holm, M. K. S. & Buhl, S. L., 2004. What causes cost overrun in transport infrastructure projects?. *Transport Reviews,* 24(1), pp. 3-18.

Frear, D., 2011. The effect of change on management planning: applying chaos theory. *International Journal of Business and Social Science,* 2(14), pp. 57-60.

Gasasira, I. & Mbabazi, P., 2016. The causative factors leading to cost overrun in dam construction projects in Rwanda: case study Kinoni 1 dam construction project. *European Journal of Business and Social Sciences,* 4(11), pp. 142-168.

Halvorsen, T., Hauknes, J., Miles, I. & Røste, R., 2005. *On the differences between public and private sector innovation,* Oslo: Publin.

Holgeid, K. & Thompson, M., 2013. A reflection on why large public projects fail. In: T. H. S. o. G. a. t. J. f. P. C. a. P. Advice, ed. *The Governance of Large-Scale Projects-Linking Citizens and the State.* s.l.:The Hertie School of Governance and the Journal for Political Consulting and Policy Advice, pp. 1-17.

Jain, N. & Singh, R., 2012. *A Theory of Cost overrun,* Delhi, INDIA: Department of Economics, Delhi School of Economics, University of Delhi.

Kasimu, M. A., 2012. Significant factors that cause cost overruns in building construction project in Nigeria. *Interdisciplinary Journal of Contemporary Research in Business,* 3(11), pp. 775-780.

Kiiras, J., n. d.. *Project management in chaos.* Helsinki, s.n., pp. 2-12.

Love, P. E. D. et al., 2014. Overruns in transportation infrastructure projects. *Structure and Infrastructure Engineering: Maintenance, Management, Life-Cycle Design and Performance,* 10(2), pp. 141-159.

Mahamid, I., 2013. Effects of projects physical characteristics on cost deviation in road construction. *Journal of King Saud University-Engineering Sciences,* Volume 25, pp. 81-88.

Mahamid, I., 2014. Contractors' perception of risk factors affecting cost overrun in building projects in Palestine. *The IES Journal Part A: Civil and Structural Engineering,* 7(1), pp. 38-50.

Mahamid, I. & Amund, B., 2012. Cost deviation in road construction projects: The case of Palestine. *Australasian Journal of Construction Economics and Building,* 12(1), pp. 58-71.

Memon, A. H., Rahman, I. A. & Azis, A. A., 2012. Time and cost performance in construction projects in Southern and Central Regions of Penisular Malaysia. *Time and cost performance in constructioInternational Journal of Advances in Applied Sciences (IJAAS),,* 1(1), pp. 45-52.

National Bureau of Statistics, 2015. *Nigerian construction sector summary report: 2010-2012,* Abuja: Federal Republic of Nigeria.

National Bureau of Statistics, 2016. *Nigerian gross domestic product report quarter two 2016,* Abuja: Federal Republic of Nigeria.

Nyamoki, N. E., 2012. *An investigation on the causes and effects of cost overrun on works projects in Mombasa country,* Nairobi: Kenyatta University.

Okoye, P. U., Ugwu, C., Ezeokoli, F. O. & Ugochukwu, S., 2016. Imperatives of economic fluctuations in the growth and performance of Nigeria construction sector. *Microeconomics and Macroeconomics,* 4(2), pp. 46-55.

Olaniran, O. J. et al., 2015. Chaotic dynamics of cost overruns in oil and gas megaprojects: a review. *International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering,* 9(7), pp. 911-917.

Olaniran, O. J. et al., 2017. Chaos theory: implications for cost overrun research in hydrocarbon megaprojects. *Journal of Construction Engineering and Management,* 143(2), pp. 1-8.

Olawale, Y. & Sun, M., 2010. Cost and time control of construction projects: Inhibiting factors and militating measures in practice Construction Management and Economics. *Construction Management and Economics,* 28(5), pp. 509-576.

Omoregie, A. & Radford, D., 2006. *Infrastructure delays and cost escalation: causes and effects in Nigeria.* The Netherlands, Delft University of Technology and TNO.

RTC Advisory Services Ltd, 2016. *Nigeria's economy and recession: outlook for 2017,* Lagos

Shanmugapriya, S. &. S. K., 2013. Investigation of significant factors influencing time and cost overruns in Indian construction projects. *International Journal of Emerging Technology and Advanced Engineering,* 3(10), pp. 734-740.

Subramani, T., Sruthi, P. S. & Kavitha, M., 2014. Causes of cost overrun in construction. *IOSR Journal of Engineering (IOSRJEN),* 4(6), pp. 01-07.

Wong, P. S. P. & Cheung, S. O., 2005. Structural equation model trust and partnering success. *Journal of Engineering and Management,* 21(2), pp. 70-80.

CONSTRUCTION HEALTH AND SAFETY AGENTS' (CHSAS') CONTRIBUTION TO HEALTH AND SAFETY IN SOUTH AFRICA

John Smallwood[1] and Claire Deacon[2]
[1,2]*Dept. of Construction Management, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

Clients may appoint CHSAs in terms of fulfilling their requirements in terms of the South African Construction Regulations. However, previous exploratory research findings and anecdotal evidence indicate that CHSAs are lacking in terms of performance. The objectives of the study were to determine the contribution of CHSAs to health and safety (H&S), the frequency of client and designer interventions, and interventions that could contribute to an improvement in their contribution to H&S and construction. Registered CHSAs were included in the self-administered questionnaire survey. The salient findings include: CHSAs are generally appointed at project initiation and briefing, tender documentation and procurement, and construction documentation and management stages; CHSAs have contributed to and impacted on H&S; CHSAs rate themselves as good relative to most composite knowledge areas and composite skills areas; the contribution of CHSAs to H&S could be improved, and a range of interventions could contribute to an improvement in the contribution of CHSAs to H&S and construction. Conclusions include: CHSAs may not be viewed as being able to contribute during project initiation and briefing, concept and feasibility, and design development; H&S is not a project value; CHSAs have contributed to and impacted on H&S; inadequate knowledge and experience due to a lack of appropriate tertiary education lead to their limited status, exclusion from decision making and management of the project, and not being consulted. The conclusions underscore the findings of a previous exploratory study, and the current study's objectives related to client and designer interventions, and the potential of interventions to contribute to an improvement in CHSA's contribution to H&S and construction. Recommendations include: comprehensive holistic education and training is required for CHSAs; related continuing professional development (CPD) courses should be evolved; a formal tertiary education programme should be evolved, and CHSAs should be appointed at Stage 1 'Project initiation and briefing'.

Keywords: agent, construction, health and safety, performance.

[1] john.smallwood@nmmu.ac.za
[2] claire@occumed.co.za

Smallwood, J. and Deacon, C. (2017) Construction Health and Safety Agents' (CHSAs') contribution to health and safety in South Africa *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 494-505.

INTRODUCTION

The report 'Construction Health & Safety Status & Recommendations' highlighted the considerable number of accidents, fatalities, and other injuries that occur in the South African construction industry (Construction Industry Development Board (cidb), 2009). The report cited the high level of non-compliance with H&S legislative requirements, which is indicative of a deficiency of effective management and supervision of H&S on construction sites as well as planning from the inception / conception of projects within the context of project management. The report also cited a lack of sufficiently skilled, experienced, and knowledgeable persons to manage H&S on construction sites. A study conducted among general contractors required the respondents to rate CHSAs in terms of, inter alia, four competencies (Smallwood, 2009). They were rated average to good / good relative to 'Construction H&S' and 'Project management', and poor to average / average relative to 'Design' and 'Construction management'. The study concluded that CHSAs are not appropriately educated and trained, and that clients do not ensure that CHSAs are competent. A study conducted among construction project managers relative to CHSAs concluded that CHSAs were lacking in terms of competencies, their contribution to H&S could be improved, and that a range of interventions could contribute to an improvement in the contribution of CHSAs to H&S (Smallwood, 2015).

The Construction Regulations make provision for the appointment of Construction H&S Agents (CHSAs), and require the appointment of either part-time or full-time construction H&S Officers (Republic of South Africa, 2014). Furthermore, the size of many contracting organisations and the increased focus on construction H&S, resulted in the appointment of H&S managers, sometimes referred to as co-ordinators. However, the cidb industry report 'Construction Health & Safety Status & Recommendations' highlighted the need for professional registration of construction H&S practitioners due to, among other, the finding that there was a lack of competencies, and no formal registration process. The Council for the Built Environment (CBE) then mandated the South African Council for the Project and Construction Management Professions (SACPCMP) in terms of Act No.48 (Republic of South Africa, 2000) to register construction H&S professionals. This in turn led to the identification of three such categories of registration, namely Professional Construction Health and Safety Agent (Pr CHSA), Construction Health and Safety Manager (CHSM), and Construction Health and Safety Officer (CHSO). Registration rules were then gazetted for these three categories for commencement 1 June 2013 in the case of Pr CHSA and 1 August 2013 in the case of CHSM and CHSO.

Given the findings in the cidb report 'Construction Health & Safety Status & Recommendations' (2009), other ad-hoc research findings (Smallwood, 2009), anecdotal evidence, an exploratory study (Smallwood, 2015), a follow up study was conducted to determine, inter alia:

- The CHSAs' contribution to and impact on H&S;

- The performance of CAH&SAs;
- The frequency at which various client and designer interventions occur, and
- Interventions that could contribute to an improvement in the contribution of CHSAs to H&S and construction.

Therefore, in terms of the concept of the paper, the framework of the study is provided by the following: whether CHSAs have contributed to and impacted on H&S or not; the stage at which they are appointed, as it impacts on their capacity to contribute; their performance relative to defined knowledge and skills areas, and scope of services; the frequency at which various client and designer interventions occur as CHSAs interface with both stakeholders, and the potential of interventions to improve their knowledge and skills areas, and scope of services.

THE REVIEW OF THE LITERATURE

Legislation and regulations

The amended Construction Regulations (Republic of South Africa, 2014), lay down important requirements with respect to clients and designers, and contractors.

Clients are required to, inter alia: prepare a baseline risk assessment (BRA); prepare an H&S specification based on the BRA; provide the designer with the H&S specification; ensure that the designer takes the H&S specification into account during design; ensure that the designer carries out the duties in Regulation 6 'Duties of designers', and include the H&S specification in the tender documents. In theory, the H&S specification should schedule the residual hazards on projects. Contractor related client requirements include: ensure that potential PCs have made provision for the cost of H&S in their tenders; ensure that the PC to be appointed has the necessary competencies and resources; take reasonable steps to ensure cooperation between all contractors appointed by the client; ensure that every PC is registered for workers' compensation insurance cover and in good standing; appoint every PC in writing; discuss and negotiate with the PC the contents of the PC's H&S plan and thereafter approve it; ensure that a copy of the PC's H&S plan is available; take reasonable steps to ensure that each contractor's H&S plan is implemented and maintained; ensure that periodic H&S audits and documentation verification are conducted at agreed intervals, but at least once every 30 days; ensure that a copy of the H&S audit report is provided by the PC within seven days of the audit; stop any contractor from executing an activity which posed a threat to the H&S of persons, which is not in accordance with the H&S specification and H&S plan; when changes are made to the design or construction work provide sufficient H&S information and resources available to the PC; ensure that the H&S file is kept and maintained by the PC; when additional work is required the client must ensure that sufficient H&S information and appropriate additional resources are available to execute the work safely; in the case of a fatality or permanent disabling injury the client must ensure

that the contractor provides the provincial director with a report that includes the measures that the contractor intends to implement to ensure a healthy and safe construction site, and must ensure co-operation between all principal contractors and contractors. Furthermore, where a construction work permit is required, a client must appoint a competent person in writing as an agent, and where notification of construction work is required the client may appoint a competent person in writing as an agent. However, an agent must manage the H&S on a construction project, and be registered with a statutory body. Clearly the requirements of clients are onerous, given that they are invariably not built environment professionals, or H&S professionals.

Designers are required to, inter alia: ensure that the H&S standards incorporated into the regulations are complied with in the design; take the H&S specification into consideration; include in a report to the client before tender stage all relevant H&S information about the design that may affect the pricing of the work, the geotechnical-science aspects, and the loading that the structure is designed to withstand; inform the client of any known or anticipated dangers or hazards relating to the construction work, and make available all relevant information required for the safe execution of the work upon being designed or when the design is changed; modify the design or make use of substitute materials where the design necessitates the use of dangerous procedures or materials hazardous to H&S, and consider hazards relating to subsequent maintenance of the structure and make provision in the design for that work to be performed to minimize the risk. Therefore, hazard identification (HIRA) is of relevance in terms of the requirement to modify the design or make use of substitute materials where the design necessitates the use of dangerous procedures or materials hazardous to H&S. Furthermore, the report that is required to be submitted to the client should schedule the residual hazards on projects, which in turn should be included in the H&S specification.

Given the requirements of clients and designers, and the indirect requirements of clients because of the designer requirements, CHSAs require a range of knowledge and skills.

Knowledge and skills areas

The SACPCMP requires a report upon application to register as a CHSA that addresses the following nine knowledge areas: Procurement Management; Cost Management; Hazard Identification Management; Risk Management; Accident or Incident Investigation Management; Legislation and Regulations; Health, Hygiene and Environmental Management; Communication Management, and Emergency Preparedness Management (SACPCMP, 2013a).

The CHSA Scope of Services in turn states that CHSAs are expected to be experienced and knowledgeable relative to the following areas: construction project H&S management systems; construction H&S management; construction H&S performance measurement and monitoring, and construction H&S continual improvement (SACPCMP, 2013b).

However, a study conducted prior to the registration of CHSAs initiative by Smallwood and Haupt (2008) investigated the importance of 79 knowledge areas and 50 skills to CHSAs. These were then consolidated in terms of 8 and 7 composite areas respectively as presented in Tables 1 and 2 below.

All the composite knowledge areas have MSs > 3.00, which indicates that they are more than important as opposed to limited importance. However, it is notable that 3 / 8 (37.5%) of the composite knowledge areas have MSs > 4.20 ≤ 5.00, which indicates that they are between more than important to very / very important.

Table 1. Importance of composite knowledge areas to the management of H&S by CHSAs

Composite knowledge area	MS	Rank
OH&S	4.72	1
Project administration	4.60	2
Design	4.25	3
Law	4.10	4
Management / Management of parameters	3.79	5
Construction technology / Technology	3.68	6
Planning	3.63	7
Financial management	3.00	8
Mean	3.97	

All the composite skills areas have MSs > 3.00, which indicates that they are more than important as opposed to of limited importance, albeit in the case of 'negotiating' marginally so. However, it is notable that none of the composite skills areas have MSs > 4.20 ≤ 5.00 (between more than important to very / very important). 5 / 7 (71.4%) have MSs > 3.40 ≤ 4.20, which indicates that they are between important more than important / more than important.

Table 2. Importance of composite skills areas to the management of H&S by CHSAs

Composite skills area	MS	Rank
Interpersonal / Developmental	3.96	1
General management	3.95	2
Leadership	3.94	3
Technical	3.84	4
Planning	3.81	5
Financial	3.28	6
Negotiating	3.02	7
Mean	3.69	

RESEARCH

Research method

A self-administered questionnaire was circulated per e-mail to all the 40 CHSAs registered with the SACPCMP nationally at the time of the study. The questionnaire consisted of 22 questions, 21 of which were close ended, one being open ended. Furthermore, 10 of the 21 close-ended questions were

five or six-point Likert scale type questions. 14 Questionnaires were returned out of 40 circulated, which equates to a response rate of 35%. The relatively lengthy questionnaire may have militated against a healthy response rate. A measure of central tendency in the form of a mean score (MS) was computed to enable ranking and comparisons. The weightings relative to the five-point scale were as per the scale i.e. 1 relative to one, 2 relative to 2, and thereafter accordingly, resulting in a MS between 1.00 and 5.00. Certain questions entailed a sixth point due to either a 'have not', 'does not', or 'will not', which was weighted 0, resulting in a MS between 0.00 and 5.00. Due to the number of questions and the conference paper page limitations, only the findings relative to six questions are presented.

Research findings

Table 3 indicates the frequency at which CHSAs are appointed relative to the six stages of projects as per the respective statutory councils in South Africa. 27.3% of respondents identified each of Stage 1 'Project initiation and briefing', Stage 4 'Tender documentation and procurement' (42.9%), and Stage 5 'Construction documentation and management', followed by Stage 3 'Design development'. It is notable that none are appointed at Stage 2 'Concept and feasibility'. Ideally CHSAs should be appointed at Stage 1 'Project initiation and briefing', or at the latest Stage 2.

Table 3. Stage at which CHSAs are generally appointed

Stage	Yes (%)
1. Project initiation and briefing	27.3
2. Concept and feasibility	0.0
3. Design development	18.1
4. Tender documentation and procurement	27.3
5. Construction documentation and management	27.3
6. Project close out	0.0

Respondents were required to indicate the extent to which they have contributed to and impacted on H&S in terms of percentage responses to a scale of have not, and 1 (minor) to 5 (major), and a mean score (MS) between 0.00 and 5.00 (Table 4). Given that the MSs are > 2.50, the contribution and impact is major as opposed to minor. However, in terms of MS ranges, the MSs are > 3.34 ≤ 4.17, therefore the contribution and impact is between moderate to near major / near major.

Table 5 indicates the frequency at which various interventions / states occur in terms of percentage responses to a scale of never to rarely, and MSs between 1.00 and 5.00. It is notable that only 3 / 14 (21.4%) of the MSs > 3.00, which indicates that 78.6% of the interventions / states occur infrequently. Only 1 / 14 (7.1%) MS is > 3.40 ≤ 4.20, which indicates that optimum construction period is realised between sometimes too often / often.

Table 4. Extent to which CHSAs have contributed to and impacted on H&S

Aspect	Unsure	Have not	Minor ……..Major				MS
			1	2	3	4	5	
Contributed	0.0	21.4	0.0	14.3	28.6	28.6	7.1	3.36
Impacted	7.1	21.4	0.0	7.1	35.7	21.4	14.3	3.55

Table 5 Frequency at which various interventions / states occur

Intervention / State	Response (%)						MS	Rank
	Unsure	Never	Rarely	Sometimes	Often	Always		
Optimum construction period	7.7	7.7	15.4	15.4	23.1	30.8	3.58	1
Optimum CHSA advice to clients regarding H&S duties	0.0	0.0	28.6	35.7	14.3	21.4	3.29	2
Client assessment of contractor resources	0.0	7.1	28.6	14.3	42.9	7.1	3.14	3
Client commitment to H&S e.g. policy or goals	0.0	7.1	21.4	42.9	21.4	7.1	3.00	4
Optimum design hazard identification and risk assessment	0.0	14.3	21.4	50.0	7.1	7.1	2.71	5
Absence of design originated hazards upon construction	7.1	14.3	28.6	28.6	14.3	7.1	2.69	6
Client assessment of contractor H&S competencies	0.0	21.4	21.4	35.7	14.3	7.1	2.64	7
Optimum CHSA pre-construction H&S information	0.0	14.3	35.7	35.7	7.1	7.1	2.57	8
Optimum period to prepare before commencement on site	7.1	14.3	42.9	21.4	7.1	7.1	2.46	9
Client assessment of CHSA resources	0.0	21.4	50.0	0.0	21.4	7.1	2.43	10
Optimum design period	7.7	23.1	23.1	30.8	15.4	0.0	2.42	11
Client assessment of CHSA generic competencies	0.0	28.6	35.7	14.3	14.3	7.1	2.36	12
Client assessment of project manager H&S competencies	0.0	42.9	28.6	14.3	7.1	7.1	2.07	13
Client assessment of designer H&S competencies	7.1	42.9	28.6	7.1	7.1	7.1	2.00	14

Optimum construction period is a pre-requisite in terms of realizing optimum H&S. 6 / 14 (42.9%) MSs are > 2.60 ≤ 3.40, which indicates that the frequency of occurrence is between rarely to sometimes / sometimes - optimum CHSA advice to clients regarding H&S duties, client assessment of contractor resources, client commitment to H&S e.g. policy or goals, optimum design hazard identification and risk assessment, absence of design originated hazards upon construction, and client assessment of contractor H&S competencies. Client assessment of contractor resources and H&S competencies are legal requirements. Client commitment to H&S influences contractor H&S performance. Design hazard identification and

risk assessment is also a legal requirement and should mitigate or eliminate hazards and risks, and will influence the existence of design originated hazards upon construction. 7 / 14 (50%) MSs are > 1.80 ≤ 2.60, which indicates that the frequency of occurrence is between never to rarely / rarely. Three are state related, namely optimum CHSA pre-construction H&S information, optimum period to prepare before commencement on site, and optimum design period. Four are client assessment related, namely client assessment of: CHSA resources; CHSA generic competencies; project manager H&S competencies, and designer H&S competencies. These too are a legal requirement.

Respondents were required to rate themselves in terms of various aspects on a scale of 1 (very poor) to 5 (very good), and a MS between 1.00 and 5.00 (Table 6). 8 / 12 (66.7%) of the MSs are > 4.20 ≤ 5.00, which indicates the rating is good to very good / very good. Four of the aspects are understand and appreciate related - construction H&S, construction process, construction management, and construction activities. The other four are construction H&S competencies, designing for construction H&S competencies, resources, and construction management competencies.

4 / 12 (33.3%) have MSs > 3.40 ≤ 4.20, which indicates the rating is average to good / good – understand and appreciate project management, understand and appreciate design, project management competencies, and design competencies. It is notable that the self-rated MSs are all higher than those accorded to CHASs during a study conducted among construction project managers (CPMs) relative to the performance of CHSAs (Smallwood, 2015).

Respondents were required to indicate the extent to which the contribution of CHSAs to H&S could be improved on a scale of 1 (minor) to 5 (major), and a MS between 1.00 and 5.00. The 4.38 MS, which is > 4.20 ≤ 5.00, indicates the extent to which the contribution could be improved is between a near major extent to major / major extent.

Table 7 indicates the extent to which interventions could contribute to an improvement in the contribution of CHSAs to H&S and construction in terms of MSs based upon percentage responses to a scale of will not, and 1 (minor) to 5 (major). The MSs are between 0.00 and 5.00. It is notable that all the interventions in terms of H&S, construction, and the mean, have MSs > 2.50, which indicates that all the interventions have the potential to contribute to a major as opposed to a minor extent.

It is notable that 11 / 15 (73.3%) of the H&S MSs are > 4.17 ≤ 5.00 i.e. between a near major to major / major extent, whereas 12 / 15 (80%) of the construction and mean MSs are. It is notable that the first five mean interventions are 'participation in the early stages of projects', 'inclusion in planning activities', 'increased consultation by project management / principal agent', 'education / training relative to construction H&S', and 'inclusion in decision making'. 'Formal CHSA qualification' is ranked sixth, and 'inclusion in the management of projects' is ranked seventh, and 'optimum position in projects' hierarchies' is ranked tenth. A further four

education / training related interventions' MSs fall within this range and are ranked eighth, ninth, eleventh, and twelfth. 4 / 15 (26.7%) H&S interventions have MSs > 3.33 ≤ 4.17, which indicates they have the potential to contribute between some extent to a near major / near major extent, whereas 3 / 15 construction and mean MSs are.

Table 6. Respondents' self-rating in terms of various aspects.

Aspect	Response (%) Unsure	Very poor	Poor	Average	Good	Very good	MS	Rank
Understand and appreciate construction H&S	0.0	0.0	0.0	0.0	21.4	78.6	4.79	1
Construction H&S competencies	0.0	0.0	0.0	0.0	21.4	78.6	4.79	2
Understand and appreciate the construction process	0.0	0.0	0.0	0.0	57.1	42.9	4.43	3
Understand and appreciate construction management	0.0	0.0	7.1	0.0	42.9	50.0	4.36	4
Understand and appreciate construction activities	0.0	0.0	0.0	0.0	71.4	28.6	4.29	5
Designing for construction H&S competencies	0.0	0.0	7.1	7.1	35.7	50.0	4.29	6
Resources	0.0	0.0	0.0	7.1	64.3	28.6	4.21	7
Construction management competencies	0.0	0.0	0.0	14.3	50.0	35.7	4.21	8
Understand and appreciate project management	0.0	0.0	7.7	0.0	61.5	30.8	4.15	9
Understand and appreciate design	0.0	0.0	0.0	7.1	71.4	21.4	4.14	10
Project management competencies	0.0	0.0	7.1	21.4	42.9	28.6	3.93	11
Design competencies	0.0	0.0	7.1	21.4	64.3	7.1	3.71	12

Table 7. Extent to which interventions could contribute to an improvement in the contribution of CHSAs to H&S and construction

Intervention	H&S MS	Rank	Construction MS	Rank	Mean MS	Rank
Participation in the early stages of projects	4.57	3	4.64	1	4.61	1
Inclusion in planning activities	4.57	2	4.50	3	4.54	2=
Increased consultation by project management / principal agent	4.57	1	4.50	4	4.54	2=
Education / Training relative to construction H&S	4.36	7	4.50	2	4.43	4=
Inclusion in decision making	4.50	4	4.36	8	4.43	4=
Formal CHSA qualification	4.46	5	4.38	6	4.42	6
Inclusion in the management of projects	4.36	6	4.29	10	4.33	7
Education / Training relative to project management	4.21	10	4.43	5	4.32	8
Education / Training relative to construction management	4.21	11	4.36	7	4.29	9
Optimum position in projects' hierarchies	4.29	8	4.21	11	4.25	10
Education / Training relative to the design process	4.14	12	4.29	10	4.22	11
Education / Training relative to construction activities	4.21	9	4.21	12	4.21	12
Education / Training relative to the construction process	4.07	14	4.14	14	4.11	13=
Increased authority	4.07	13	4.14	13	4.11	13=
Optimum resources	4.00	15	4.00	15	4.00	15

DISCUSSION

Although there were only fourteen responses and the data from a minimum of thirty questionnaires should be analysed, there were only a maximum of fourty potential respondents, which represents a respectable response rate of 35%. At the very least, it can be argued that the findings are indicative in that they provide an indication of the status quo, and what interventions are required. Furthermore, given that to date, only an exploratory study has been conducted relative to CHSAs, the study has contributed to the related body of knowledge, namely construction H&S practitioners, and more specifically those that are required to be registered.

For CHSAs to be effective as per the requirements of the Construction Regulations, they need to be appointed at least at Stage 2 'Concept and feasibility', and ideally at Stage 1 'Project initiation and briefing'. This is not the case, and furthermore, 77.7% are only appointed after Stage 2.

The finding that CHSAs made between a moderate to near major / near major contribution to and impact on H&S is a notable finding. Firstly, in that it is a self-rating, yet the MSs barely fall within the range 'moderate to near major / near major', and secondly, is likely to be related to the stages when CHSAs are appointed.

Construction H&S is a multi-stakeholder issue, and stakeholders have a range of responsibilities, not least clients. Therefore, CHSAs are effectively dependent on other stakeholders in terms of performance. In fact, 78.6% of the interventions / states occur / exist infrequently. These include design HIRAs, absence of design originated hazards, and client assessment of a range of competencies and resources. The frequency of these is likely to marginalise CHSAs' contribution to and impact on H&S.

The CHSAs rated themselves good as opposed to poor with respect to the understanding and appreciating of various aspects, competencies, and resources. However, as stated earlier the self-rated MSs are all higher than those accorded to CHASs during a study conducted among construction project managers (CPMs) relative to the performance of CHSAs (Smallwood, 2015).

The extent to which CHSAs contribution to H&S could be improved, and the extent to which interventions could contribute to an improvement in their contribution to H&S and construction is such that it contradicts their rating of themselves. The extent is between near major to major / major in the case of their contribution to H&S, 60% of the interventions relative to H&S, and 80% relative to construction. These include education / training related interventions in addition to participation in the initial stages of projects, inclusion in planning activities, increased consultation by project management / principal agent, and inclusion in decision making.

CONCLUSIONS

CHSAs are mostly appointed during Stages 4 and 5, which does not enable them to influence construction H&S through design, and leads to the conclusion that they may not be viewed as being able to contribute during these stages, which the other findings underscore.

CHSAs have contributed to and impacted on H&S, which leads to the conclusion that they have a role to play relative to construction H&S, however the extent to which their contribution to H&S could be improved, and which a range of interventions could contribute to an improvement in their contribution to H&S and construction, leads to the conclusion that their contribution could be improved, and there is a need for developmental interventions.

The frequency at which most interventions / states occur / exist that impact on CHSAs and their performance, leads to the conclusion that H&S is not a project value.

However, the identification of the stages at which CHSAs have been mostly appointed, the range of interventions that could contribute to an improvement in their contribution to H&S and construction, has contributed to the closing of the gap in knowledge, and the related body of knowledge.

RECOMMENDATIONS

Given the potential of a range of education / training related interventions in terms of contributing to an improvement in the contribution of CHSAs to H&S, and construction, comprehensive holistic education and training is required for CHSAs. This would include construction management, construction project management, design, the construction process and its activities, and construction H&S. Given the reality of the existing cohort of CHSAs, continuing professional development (CPD) courses should be evolved relative to these subject areas. With respect to the future, ideally a formal tertiary education programme should be evolved.

Ideally, CHSAs should be appointed at Stage 1 'Project initiation and briefing', for the duration of a project i.e. all six stages. Furthermore, they should be afforded status equal to that of other project consultants and included in all aspects of project planning and control.

REFERENCES

Construction Industry Development Board (cidb). 2009. Construction Health & Safety in South Africa Status & Recommendations. Pretoria: cidb.

Republic of South Africa. 2000. Project and Construction Management Professions Act 2000. No. 48 of 2000. Pretoria.

Republic of South Africa. 2014. No. R. 84 Occupational Health and Safety Act. 1993 Construction Regulations 2014. Government Gazette No. 37305. Pretoria.

SACPCMP. 2013a. SACPCMP Registration application form – CHS. SACPCMP. Midrand.

SACPCMP. 2013b. Registration Rules for Construction Health and Safety Agents in terms of Section 18 (1) (c) of the Project and Construction Management Professions Act. 2000 (Act No. 48 of 2000). SACPCMP. Midrand.

Smallwood, J.J., 2009. The coordination of health and safety (H&S) and the integration of H&S into projects and the construction process. In: Proceedings CIB W99 Conference 'Working Together: Planning, Designing and Building a Healthy and Safe Construction Industry', Melbourne, Australia, 21-23 October, 12-21.

Smallwood. J.J. 2015. The Performance of Construction Health and Safety Agents (CHSAs). In: 6th International Conference on Engineering, Project, and Production Management (EEPM) 2015 Conference, Surfers Paradise, Australia, 2-4 September, 449-458.

Smallwood, J.J. and Haupt, T.C. 2008. Competencies Required to Manage Construction Health and Safety, In: Proceedings Rinker International Conference 'Evolution of and Directions in Construction Safety and Health', University of Florida, Gainesville, Florida, USA, 9-11 March, 227-240.

CONTEMPORARY ARCHITECTURAL PRACTICE IN NIGERIA: A REVIEW OF ISSUES AND CHALLENGES

Abdullahi Abubakar[1]
[1]*Department of Architecture, Ahmadu Bello University, Zaria, Nigeria*

Contemporary architectural practice in Nigeria is suffering from multifaceted problems. The paper reviews historical and contemporary architectural practice in Nigeria using secondary data from previous studies and also taps from the author's over twenty years of practice/experience in the Nigerian building industry and architectural education. Highlighting internal problems ranging from interrelationship between the architects themselves and between the architects and the Nigerian Institute of Architects (NIA)/Architects Registration Council of Nigeria (ARCON), and external problems ranging from threat of leadership of architects in the building industry and problems that are socioeconomic in nature, as some of the major problems affecting the practice. The paper recommends that schools of architecture be allowed to be independent to reflect their philosophy in order to create room for specialization and the elimination of quacks as the way forward. It concludes by emphasizing the need for all stakeholders to play their respective roles in accordance with contemporary architectural practice to overcome these problems.

Keywords: building industry, contemporary architectural practice, multifaceted problems, schools of architecture, stakeholders

INTRODUCTION

Architectural practice as we know it today is a product of colonization in most developing countries, Nigeria inclusive (Suleman and Abubakar, 2015). Contemporary architectural practice in Nigeria started in the 1940s with the commissioning of Maxwell Fry and Jane Drew to prepare master plan and design buildings for the University College Ibadan (Arayela, 2001; Olotuah, 2001). The practice passed through different stages of development, which can be broadly classified into colonial and post-colonial periods. Expatriates dominated the scene throughout the colonial periods up to the mid-seventies; this was the period that marked the end of the oil boom era. The post-colonial period may be further classified into three major

[1] abdulubale@yahoo.co.uk

Abubakar, A. (2017) Contemporary architectural practice in Nigeria: a review of issues and challenges *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 506-515.

stages that is the pre-oil boom era, the oil boom era and the post oil boom era.

The pre-oil boom era is that period from 1960 – 1967, from independence to the time of the civil war. This period marked the emergence of indigenous architectural firms in Nigeria. Although Oluwole Olumuyiwa and Associates was established in 1958 as the first indigenous architectural practitioners, others came into existences as from 1960. As at 1960 there were only two indigenous architectural practitioners, i.e. Oluwole Olumuyiwa and Associates and Alex Ekwueme and Associates. However, towards the end of the pre-oil boom era there were about eight indigenous architectural firms out of the twenty in existence then (Arayela, 2001).

The oil boom era was the period immediately after the civil war and ended towards the end of the third development plan (1970 – 1979). Within this period there were over one hundred indigenous architectural firms. This period marked the apex of architectural practice in Nigeria and only registered architects were permitted to practice and there was strict compliance with professional ethics and code of conduct (Olotuah, 2001).

Architectural practice in the post oil boom period from 1980 to date constituted the contemporary architectural practice period and is a period during which architectural practice suffered some draw backs such as decline in commissions, threat to leadership by other professionals in the building industry, lack of adherence to the ethics and codes of conduct of the profession and so on. Challenges and issues are phenomena that cannot be excluded from all human endeavours, but articulating the challenges and issues via identification, careful study and application of appropriate strategies is what makes the difference. In other words, we do have limitations in totally averting challenges/problems, but our reaction to them is what makes the difference. Hence, to succeed we must be able to identify the issues and challenges confronting contemporary architectural practice in Nigeria, only then can we come up with strategies for addressing them. In the recent past Haruna (2008), Awolere (2011) and Opoko & Oluwatayo (2015) have carried out studies regarding architectural practice in Nigeria, but, current developments lead to the need for this phenomenon to be given a closer look.

Therefore, this paper aims at evaluating contemporary architectural practice in Nigeria through the following objectives, 1) unfold the state of contemporary architectural practice, 2) identify both internal and external problems affecting architectural practice; and 3) recommend the way forward.

The study is based on purposely selected secondary data and the author's over twenty years of practice/experience in the Nigerian building industry and architectural education. The secondary data was obtained through systematic review of thesis, journal articles and periodicals; which complements the author's experience as a practitioner both in the public and private sectors, an academic and active member of the Nigerian Institute of Architects at the state and national levels. Certainly, both the data and

experience in no small major enhance the author's understanding towards the evaluation of contemporary architectural practice in Nigeria.

STATE OF THE CONTEMPORARY ARCHITECTURAL PRACTICE

As earlier stated, the contemporary architectural practice is classified under the post oil boom era, a period that marked the historic turning point in architectural practice in Nigeria, is characterized by many developmental problems (Abubakar, 2011).

Most firms are now out of business as there are no commissions to go around. Some firms have closed up; some partners have taken up jobs in the public sector, while some others have scaled down their number of staff to remain afloat, and other firms have diversified into other ventures like property development and contracting (Abubakar, 2011). Globalization with its inadvertent challenges has made this phenomenon not peculiar to the architectural practice (Awolere, 2011; Opoko & Oluwatayo, 2015).

The problem of lack of commissions did not last throughout the period, as evidenced in the establishment of the Petroleum Trust Fund (PTF) in 1996 that changed the situation. Within the period of its existence (1996 – 1999), PTF brought relief, not only to architectural practice, but to all other fields of human endeavour in Nigeria. Architectural firms were commissioned as consultants in different capacities either as project managers at the national, zonal, or state level, or as project consultants in various sectors such as health, education, military facilities and so on. During this period, the practice regained its past glory of the period before the end of the third development plan, when ethics and code of conduct were fully observed. Architectural practice during this period assumed International Standards, but this period lasted for only about three years, as the PTF was scraped in 1999 (Abubakar, 2011).

PROBLEMS AFFECTING THE CONTEMPORARY ARCHITECTURAL PRACTICE

The problems affecting contemporary architectural practices are multifaceted; these problems are discussed below under two broad categories; namely training and practice based problems.

Problems Based on the Training of Architects

Architectural training in Nigeria started at the University College Ibadan, in 1952, but was later transferred to the Ahmadu Bello University, Zaria in 1955. It is good to note that the Zaria School of Architecture was established based on the English Architectural Philosophy. This was later followed by the establishment of the School of Architecture in the University of Nigeria, Nsukka and University of Lagos in 1970, based on the American architectural philosophy. These marked the beginning of the two sets of architectural philosophies in the training of architects in Nigeria. These schools of architecture were headed by Nigerian architectural educators

trained abroad in these philosophies and they continued implementing curriculum which did not take cognizance of the socio-cultural values of Nigeria (Chukwuali, 2001). Currently this has changed; most of the Nigerian schools of architecture are headed by educators trained in Nigeria. However, there seems not to be appreciable changes in term of implementing the curriculum that puts into consideration the socio-cultural values of Nigeria (Abubakar & Suleman, 2015).

From the time architectural training started to date, there exists some remarkable changes in the development of different sectors in Nigeria, but same cannot be said of the training of architects in the Country (Amole, 2004). This is to say that the training failed to adjust to the need of contemporary Nigeria. Adeyemi (2004) confirmed that the present circumstances architects and architectural practice find themselves in, is because architectural training is not yielding to the requirements of contemporary Nigeria; especially in the area of varieties of specialization. This is to say graduates of architecture will tend to seek for employment either in the public sector or private sector as project architects, working in the studios or designing and supervising of public projects, thereby restricting the work of the architect to offer specializations like project management, landscape architecture, manufacturing sector which are left unattended as architects are not trained to pursue careers in these areas (Abubakar and Suleman, 2013).

The 21st century is the century of information technology and as such any discipline that does not restructure its curriculum in line with it will lose its relevance. In Nigeria today, very few schools of architecture can boast of having their own Computer Aided Design Laboratory and where the lab exists, it is either not having sufficient number of computers to go around the students or have inadequacy of lecturers to teach courses in the area of Computer Aided Design or both (Abubakar, 2011). This implies that most graduates of architecture are not fully equipped with the knowledge and skills required of an architect in Computer Aided Design and other design software packages. Meaning that for them to fit into practice they may have to remedy such deficiency with further education or on the job training.

Problems Based on Practice

As stated above, practice-based problems are both internal and external. The internal problems are those problems that are within the sphere of architectural practice, ranging from interrelationship between the architects themselves and between the architects and the Nigerian Institute of Architects (NIA)/Architects Registration Council of Nigeria (ARCON), and between the NIA and ARCON. While the external problems range from threat of the leadership role of architects in the building industry and problems that are socioeconomic in nature.

Internal problems

Although architects are gradually changing from the traditional approach to information technology using all the technological innovations, this is happening at a very low pace as most firms are not fully computerized

(Babadoye, 2001, Abubakar, 2011), as ICT has not been fully explored by most of the firms. In other words, most firms are not fully equipped in term of virtual modeling and other design software packages that can facilitate efficient and effective outcome that could make them more competitive in terms of service delivery required by clients that offer high profile jobs (Abubakar, 2015).

Architects are expected to relate with one another based on mutual relationship whether personal or professional relationship, adhering fully to the professional ethics and codes of conduct. But this is not the case, as you find architects accepting to negotiate outside the scale of fees just to win commission so that other architects could lose. Or you find architects having more than one commission, while other architects participate as form of assisting him/her. Also, architects are expected not to do anything which will have any negative impact on architects or architectural profession. And where architects have disagreement within themselves or with the Institute, they are expected to handle such issues in a more matured manner. In this regard, the case reported by the Daily Trust of Wednesday, January 5, 2005 comes to mind; where Arc. (Dr.) Femi Olomola addressed newsmen and challenged the request of the Lagos chapter that architects be given more responsibilities in building plan approvals, due to the fact that some architects are fond of misusing the ARCON Seal. However, Arc Patric Elikwu, a Port Harcout-based practising architect challenged him and explained that such reason is not enough to disengage from having active roles in the building approval process. Such open antagonism by two professionals in the same field will certainly damage both the image of both architects and the NIA/ARCON.

Another problem is the relationship between the architects and NIA/ARCON. Some architects are of the opinion that both NIA and ARCON are not doing enough to create a conducive environment for the architectural practice in Nigeria in particular; they have not done enough to prevent quacks from practising; as such they do not see the relevance of both the NIA and ARCON (Abubakar, 2011). As a result of which, such members no longer participate in the activities of both the NIA and ARCON. This is evidenced by the low turnout of members at the Annual General Meeting (AGM) and Biannual General Meeting (BGM) of the NIA and annual ARCON Colloquium. The implication of this is that whatever resolution is taken at the general meeting may not be implemented successfully due to noncompliance by members, unlike in the case of other professional association or institute, such as the Nigerian Bar Association (NBA) and the Institute of Chartered Accountants of Nigeria (ICAN). Also, most members once they are registered they no longer pay their annual dues (NIA, 2015) and by implication both the NIA and ARCON find it difficult to organize their activities due to financial problems.

Another issue is that number of non-registered architects (quacks) outnumbered the registered architects, and this problem tend to persist due to patronage by clients especially government agencies. To elaborate this further Shodunke (2004) asserts that the lack of commissions to the

architectural practices could be attributed to the fact that quacks are allowed to fully operate in the practice of architectural profession. Since the quacks do not have anything at stake, compliance with the professional ethics and code of conduct is not in their character.

Another internal problem that is seriously affecting architectural practice is the current crisis between the NIA and ARCON, which started sometime in the first quarter of 2016 just some few months after the current Executives of the NIA took the Oath of office; this crisis can be seen as the mother of all the internal problems, because it has caused divisions between the Nigerian architects. In fact, at every opportunity in all events, at the local (state) or national level architects bring up the issue of the crisis. The crisis is no longer just known within the architecture family, but it is widely publicized on the social media and national dailies where memos and rejoinders and counter rejoinder fly all over justifying the actions and inactions of NIA and ARCON.

At the moment, ARCON is proposing to completely take over all the delegated duties it has earlier saddled the NIA with as contained in the Architects Act of 2004 by proposing some amendments to the Act, like preparation of tutelage level: preparation for licensing of the graduands of Architecture with M. Sc. Architecture, and accreditation of schools of architecture (Dotun, 2017). As a result of this some architects filed a suit (Suit NO.FHK/L/CS/925/2017) challenging the proposal. In addition, in its effort to forestall the proposal, the NIA has called for an Emergency General Meeting (EGM) to hold on 29th July 2017 (Daily Trust, 2017) in order to table and discuss this and some other issues that caused the strained relationship between the NIA and ARCON towards finding ever lasting solution. Is the crisis impacting on architectural practice?

Certainly, the crisis is negatively impacting on the architectural practice. For example, the annual Architectural Colloquium that is usually jointly organized by ARCON and NIA, for the first time that of 2017 (held in April) was independently organised by ARCON which it has been observed that architects' attendance was not as it used to be. Other event jointly organized by both NIA and ARCON, especially the Continuous Professional Development (CPD) is also affected. It is clear that both of them have lost focus as they are now channelling their energies into fighting each other hampering the growth and development of the architectural profession instead of channelling the energies towards the external threat like territorial incursion by allied professionals and foreign firms.

External problems

Threat of leadership role posed by other professional colleagues in the Nigerian building industry is one of the external problems currently being faced by contemporary architectural practice (Adeyemi, 2004). This is pronounced with the introduction of project management specialization. Although there exist few projects where the services of a consultant project manager is required, such scenarios however no longer accord the architect the right to be the team leader, particularly where the project management

procurement method is employed as it is being observed in the traditional procurement method. The implication is that today in Nigeria there are projects where architects find themselves just as project architects. This is certainly affecting the status of the architects and indirectly reducing the dignity of architectural practice.

The other external problem is the lack of awareness of the role of an architect in the society (Abubakar, 2011). This results in clients, particularly individuals, not wanting to pay professional fees as contained in the Federal Government Approved Professional Scale of Fees leading to patronizing quacks in trying to subvert the payment of the fees. This is one of the reasons why the battle between the NIA/ARCON and quacks is not yielding a positive result, as clients are not cooperating/complying with the provisions of Architects Act 2004, especially the public clients (Abubakar, 2005).

Furthermore, Babalakin in Kayode (2015), adduced that the lack of compliance with the provisions of the Architects Act comes the operation of foreign architects not in accordance with the provisions of the Architects Act, which is a threat to the local architects' survival as a lot of architectural firms have folded up due to operation of the foreign architects.

THE WAY FORWARD

For contemporary architectural practice to be successful, the problems discussed above ought to be addressed or properly managed. According to Amole (2004), schools of architecture should be independent to reflect their own philosophies. However, bearing in mind the socio-cultural values of the country, these schools should also have focus that is beyond visual design specialization (Adeyemi, 2004). By so doing, other areas of specialization such as landscape architecture, Project Management and so on will spring up and ultimately reduce the pressure on the visual design specialization. Schools of architecture should be fully computerized to avail students of architecture the opportunity to be fully equipped with the knowledge and skills in information technology, particularly in CAD and other design software packages, while in school.

The 21st century requires that architectural practice can only remain relevant if it continue to improve clients' needs; this can be achieved through adoption and exploration of technology. In other words, architectural firms should invest heavily on ICT infrastructure in order to enhance both technical and managerial capacities, efficiently and effectively.

Architect and architectural firms may have to consider Collaboration/consolidation that could facilitate collaboration with foreign firms in order to scout for job within and outside Nigeria this will go a long way in providing more commissions for the architectural firms and invariably more employment opportunities for architects. With more commission and employment, certainly it could reduce supplanting and other unethical practices; hence, enhance the service delivery in an efficient and effective manner (Lorrimer, 2015).

The NIA should encourage its members to be channeling/discussing issues of local or national interest that could affect the integrity of architects and architecture through their respective state chapters or the executive council or at any of NIA events/meetings rather than attacking themselves via newspapers.

The NIA and ARCON should be organizing monthly, quarterly and national events that are of benefits to architects in order to keep the NIA family together as well as enhance the revenue base of both the NIA and ARCON to sustain their activities.

The Emergency General Meeting (EGM) that will hold on 29th July 2017 is a welcome development; but, the suit filed by some architects should be resolved out of court as it might tend to worsen the situation. In addition, both the state chapters and Executive Council of the NIA should mobilize architects to attend the EGM and NIA should create an enabling environment where issues will be discussed critically and objectively so that the desired outcome can be achieved at the end of the meeting.

NIA and ARCON should work together towards ensuring that quacks (unlicensed architects) are no longer patronized and especially by government agencies through the launch of an awareness campaign that ensures that registerable architects pass through the process of registration with the ARCON to become registered, and that foreign architects' operation complies with provisions of the Architects Act. This will go a long way in eliminating or reducing the number of quacks in the building industry. Also, as part of the Continued Professional Development, in addition to schools of architecture running programme in Project Management, NIA should continue to mount short courses/workshops in project management so that the threat to leadership could be lessened or eliminated.

Nigeria being a signatory to the WTO agreements, the era of protectionism seems to be over. The best way to approach the enthronement of foreign architects is to remain competitive; this can be archived by local architectural firms measuring up in terms of their capacity both human and material. The firms have to invest not only on the ICT infrastructure, but also on human capital in terms of training and retraining in order to increase technical and managerial expertise (Lorrimer, 2015).

CONCLUSION

Contemporary architecture is faced with multifaceted problems that are both internal and external in nature. To solve the problems, stakeholders most play their respective roles fully. This is to say that the NIA/ARCON have the responsibility to play their statutory roles in a symbiotic manner towards leading architects and architecture to the acme; architectural firms should invest in ICT infrastructure and human capital through training and retraining to remain competitive and afloat; the government should enforce these laws and the society to give its cooperation. Architectural education should be broadened to allow specialization beyond visual design, this will

prepare future architects to face the challenges and turn out to be of sound values, which may facilitate compliance with the ethics and code of professional conduct. By so doing contemporary architectural practice will be geared towards responding to human needs.

REFERENCES

Abubakar, A. (2011). An assessment of architectural curricula of selected Nigerian universities and its relevance to the building industry. Unpublished PhD Dissertation Submitted to School of Postgraduate Studies, Ahmadu Bello University, Zaria.

Abubakar, A. & Suleman, N. E. (2013). The state of architectural education in Nigeria: Growth and development, challenges and the way forward. *Journal of the Nigerian Institute of Architects (JNIA),* June-September, pp 49-61

Adeyemi, E. A. (2004). The NIA strategic choice of the millennium. *Conference proceeding of the Nigerian Institute of Architects 2004 Annual General Meeting held at Maiduguri, Nigeria*.

Amole, B. (2004). The Challenges of Architectural education in Nigeria today. *Conference proceeding of the Nigerian Institute of Architects 2004 Annual General Meeting held at Maiduguri, Nigeria.*

Arayela, O. (2001). An introspection into forty years of architectural practice in Nigeria (1960 – 2000) – The way forward. In Nkogwu, O. U. (Ed). *Architects and Architecture in Nigeria.* Association of Architectural Educators in Nigeria(AARCHES), 92 -95.

Architects Act Cap A19 Laws of the Federation of Nigeria 2004.

Awolere, O. O. (2011). Challenges facing architects in Nigeria. Retrieved June 18, 2017 from www.academia.edu/13534425/challenges_facing_architect_in_Nigeria

Babadoye, S. A. (2001). Emergent Trends in Computer application to architecture in Nigeria. A paper presented at the *National Conference of the Association of Architectural Educators in Nigeria (AARCHES)* held at the Federal University of Technology, Akure, 2

Chukwuali. C. B. (2001). The basic problems of architectural education: A Nigerian perspective. In Nkogwu, O. U. (Ed). *Architects and Architecture in Nigeria.* Association of Architectural Educators in Nigeria (AARCHES), 145.

Dotun, A. (2017, June 20). Exclusive! Architects in crisis as NIA, ARCON registration war gets messier. *The New Diplomat.* www.newdiplomatng.com/business/exclusive-architects-in-crisis-as-nia-arcon-registration-war-gets-messier/

Haruna, I. A. (2008). Architectural practice: The NIA point of view. Paper presented at the ARCON Colloquium, held at Shehu Musa Yaradua Center, Abuja, 1 – 3rd April 2008.

Kayode, O. (2015, December 5,). Architects advocates due process in building sector. *Daily Trust*, p. 61.

Lorrimer, L. (2015). 10 challenges facing architecture and ways to turn them into opportunities. Retrieved June 18, 2017 from www.architectureanddesign.com.au

Nigerian Institute of Architects - NIA (2015). The NIA 55th bi-annual general meeting and Conference report.

Olotuah, A. O. (2001). Architecture: Architects and contending factors: The reality of inter-professional rivalry. *Journal of Association of the Architectural Educators in Nigeria (AARCHES), 1* (6), 41 – 42.

Omolola, F. (2005, January 5,). Architects advocates due process in building sector. *Daily Trust*, p. 61.

Opoko, A. P. & Oluwatayo (2015). Architectural education for today's challenges. *Arts and Design Studies, 38*, 24-30.

Shodunke, F. (2004). Contributory factors causing joblessness for architects/architectural firms and apathy of members towards ARCON/NIA: Root causes and solutions. *Conference proceedings of the Nigerian Institute of Architects 2004 Annual General Meeting held at Maiduguri, Nigeria.*

Suleman, N. E. & Abubakar, A. (2015). Collaboration between practice and academia for the adequate training of the architect in Nigeria. *Journal of the Nigerian Institute of Architects (JNIA),*1&2, 29 – 33, September,

DESIGN INNOVATION IN STRUCTURAL ENGINEERING

Olawale, Simon O.[1] and Ogunbiyi, Moses Adebowale[2]
[1&2]Department of Civil Engineering, Osun State University, Osogbo, Nigeria

This work examines how innovations could be factored into design of structural engineering systems to provide a deviation from the codified design approaches that grossly under-utilise engineering materials and lack of optimization and reliability considerations. The paper highlights some of the innovative approaches in design and innovative construction materials. The context in which innovation as a process or concept can be used effectively is dealt with in the paper. The use of innovative materials such as Fibre Reinforced Self Compacting Concrete could be beneficial for dry joint construction which provides solution to the construction in confined places such as congested city centres. In addition, the use of numerical analytical tools interfacing with optimization and reliability analysis such as Monte Carlo simulation is highlighted. This clearly leads to design optimization that leads to efficient system and reduction of construction cost.

Keywords: design innovation,, dry joint construction,, numerical simulation,, structural engineering,

INTRODUCTION

It is important to understand the meaning of innovation before interpolating to the realm of structural engineering. Innovation is an improved way of doing old things such as processes and services with added values for the benefit of the consumers. It is clearly understood that traditional design is very conservative with the use of high safety measure with material usage in the elastic region. This leads to high construction cost and inefficient use of materials. In this respect, the present work examines some best practices that could be argued as new means of structural engineering with value addition of some sort for the benefit of the consumers. The innovation is examined on the premises of new materials that provide better performance at reduced weight and cost. Also, the new construction methodologies such as dry joint that provides more span with reduced depth leading reduced cost. Application of Finite Element Method

[1] olawales@hotmail.com
[2] moses.ogunbiyi@gmail.com; ogunbiyimoses@yahoo.com

Olawale, S. O. and Ogunbiyi, M. A. (2017) Design innovation in structural engineering *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 516-523.

of analysis provides platform for the complex interaction of structural members. This could be coupled with the reliability analysis of the engineered structures using Monte Carlos simulation or any other stochastic approach linked with structural optimisation using Genetic Algorithm or Evolutionary Genetic Algorithm for multi objective functionalities. This definitely defines the failure probability of such structures using the optimal structures.

TRADITIONAL PRACTICE

The traditional codified design approach has been the practice of most engineers across the world and most especially in Nigeria. This approach is inherent with lack of intuition of experimenting with novel approach that can be beneficial to the consumers. Although the ultimate limit state design tends to lean on reliability approach for the determination of partial factors of safety and in most cases the stress resultants from the elastic analysis using factored loads are used in design. The reason is not far-fetched because at the planning stage project cost analysis are not the priorities of planning of the project and the life cycle cost is never in the mind of the designers. It is understood that resolution of constraints, code specifications and the client's need are usually the overriding considerations. The need for innovation is seldom considered at this stage. This leaves the gap for improvement unfilled and most times opportunities are missed to have a process for value addition for the design under consideration. Although, in certain cases, nonlinearity of material and geometry are taken into consideration in stability analysis but the ultimate design is based on the use elastic stress resultants. Even, the elastic perfectly plastic material idealisation is not an ultimate realisation of material capabilities in steel for example, the material ductility that takes the response of structural members to the strain hardening realm of stress-strain relationship is never exploited by the current codified design approach.

This may be argued as charting the extreme utilisation of material but the factor of safety has discounted any excessive usage of material strength. This leaves a substantive material strength unused and on top of this is the huge factor of safety on both the materials and loadings. It is very evident that such a system of design based on codes is uneconomical despite the facts much is known of the capabilities of modern material. Although certain codes such Euro Codes provide for stability analysis that accounts for the material and geometric nonlinearities.

In many countries in the world, particularly developing and underdeveloped worlds such as Nigeria, British Standards are adopted without customising the codes provision to the situation on ground. For example, blank adoption of foreign codes without adjustment for local materials available on ground can be a dangerous proposition. Most of the research outputs from the country are of substandard and with little or no effort to explore numerical simulation that can assist greatly in coming up with innovative design concepts. Apart from the lack of adequate facilities, it is a strange concept

to many practising engineers in the countries the use of numerical modelling to solving engineering problems. The engineering bodies are virtually doing little or nothing to advance the agenda of innovative design. This is evident in the research papers published in many of the conferences organised in the country. This could be said of many developing countries. In situations where researchers are interested in the pursuant of competitive research using state of the art computing facilities, hardly can you find adequate resources such as high-powered computer software such as ANSYS [1] and ABAQUS [2] to mention but few. The laboratories in most Nigerian universities are scantly resourced with obsolete and non-functioning equipment. Where modern equipment is available, they are either not put into use because of lack of knowledge of calibration or some components are missing. In an instance, a full tri-axial machine is lying fallow in a laboratory because the engineers could not operate it. These are just some of the inherent problems facing researchers in Nigeria today and thus innovation in structural design is not explored rigorously.

Strictly speaking, innovative design can be summarised as follows according to Yusuke Yamakazi [3]:

- Innovative material-based structural components and elements, that is reusable and recyclable as social infrastructure stocks.
- Multi-functional, flexible, and long-life building systems that support to maintain and to improve urban functions.
- Maintenance and revitalization technologies for urban functions that create a new urban building industry.

INNOVATIVE MATERIALS AND DRY JOINT CONSTRUCTION

It is imperative to exploit the huge capacities in the modern materials to reduce cost and add values in term of space and aesthetics for the benefits of mankind. Some innovative materials have been found to be of great asset. Such composite material is Fibre Reinforced Self Compacting Concrete. There are other composite concretes that are of great values in term of strength and improved shear resistance. Even, the use of ceramic wastes has proven to be of great benefit to the industry with the material strength improvement in excess of 30%. Fibre Reinforced Polymer (FRP) is another innovative material for the repair of damaged concrete. This may be seen as post design and construction phases of engineering system but it requires innovative approach to accomplish the set goals. In the third world, engineering systems never perform to the end of designed life span before being degraded leading to sudden collapse. Using a product like FRP will rectify the anomalies built into the systems during design and construction phases with enhanced reliability. Ede [4] demonstrated the improved performance of strengthened cracked concrete beam using FRP that is externally bonded to the concrete surface.

The objectives of innovative structural design could be summarised into the followings:

- Reduction of the structural weight by a sizeable proportion that is beneficial to founding medium and cost
- Cost reduction of complex fabrication
- Reduction of the design, engineering, build, test & qualification time cycle by a sizeable proportion.

These objectives could be realisable through system optimisation, efficient analytical tools, statistical reliability analysis, new material developments, construction methodologies and reduction of time cycle to a nominal window. In the current situation of climate change, new materials are currently being experimented using agricultural and industrial waste products. For example, composite concrete developed from coconut fibres and lathe steel wastes are proving to be of high strength and their potential use in the blast resistant construction is looking good. Although more work needs to be done to fully characterise these materials for blast resistance design and construction but reports already published are positive indicators. Galvanized steel also is of great values in the construction industry in the developed world today. In the Asian countries, bamboo stems have been used successfully to construct fascinating and aesthetically pleasing structures. The use of many stabilising materials for soils has proven to of great value adding approach. In Nigeria, Nigeria Building and Road Research Institute has developed a methodology of constructing stabilised roads in the rural country sides without the use of any fossil materials such as asphalt [4]. These roads are proving to be durable but statistics on their long time performance are non-existent. The innovative concept of design and construction is yet to be standardised. The institute has developed pozzolanic material that can be used as cement replacement for low cost building construction [5]. This material could also be of great benefit in stabilising weak founding medium for structures. Standardising the design and construction methods for such materials is necessary in order to permit the engineers to take advantage of these innovative materials.

The utilisation of new materials is linked to the innovative structural designs. Such materials are high performance steel and advanced complex functional materials that render the attainment of wider span and higher vertical dimension beyond what could be attained some years back a reality. This is made possible because of their light weight and high strength. These materials have excellent service performance, durability and low cost maintenance. The combination of these characteristics enables few connections for rapid assembly and disassembly of buildings which reduce wastes of structural materials and components.

The concept of dry joint construction is a fascinating one more so in a restricted city centre enclaves where multi storey buildings are needed for commercial purposes. The large operational space for in-situ construction can be a constraint to such an extent that surrounding buildings

encroachment is a hindrance to the required haulage manoeuvring space for heavy duty cranes. The only solution is dry joint precast structural elements that could be assembled on site. This may not be limited to only beam and column framing but the entire building including the slab system. The use of post tensioning technology like Mac Alloy bars to hold the beam slabs together and the jointing of the beam and columns that can be a hybrid of post tensioning and in-situ construction. Although, traditional precast building construction is the moment resisting column base with a hinged connection between the beam and column. The provision of the hybrid in-situ and post tensioning mechanism using un-bonded tendon can produce a ductile connection of significant moment capacity that is quite useful in a seismic event. A particular special beam-column joint was investigated by G. Meteli and P. Riva [6] whereby the joint is characterized by the use of high strength steel bars and of a fibre reinforced grout pad in the "Z" shaped beam-column interface, increasing the shear resistance of the connection. The experimental results show a good performance of the joint, in term of resistance, ductility and energy dissipation, with little damage observed in the connected members. A pictorial view of such a joint is shown in figure 1.

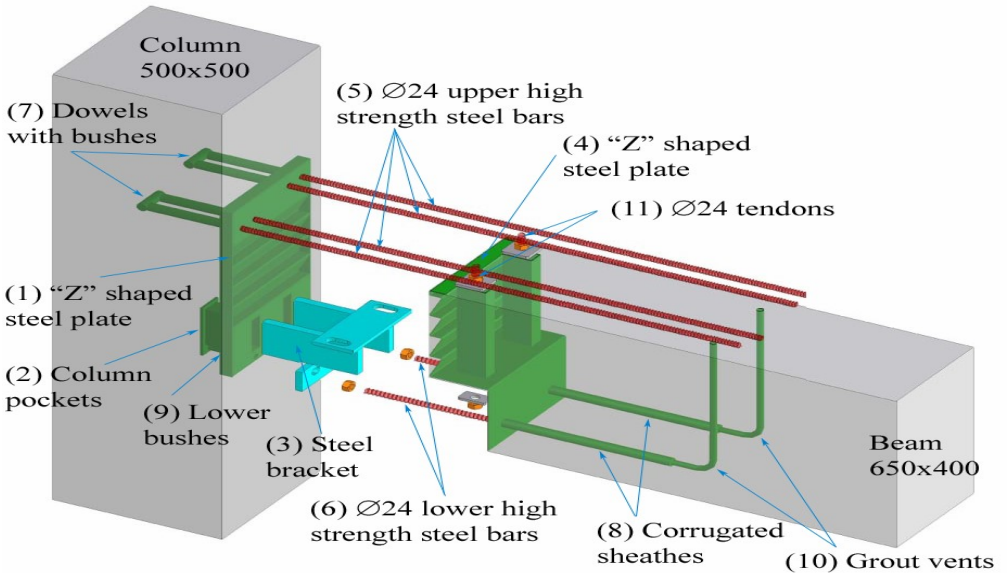


Figure 1: Details of the dry beam-column joint without rebar linkage.

It is clear that the three encapsulating philosophies of innovative design can be developed to accommodate the break downs of each of the main captions. Some of these sub themes have been highlighted earlier but it is important to expatiate to broaden the scope of the current discourse. Innovative materials have been correctly identified for an innovative design. In the current culture of prevailing climate change and environmental degradation, researchers have embarked on the research programs with the emphasis on turning waste to wealth. Among such laudable investigation are the composite concrete made from lathe waste, coco nut fibre and so

many as discussed earlier. These composite concretes are highly improved that their shear resistance is so high that fibre is suspected of providing more of the shear resistance. A self-compacting concrete used with these materials can lead to high strength and durable concrete that can improve dry joint capacity with great ductility. The modern innovation of buildings must be anchored on reusability of structural members among other important factors. This calls for limited connections that would permit rapid disassembly and reassembly that ensures limited generation of waste materials.

The second of its kind is the development of high strength light structural materials that will be capable of wide span members in ultimate limit state and the same time satisfying the serviceability limit state. Such materials must have high energy dissipation characteristics such that even in the event of seismic activities limited damage will be experienced and the building will be reusable with little retrofitting. It is important to note the current demand as a result of terrorism. The colossal loss of life and properties as a result of terrorist attacks across the globe calls for development of blast resisting materials. In Africa where technological advancement is at slow pace, the double whamming consequence of terrorist attack is very visible. The effort has to be doubled with the help of international agencies to pay more attention to the development of blast resisting materials that will improve the performance index of buildings. Although, many researchers are very much keen to search for such materials but lack of adequate equipment and computing resources has plagued their initiatives. Some of the composite concretes investigated recently have shown promising signs of their blast resisting capabilities. However, more exhaustive works need must be done to fully characterise these products. It is unfortunate to note that despite the incessant terrorist attacks in Nigeria, the government has not come to the realisation of employing engineering to fight terrorism. The effort is on humongous spending to acquire ammunitions. The emphasis on the development of high calibre materials is very elusive. The regulatory bodies for engineering in the country are in a deep slumber into the foreseeable future. They are the extensions of the political institutions in various shapes or forms. We hope they will heed the clarion calls to rise up to their original responsibilities.

APPLICATION OF NUMERICAL SIMULATION

It is important to focus on the use of technology to develop innovative design in structures and other engineering systems. The application of Finite Element Methods (FEM) is paramount to full realisation of the potential of innovative design. In fact, it is absolutely impossible to discount FEM out the equation of innovation in engineering. Ranging from inelastic analysis to the reliability analysis of engineering systems, FEM is positioned to help drive this agenda. There is no way we can rely on elastic analysis only in the drive to establish innovative design. The inelastic static and dynamic analysis (material and geometrical) could only be carried out with FEM and other versatile numerical computational approaches. For example, to

effectively simulate the reliability of new design method using Monte Carlo approach, it may be required that the system has to be analysed to its collapsed capacity for various configurations and sizes of members. These physical analyses could only be achieved through the employment of powerful analytical tools like FEM. The outputs are fed into Monte Carlo simulation computer system. In many African tertiary institutions today, hardly can one find well equipped computing laboratory to accomplish such tasks. One has to praise the courage of our researchers who persistently continue to bite the finger nails to get things done. The administrators in those institutions are concerned with the immediate benefits for themselves leaving the primary reasons of having a job in the first instance to suffer. The dry joint construction could not be fully realised without the application of FEM to fully understand the true behaviour of tensioned and non-tensioned joints. The friction surface where elements overlap cannot be fully studied without the representation of the slip surface elements in the FEM models. Ordinary classical analysis cannot avail the researchers the opportunity to fully investigate the dry slip plane interaction. In order to engineer systems to resist fire for a desired period before catastrophic collapse, FEM is the only available tool to study the collapse behaviour of various frame configurations. The likely culprit phenomenon, local buckling, in the progressive collapse of high rise steel buildings can effectively be studied using nonlinear FEM analysis. Even the business of soil-structure interaction can only be effectively investigated using FEM without recourse to extensive soil test that is time and resources consuming. It is apparent that powerful analytical tool like FEM cannot be overlooked in the drive to establish innovative design approaches for engineering systems.

Finally, Value Engineering is a driver for innovation in design and construction. It is understood to be a means of analysing alternatives to either drive the cost down with an improved performance or to improve performance without change in cost or performance remains unchanged but cost is driven down. Through the process of Value Engineering, innovation becomes a vital aspect of sourcing for alternative solution that is optimum without increasing cost and the performance is enhanced.

CONCLUSION

It has been demonstrated that design innovation will resort to added value for the engineering systems and thus the consumers will benefit immensely. Light is shed on the use of innovative materials, dry joint construction and numerical analysis to predict structural responses. In addition, reliability analysis is an important of design tool to predict how reliable any design is before being built or constructed. In the 21st century, innovative material-based building structures are solutions to urban rejuvenation and development of new cities that will reduce pressure on the land utilisation by utilising the vertical space. Value Engineering is shown to be important in structural systems design because of it enable performance enhancement and cost reduction through innovation.

REFERENCES

ANSYS Engineering Simulation Software, Pittsburgh, Canorsburg, Pennsylvania, USA, 2017

ABAQUS Engineering Simulation Software, 3DS Academy, USA

Yamakazi Y. Development of new building systems using innovative structural materials Part1, Japan.

Ede A. N. Fibre reinforced polymer (FRP) composites: Exploring the potentials for repairs of deficient RC structures in Nigeria. Journal of Civil Engineering, Publication of Nigeria Institution of Civil Engineers, vol. 7 No 1, ISSN 01897691 June 2011

Nigerian Building and Road Research Institute (NBRRI), Abuja, Nigeria

Metelli G. and Riva R. Behaviour of Beam to Column "Dry" Joint for Precast Concrete Elements, World conference on Earthquake Engineering, October 12 -17 2008, Beijing China.

DESIGN OF AN AUTOMATED STAIRCASE CLIMBER TROLLEY FOR GENERAL HOSPITALS IN DEVELOPING COUNTRIES: CASE OF AN ANONYMOUS HOSPITAL IN ZIMBABWE

T. M. Kadzunge[1], T. Mushiri[2] and C. Mbohwa[3]

[1]*Department of Mechanical Engineering, University of Zimbabwe, P.O Box MP167, Mt Pleasant, Harare, Zimbabwe*

[2,3]*Department of Mechanical Engineering, University of Johannesburg, P.O Box APK524, Johannesburg, South Africa*

The transfer of equipment between floors in many institutions that are found in developing countries is a task that is greatly dreaded. There are no adequate, efficient means to make the task bearable. Often than not employers tend to use their human labour force to complete these transfers, it comes along with many complications that might include safety risk, health complications, and risk of damaging equipment among other disadvantages. In most developing countries, there are limited escalators and elevators. This leaves stairs as the most common route of movement. One such institution is the hospital in Zimbabwe and is one of the busiest hospital in Zimbabwe with stairs linking floors in each of its buildings. In this paper, the various options of lifting mechanisms were looked at and analysed. A system that utilizes small wheels attached to a chain moving around a sprocket was selected and further developed. A power source was also added to minimize effort used by operator in the trolley function. A battery and an electric motor would achieve this. The system was also automated to give the trolley a level of intelligence that it can use to tackle any circumstances as set by the designer. The paper has cost benefits as labour cost are minimized and also the environment is safer hence saves the institution from safety penalties. This paper aims to improve the day to day running of hospital institutions such that more effort is placed on the purpose of the institution and effort is minimized on everyday tasks like shifting equipment from one floor to another.

Keywords: automated, design, developing countries, general hospital, staircase climber, trolley

[1] tawanda.mushiri@gmail.com

[2] kadzungetariro@gmail.com

[3] cmbohwa@uj.ac.za

Kadzunge, T. M., Mushiri, T. and Mbohwa, C. (2017) Design of an automated staircase climber trolley for general hospitals in developing countries: case of an anonymous hospital in Zimbabwe *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 524-542.

INTRODUCTION AND BACKGROUND

The lifting of objects, books, food and laundry to store above ground level is not an easy job, especially where there are no lifting facilities (Gaikwad, 2013). These objects may include surgical equipment, medications, sanitary equipment, dressings, charts, food, laundry etc. Hospitals in Zimbabwe are busy areas especially the General Hospitals where they cater for people coming from a wide range of places. People are always trickling in and out to get treatment. The buildings are flooded with people moving from one point to another and everyone seems to be always in a rush, both patients and hospital employees. At one point, one has to move up and down the floors either by means of elevators or by means of stairs and in other cases, an individual has to carry objects up and down the floors. To achieve the movement of objects between floors, trolleys have become common in most institution. They act as the package carrier of various goods and equipment. These trolleys differ in their sizes. Some are enormous and carry large amounts of weight from one point to another. Other trolleys are small and require one person's effort to facilitate their movement. The trolleys also differ in designs. These depend on their required function and also environments. Some trolleys are specifically for outdoor uses while other are multipurpose trolleys. In most developing countries, these trolleys are manually operated. This means that at any given time an operator has to be present to push or pull the trolley from a point to another point. This alone is tedious and time consuming. This becomes more difficult when the trolley has to move up and down the stairs. There is need for a solution to solve this problem or hindrance faced when a trolley hits an obstruction like a staircase. There is difficulty in moving hospital equipment from one floor to another

In some hospitals, elevators are present but the use of these elevators is limited. This is usually for the following reasons:

- There is an increased rate in the electricity load shedding in Zimbabwe. Some hospitals do not own backup electricity generators in case of these circumstances and some hospitals only limit the use of generators to refrigerators with medication, lighting and mortuary. This leaves stairs as the only means to move between floors. These stairs do not offer suitable terrain for most of the trolleys in hospitals.
- General Hospitals carter for a large number of people. This causes the building to be flooded most of the time. The number of people present and the number of elevators usually do not match up. It causes high congestion for the elevators. Patients and workers face prolonged delays brought about by waiting for elevators.
- Due to economic hardship in Zimbabwe, some elevators are no longer functional and have just been left with no maintenance.

It is more strenuous to carry equipment up and down stairs. This is because the stairs do not offer an appropriate terrain for the movement of trolleys.

Hence workers and patients end up taking more time and putting in more effort in moving objects up and down stairs.

Patients and hospital workers resort to using their hands and bodies to carry equipment between floors. This is a dangerous act for the following reasons:

- It is not safe
- Some of the equipment being moved between floors are sharp and dangerous. A typical example is some of the surgical equipment. People are put at the risk of hurting themselves while in the process of transporting from one floor to another. This causes an increased rate in work related injuries
- It is not healthy
- The transportation of equipment between floors sometimes causes people to come in contact with the things they are moving. This is a threat, for example, in transporting cooked food. Germs may transfer from body to food and cause diseases.
- The average weight for an individual is 65kg. In some cases, employees have to carry objects that do not tally with their weight causing great strain on the muscles. Muscle fatigue is high when people have to use manual labour to lift objects up and down stairs. This reduces productivity as the employees get tired from unnecessary events

The major objectives of this paper are:

- To design a climber that can carry a maximum load of 35kg
- To design a climber that is automated and portable
- Design a climber that has mobility and can climb up and down stairs

In Bangladesh, a climber for the stairs was developed as shown in figure 1.

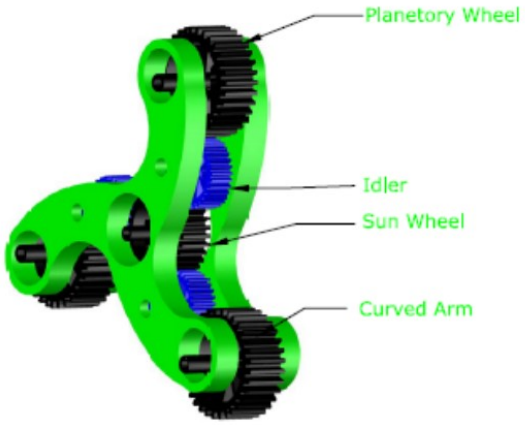


Fig 1: 3D view of wheel arrangement

The technical issues in designing of this vehicle are the stability and speed of the vehicle while climbing stairs. However, the steepness of the stairs is also the important concern of this study. The uses of this special vehicle are in the frequent lift of goods such as books for library, medicines for hospital, regular mails for any institutes, or transportation any toxic material for industries and give freedom to the retarded person or paralyzed patients to move anywhere over flat surface as well as stairs (Md. A. Hossain. Nafis A. Chowdhury, Rubaiat I. Linda, and Shamiuzzaman Akhtar, 2010). In China, they also prepare some trolleys as shown in figure 2.

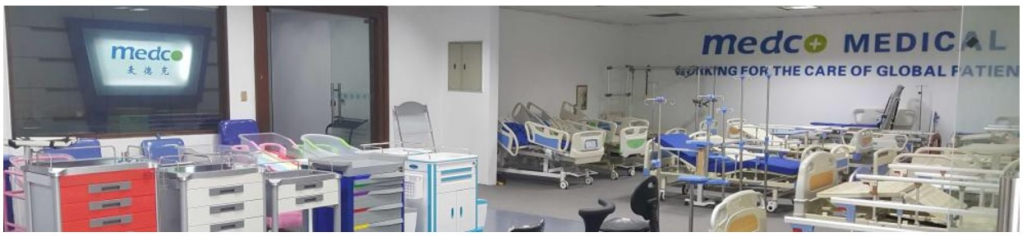


Fig 2: Audited Supplier Foshan Medco Medical Equipment Co. Ltd (Medco, 2016).

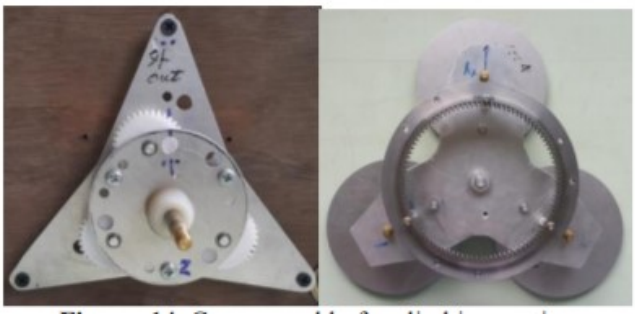


Fig 3: Prototype for climber in Japan (Aye MyaMya Thu, Than Zaw Soe, Tokuji Okada, 2016).

LITERATURE SURVEY

Stairs

Stairs are important part of a building as they lead from one floor to another and connect the different levels. A stair is constructed with steps that rise without breaking. This occurs from floor to floor. A step is a horizontal surface for the foot to facilitate ascent from one level to another (Radu, 2009). A stair is a series of steps, each elevated at a measured distance, leading from one level of structure to another (Stanford, 2007). A staircase is formed when there is a continuous section without breaking. Stairs are usually the conventional means to accessing floors in various buildings.

Elements of a stair

The horizontal element of a step is called a tread or a going. The depth of tread is the horizontal distance to the face of the riser (Bangash, 1999). The vertical element is called a riser. The external junction of the tread and riser is called the nosing. A landing is a horizontal platform of the flight at the

end or between flights. A waist is the thickness of a stair slab. A nosing is the intersection of the tread and the riser

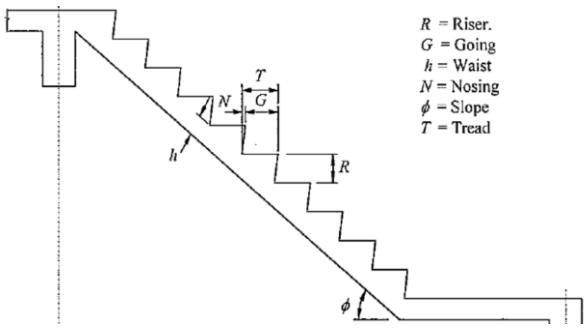


Fig. 4: Technical arrangement of a stair

Stair climber

A stair climber trolley is a type of a trolley that can be fitted with wheels or tracks or any other locomotion device to enable it to be pushed or pulled on stairs. This movement involves ascending and descending. A stair climber can be battery powered or it can be manual. The different modes of operation of the stair climber have major advantages and disadvantages and the choice of selection of a mode to use depends on various factors

MATERIALS AND METHODS

Case study visit

The type of health services offered include physical health, mental health and also involves the social wellbeing of the community. It has a capacity of about 1800 beds and the workforce present are around 2000 employees.

General problems relating to lifting

The hospital is a big one with a large coverage. Due to the great demand for health services and also the various departments, the hospitals have more than one floor. Employees and patients have to move between these floors on a daily basis. The hospitals have various lifting mechanisms for people and objects. These include elevators and stairs. Some of the elevators at the hospital are malfunctioning. The elevators available are also not sufficient enough to handle everyone that has to move between floors. They are congested on busy days and sometimes not functioning due to the load shedding programs by the country. Patients and employees end up resorting to stairs as a means of getting up and down various floors. Doctors and their assistants have to move surgical equipment to theatre rooms. Pharmacy team moves boxes of medications around the hospital to facilitate the demand in the different departments of the hospital. Tutors move charts and books to their various points of study depending on the time periods. General hands move linen around the approximately 250 beds available at the hospital. They also move food to the various wards on a daily basis. The hospital has had cases where employees have been injured whilst attempting to move objects up and down stairs. This has cost the hospital a loss in labour and also the need to treat the wounded employees. A lot of

jobs have been left unattended as the already short-staffed team tries to move equipment up and down stairs. In some instances, the equipment gets damaged in the process of transporting it from one floor to another

Dimensions of stairs

Dimensions of stairs are important as they determine the level of ease of stairs to the users. They must be able to give maximum comfort to the users. This usually depends on the use of the building itself.

Table 1: Technical specifications of the staircases

Staircase type	Rise (MAX)	Going (MAX)
Private giving single access	220	220
Common giving multi-access	190	240
Disabled	170	250
Institutional and assembly buildings	180	250
Any other type	190	250

Experiment to determine required speed of trolley

The researchers carried out an experiment to determine the speed that is required to move the trolley up and down a number of stairs using a two-wheeled trolley being manually pulled. The procedure is as follows.

1) Load the trolley with a known mass
2) Pull the trolley up a staircase
3) Time the process
4) Record the time taken to reach the last stairs
5) Repeat the process going down the stairs
6) Repeat the experiment 4 times and calculate average speed
7) Record the results

Specifications

Table 2: Experiment specifications

Specification	Quantity
Going	240mm
Rising	190mm
Load	350N
Number of steps	10
Type of trolley	Two wheeled
Total distance moved	4.3m



Fig. 5. Experiment to determine the time whilst moving a.) Up b.) Down

Table 3: Results of time in seconds up and down

	Experiment	Time/s
UP	1	36.69
	2	47.54
	3	38.23
	4	54.38
Average time		44.21
Down	1	33.30
	2	46.29
	3	25.83
	4	42.43
Average time		36.96

Speed of trolley

When going up = $\frac{4.3m}{44.21s}$

=0.0973m/s

=5.8m/min

≈ 6m/min

When going down = $\frac{4.3m}{36.96s}$

= 0.116m/s

= 6.96m/min

≈ 7m/min

RESULTS

Parameters of case and frame

Table 4: Parameter versus magnitude of the trolley under discussion

Parameter	Magnitude/mm
Width	450
Length	450
Height	1000

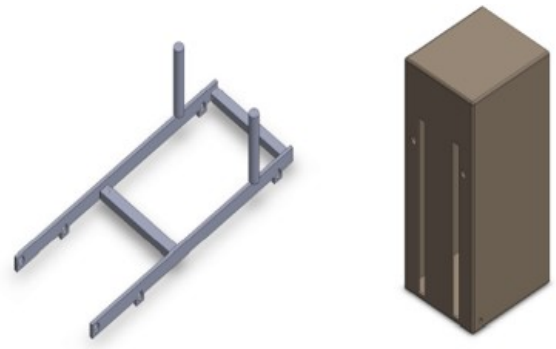


Fig 6. The trolley and case are made of aluminum alloy due to its light weight properties.

4 drive system selection

Duplex chain and sprocket drive are selected

Pitch of chain is selected as 1/2inch. This is to accommodate the desired function

Velocity ratio, V = 1 since the number of teeth is the same for both sprockets

$V = \frac{\pi DN}{60} = \frac{TpN}{60}$

Therefore number of teeth = 20

Pitch circle diameter of sprocket, d = p ×cosec (180/T)

= 12.2 × cosec (180/20)

Centre distance between the sprockets, x = 30p

= 30 × 12.2

= 366mm

To accommodate the initial sagging in the chain, the value of the centre distance is reduced by 2 to 5mm

Therefore the correct centre distance, x = (366- 4) mm

= 362mm

Shaft Analysis

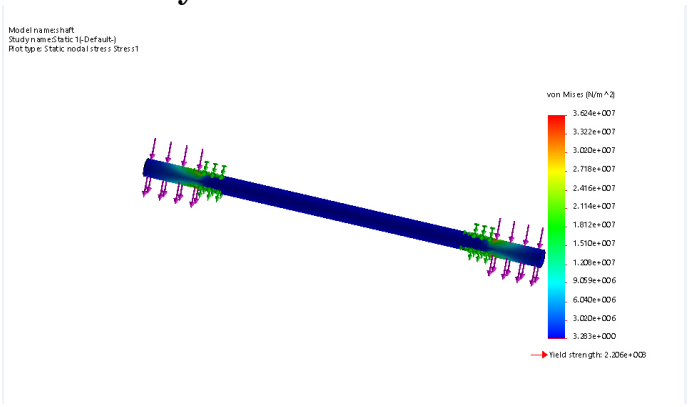
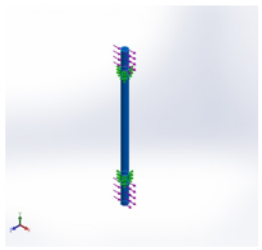


Fig 7. The von misses stresses are within the limits

Model Reference	Properties		Components
	Name: Model type: Default failure criterion: Yield strength: Tensile strength: Elastic modulus: Poisson's ratio: Mass density: Shear modulus: Thermal expansion coefficient:	Plain Carbon Steel Linear Elastic Isotropic Unknown 2.20594e+008 N/m^2 3.99826e+008 N/m^2 2.1e+011 N/m^2 0.28 7800 kg/m^3 7.9e+010 N/m^2 1.3e-005 /Kelvin	SolidBody 1(Split Line1)(shaft)
Curve Data:N/A			

Lifting arms

The lifting arms are made of the same material as the wheels. They also have the same thickness. This is to assure that the same surface is achieved for all wheels hence it can sustain the load. There are 4 lifting arms. Two are placed at each chain equidistant from one another. The lifting arms component is in the shape of a tri arm with two of the sides similar and the third part being a small wheel made of nylon. The two similar sides are rigidly fixed to the chain system while the wheel is free.

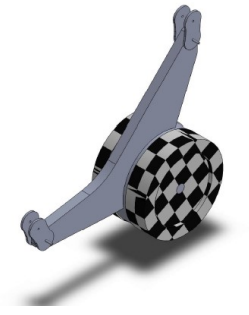


Fig. 8. Lifting arms

Selection of bearings

Selected ball bearing: SKF 6004 Open Deep Groove Ball Bearing

Specifications:

Inside diameter: 20mm

Outside diameter: 42mm

Width: 12mm

Number of bearings = 2 (2 for linking shaft with trolley)

Bearing on shafts on sprocket:

Type: Flange bearing

Selected: F605 (2 for sprocket and shaft connection)

4.6: Required speed of trolley

Since the diameter of the wheel is 100mm, the circumference becomes πd.

$C = \pi \times d$

$= \pi \times 100$

$= 314mm$

$= 0.314m$

$\approx 0.3m$

For the trolley to travel 6m in the minute, the wheels would have turned 6/0.3 revolutions

Therefore the required speed in revolutions per minute = 20rpm

Vertical hoisting motion

Power is required to lift the trolley onto one step and another.

$Hp = \frac{W \times S}{33000 \times E}$

For the trolley:

KG = lbs./2.2046

$W = 85 \times 2.2046$

$= 187.391lb$

$S = 6m/min \times 3.281ft$

$= 19.686ft/min$

$E = 0.65$

Therefore $Hp = \frac{187.391 \times 19.686}{33000 \times 0.65}$

$= 0.172$

Power required $= 0.172 \times 746W$

$= 128W$

Motor selection

The selected motor was permanent magnet synchronous dc servo

Advantages

- High efficiency
- Small in size
- Can maintain constant speed
- Little maintenance

Mounting of motor: Foot Cum Flange

From the power required a dc motor of ¼ horsepower is selected

Power source
Type: sealed gelled

The battery is a 12V battery with a current of 9A.

A battery charger is used to charge the battery.

Braking system and clutch system selection
Electromagnetic brake selected. It has an electromagnetic coil which when energized is attracted to its other plate. In between the brake are springs that return the electromagnetic coil plate to the rotating disk when there is no power hence gives grip/brake. For energy saving the brakes become on when there is no power such that when the trolley is off, the brakes are on yet there is no power that is being consumed from the battery. An electromagnetic clutch is selected. This clutch is used to engage both the normal operation and also the lifting mechanism. One clutch is utilized to minimize the weight of the trolley. This clutch at one point engages the normal operation of the trolley when the trolley is moving on a flat surface. When the trolley moves on stairs, the clutch disengages the wheels on the axle and engages the lifting mechanism. The clutch work in connection with the brakes using the logic gate system whereby only one can function while the other is dysfunctional.

Mode of operation
To move up the stairs the load is positioned in the centre of the trolley base and secured. The trolley is placed against the edge of the stair tread. The trolley is pulled back so that the stair glides rest against the step and load pulled back. The switch is pushed to go up and the lifting mechanism activates. The lifting arms rotate around the sprocket connected to the chain and contact the stair tread lifting the trolley wheels up and over the step. A change in the centre of gravity occurs and the load shifts from trolley wheels to lifting rollers. To compensate the change in the centre of gravity the weight is kept slightly towards the operator. The trolley does the lifting and operator does the balancing. The process is repeated to climb the stairs.

Electrical circuit diagrams

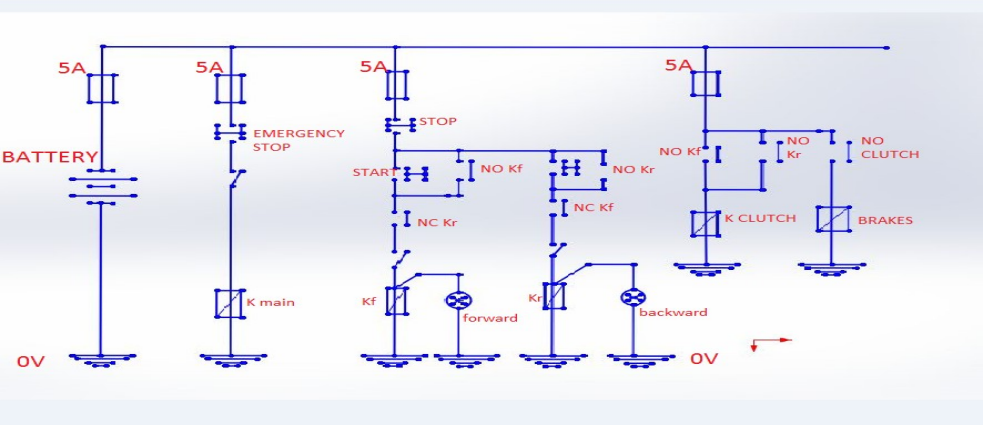


Fig. 9. Electrical circuit diagram (Courtesy of Paint on Microsoft Office)

When the emergency stop button is pressed in the trolley cannot start but it can be charged. When the emergency stop button is not pressed and the charger is not plugged in, the trolley can be started by either pressing forward or reverse button. When the forward button is pressed and the sensor is working, the trolley moves forward. The same applies in reverse. When the clutch is energized the brakes are not energized hence the brakes release. The trolley cannot go forward when running in reverse. It cannot go backward when running in forward mode. A fuse is used instead of a circuit breaker because circuit breakers are more mechanically sensitive specially to bumps. This would be a disturbance when climbing up stairs. A photocell sensor detects holes and also assists in the smooth movement of the trolley. When the charger is plugged in, the trolley cannot be activated. This is to allow the trolley to fully charge and also reduces risk of mistakenly activating the trolley components and hence waste energy. The emergency stop button is placed on handles to allow the user easy access in case of emergencies and hence prevents lapse time that can be incurred when emergency buttons are not easily accessed. Lights are incorporated to be able to notify the user of which mode is in operation (forward or reverse). This avoids cases where the trolley is in a certain mode and the operator is unaware.

Automation



Fig. 10. Process control stages

A limit switch is used as a down sensor. This sensor is used to read when the trolley comes to a step when moving down. It senses the depth of the step hence when the depth is great, it assumes it signifies the presence of a step. Another limit switch is used as a load sensor. It senses when there is load added to the trolley. If there is a load the sensor is suppressed. When there is no load the limit switch signifies no load as it is not suppressed. A photo sensor is used as an up counter to be able to notice a step/obstruction from a distance and be able to notify the actuators to activate lifting for going up. Another photo sensor is used as a down counter to be able to notice the step from a distance and be able to notify the actuators for down movement.

Controller

PIC micro controller is selected because it has a faster speed in its execution. Decision flow chat and source code are found in appendix A and B respectively. These are to be used by the trolley to assist its manoeuvre from flat surfaces onto the stair climbing. The various obstacles and parameters that the trolley might need to make an intelligent decision are considered and solutions highlighted.

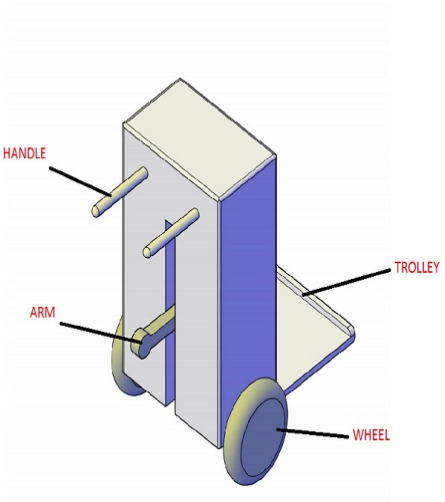


Fig. 11. Staircase designed by the researchers (Courtesy of Solidworks)

RECOMMENDATIONS AND CONCLUSIONS

Solar systems can be used as a source of power. Panels with the required capacity and areas can be placed on top of the trolley casing. The trolley can be periodically set in sunlight to accommodate recharging of the batteries. This would assist in reducing the cost of operation of the trolley. It would also add onto the sustainable development program as it would utilize renewable energy that is clean and in great abundance. Solar power operates by converting sunlight into electricity. This can be done directly using photovoltaic or indirectly using concentrated solar power. Solar power can make use of photovoltaic qualities. Photons strike the material and enough energy is added to it as to knock off the electrons. Photovoltaic convert light into electric current using the photoelectric effect. Advantages

include high power densities, no pollution, low electricity bills. Operators should have a basic training that allows them to be able to operate the system without risk to themselves or the trolley. Operators should check the trolley for any faults before using it to avoid damage that can be caused by improperly connected cables. The battery should be charged on a regular basis even when trolley is not in use as repeated discharge can result in the battery failure. The trolley should be regularly lubricated to minimize rusting and also the frame and case painted. In this project, the system utilizes small wheels attached to a chain moving around a sprocket. A battery was selected as the power source and this battery will be periodically recharged using a battery charger. An electric motor is used as the actuating system. The system was also automated to give the trolley a level of intelligence that it can use to tackle any circumstances as set by the designer. Sensors are used to be able to identify any physical parameters like distance and object identification. The sensors would send signal that can be processed and used to help the trolley make decisions. Codes were programmed that would help with the automation. The institution can minimize the cost it uses in labour and also make the environment safer to the workers. It allows more effort to be placed on the purpose of the institution and effort is minimized on everyday tasks like shifting equipment from one floor to another.

The project was a success as all components were designed to suit the required purpose and light enough so as to not add unnecessary weight to the trolley system The trolley was to be manufactured but the electromagnetic clutch and brake could not be procured on time hence prevented the manufacturing of a prototype that can be used to validate the designs and bring to surface errors in design or areas that may require improvements.

REFERENCES

Ableminded Company, LLC 2011. Scalamobil S27 stair-climbing wheelchair lift - portable climber, Abletrader, http://www.abletrader.com/listing/924/scalamobil_s27_stair_climbing_wheelchair_lift_portable_climber.html

Aye MyaMya Thu, Than Zaw Soe, Tokuji Okada 2016; Dynamic Analysis for Both Rolling and Climbing of Tri-Star Wheeled Robot; IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 13, Issue 5 Ver. III (Sep. - Oct. 2016), PP 52-62 www.iosrjournals.org

Bangash, 1999. Staircase structural analysis and design. Second ed. London: Thomson Reuters.

Fayees, 2015. Battery powered and solar powered sensors nodes. Volume 10, Issue 3

Gaikwad, A., 2013. Design of a staircase material handling system or hand truck. 2(3).

Healthy and Safety Authority, 2007. Safety, Health & Welfare in Hotels, Restaurants, Catering & Bars, USA: Prevention and Management of Workplace Bullying.Khurmi, 2005. A textbook of machine design.

Moore E.Z and Buehler M 2014, Stable Stair Climbing in a Simple Hexapod Robot. Ambulatory Robotic Lab, Centre for Intelligent Machines, McGill University Montreal, QC, H3A 2A7, CANADA, www.cim.mcgill.ca/~arlweb

Parveen, S., 2013. Wheel modification of a wheel type stair climber. Volume 3. Issue 1

Richard J. Hodes, 2011. NATIONAL INSTITUTE ON AGING NATIONAL INSTITUTES OF HEALTH, USA: DEPARTMENT OF HEALTH AND HUMAN SERVICES.

Richard S. Wellins and Paul Bernthal, 2005. EMPLOYEE ENGAGEMENT: THE KEY TO REALIZING COMPETITIVE ADVANTAGE, London: Development Dimensions International, Inc.

Radu 2009, Robotic climber for stairs. Journal of automation Volume 6 Issue 2

Rowe, M., 2013. Sensor basics,types,functions and applications. .

Safety Institute of Australia Ltd, 2012. Physical hazards: Gravitational. First ed. Australia: Safety Institute of Australia Ltd.

Shigley, 2006. Mechanical engineering design. EIGHTH ed.

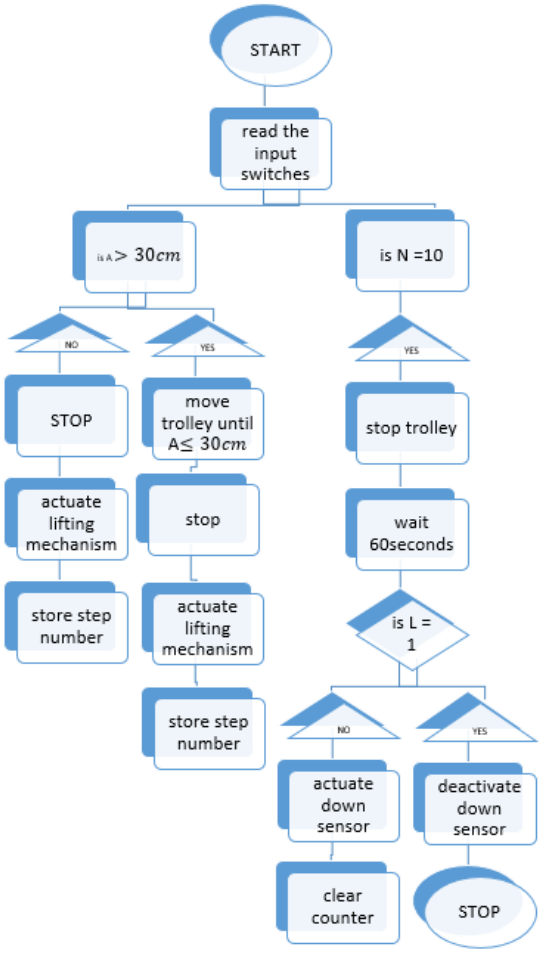
The Goodheart-Willcox Co, 2011. Stair construction. In: Stair types. London: The Goodheart-Willcox Co, p. 4.

Tokuji Okada, Wagner Tanaka Botelho, Toshimi Shimizu 2010, Motion Analysis with Experimental Verification of the Hybrid Robot PEOPLER-II for Reversible Switch between Walk and Roll on Demand, The International Journal of Robotics Research 2010 29: 1199-1221 Volume 29 Issue 9 - Publication Date: August 2010

Wildi, T., 2002. Electrical machines,drives,and power systems. 5 ed.

WorkSafeNB, 2011. HEALTH AND SAFETY ORIENTATION: WHAT YOU NEED TO KNOW, Italy: WorkSafeNB.

APPENDIX A: DECISION TREE



APPENDIX B: SOURCE CODES

TIMER SOURCE CODE:

```
void delay_50ms(void)
{// Configure Timer 0 as a 16-bit timer
   TMOD &= 0xF0;      // Clear all T0 bits (T1 left unchanged)
   TMOD |= 0x01;      // Set required T0 bits (T1 left unchanged
   ET0 = 0;           // No interrupts
                      // Values for 50 ms delay
   TH0 = 0x3C;        // Timer 0 initial value (High Byte)
   TL0 = 0xB0;        // Timer 0 initial value (Low Byte)
   TF0 = 0;           // Clear overflow flag
   TR0 = 1;           // Start timer 0
   while (TF0 == 0);  // Loop until Timer 0 overflows (TF0 == 1)
```

```
   TR0 = 0;          // Stop Timer 0}
```

SERIAL PORT CODES:

```
// serial port initializing function
void serial_init(void)
{TMOD = 0x20;        // T1 in mode 2, 8-bit auto reload
    SCON = 0x50;        // 8-bit data,  none parity bit, 1 stop bit
    TH1  = 0xFD;        //12MHz freq. 12 osc. cycle and 9600 baud rate
    TL1  = 0xFD;
    TR1  = 1;           // Run the timer}
// serial port reading function
unsigned char serial_read(void)

{bit over = 0;
    while(!RI || !over)
    {    wait(500);
        over = 1;
        RI = 0;
         return SBUF;
    }//wait some time till received flag is set and read the buffer
}
// some 'sec' milliseconds wait function
void wait (int sec)
{   unsigned int i;
    for (  i = 0; i < (sec / 50); i++   )
    { delay_50ms();   }
}
```

MAIN FUNCTION CODE:

```
//here goes the main function
void main( void )
    {
    P0 = 0;                    // initialize P0
    P1 = 0;                    // initialize P1
    P2 = 0;                    // initialize P2
```

```
while(1)
{   unsigned char val = 0x00;
    unsigned char var1 = 0x00;
    unsigned char var2 = 0x00;
    var1 = P2;              //read IR sensor
    wait(50);               // delay
    P2 = num[1];            //turn IR LED ON
    wait(200);              // delay
    var2 = P2;              //read IR sensor again
    wait(50);               // delay
    P2 = num[0];            //turn IR LED OFF

    if(var1 == num[2])
    {
       if(var2 == num[1])
          P0 = num[2];      //Set sensor error flag
      if(var2 == num[3])
          P0 = num[1];      //Set high ambiet light flag

      serial_init();
      val = serial_read();   //Read the serial port
      P1 = val;             //Command motors
   }

   if(var1 == num[0])
    {
      if(var2 == num[3])
      {
         P1 = num[4];       //drive motors backward
         wait(1000);        //delay for a second
         P1 = num[0];
      }

      if(var2 == num[1])
```

```
        {
            serial_init();
            val = serial_read();   //Read the serial port
            P1 = val;              //Command the motors
        }

        P0 = num[0];               //Set the flags to zero
      }
   }
  }
```

CIMBING CODE:

```
public static int Climber(int n)
{// More or less like a fibonacci
 if (n==1) return 1;//climb first step
 if (n=2) return 2;
 if(n=3)  return 3;
 //you only need to remember the three stirs for memory efficiency
 int[] prev={1,2,3};
 int current=3;
 while(current<n)
 {
            //Update the previous three steps!
            int preTotal=prev[0]+prev[1]+prev[2];
            //Now update prev[0] with original prev[1]
            prev[0]=prev[1];
            prev[1]=prev[2];
            prev[2]=preTotal;
            ++current
 }

 return prev[preTotal];                                    }
```

DESIGNING FOR OLD AGE IN NIGERIA

Folake Ekundayo[1]
[1]*The NHS Estates Design and Technical Services Department, St Marks Hospital, Maidenhead, Berkshire, UK. SL6 6ES*

Many Nigerians spend a considerable part of their working lives accumulating the finances to build a home to live in in their old age, and to pass on to their heirs upon their demise. However, if they were to develop some chronic illness, infirmity or disability in their latter years, there is a possibility that they could find the house they had intended to live in for the rest of their lives insupportable for their special needs, particularly if adaptability for disabled use was not part of the original design brief considerations. Using a sample of ten houses designed by Nigerian architects for private clients, the paper appraised the layouts using the Lifetime Homes standards, which was developed in the United Kingdom as a design checklist to develop homes that could be adapted to support the special needs of any resident for their lifetime. The study found that structural features such as internal steps, bath-tubs, width of corridors, and the solid blockwork walls; ironmongery – door and window handles, locking mechanisms; and water taps became obstacles in achieving successful adaptability of homes to meet the changing needs of disabled older people in Nigeria.

Keywords: accessible environment, ageing, disability, inclusive design, housing the elderly, universal design.

INTRODUCTION

Terminology

[2]Ageing or Aging – Old people have at various times been referred to as senior citizens, the elderly, the third age, older adults, retirees, geriatrics and so on., and each terminology had been acceptable at some time, and may later be considered offensive. For instance, Avers, D et al (2011) claim that the use of the term 'elderly' connotes frailty and is "ageist", and should not be used, and consider 'older person' more respectful. This frame of reference is misleading because the term "older adult" is a relative term to 'younger adult' and there is no clarity as to where the boundaries lie; and secondly,

[1] folake.isaacs@live.co.uk

[2] Ageing in this paper will be spelt using the United Kingdom English, i.e. Ageing with an "E" to indicate text from the author. The spelling without the "E" will be used if a journal or book reference title or a quotation has employed that pattern

Ekundayo, F. (2017) Designing for old age in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 543-564.

the term 'elderly' could represent anyone aged 60 and over, but there could a 30-year age gap between the people being referred to within that subset, who would be of different generations, and they would have different needs and aspirations. Therefore in this paper, the terms 'older people' and 'elderly' is not considered to connote a negative view of the category being referred to, and as such either terms will be used interchangeably to mean anyone aged over 60.

Older people are our future selves, and demographic studies reveal an ageing population. In tandem with declining birth rates and increased life expectancy, many population studies predict that in the next decade, people over 65years of age will be the dominant sector of the population in the developed and industrialised nations in Western Europe, the USA, Canada, and Australia etc., (Hanson, 2001; Frye, 2015; Gibler & Tyvimaa 2015; Rooney et al 2016). On a global scale, organisations such as HelpAge International predict that by 2022, the number of people aged over 60 will surpass 1 billion, and by 2050, there will be more people over 60 than children under 15 (HelpAge International 2012). This is unprecedented, and it is going to have major social and economic implications that will have an impact on social policy and infrastructure.

Studies in gerontology and geriatric care declare that medical conditions such as arthritis, heart disease, and dementia including Alzheimer's disease, osteoporosis, diabetes, stroke, cataracts, glaucoma and macular degeneration are more commonly found in older people (Tomaka, Thompson & Palacios 2006). Collectively, these demographic and epidemiology studies give a bleak picture of an ageing and unhealthy population across the globe. The mobility, sensory and cognitive impairments brought on by these non-communicable conditions are life-changing, and they can determine how much independence an older person can still retain over their life choices, and limit how long a person can remain in his/her own home without having to submit to some form of intervention, either in form of professional nursing care, or by the adaptation of their domestic environment (Nicholson et al, 2009; Dutton, R 2009).

According to the 2011 National Population Commission of Nigeria Census, 13.3 million people in Nigeria's working economy are aged 50 and above, and they constitute 14% of the resident population at the time. At present, 6% of this age group has some form of disability, and this figure can be expected to rise as the ageing process sets in. Bearing in mind that in sub-Saharan Africa, where little or no public-funded welfare support exists, tradition expects older people to be cared for by their younger kin. (Dokpesi, 2014; Aboderin and Hoffman, 2015). If any infirmity that could result in disability were to arise in the future, many households may find themselves ill-equipped to support their older kin; and the situation could become more challenging particularly if physical environment had neither been designed, nor had the potential to adaptable to support the special needs of the disabled.

Furthermore, because disability in Nigeria evokes sentiments ranging from sympathy and shame to stigma and outright antipathy, afflicted elderly people are more likely to be hidden away and excluded from society (Eskay et al 2012; Sango, 2013). This is even more tragic when the alienation happens at home, and they are unable to move around and care for themselves without assistance, particularly if technological aid and appliances exist to support them. .

Problem definition

Therefore, starting from the premise that ageing is inevitable and disability is a possibility, this paper will explore if Nigerian houses are adaptable for disabled use; identify barriers to flexible adaptations; and then argue the potential to adapt domestic space in Nigerian homes for disabled use ought to be fundamentally integral to the design process in order to avoid costly attempts at conversions in the future.

Essentially, an adaptable home has to support impairments in the area of (a) mobility, (b) sensory – blindness, deafness, and (c) cognitive – dementia and Alzheimer's disease. To this end, ten family houses designed by Nigerian-trained and Nigeria-based architects for private clients were selected for this exploratory study to assess how equipped and adaptable they were to accommodate the special needs of a frail or disabled elderly person. Using a two-pronged approach, the analyses will first appraise the generic characteristics of the floor plans, i.e. spatial configuration, circulation, connectivity between spaces; and secondly, the specific properties of the houses, its dimensions, components, with the focus being on its credentials in the area disability, accessibility, adaptability and inclusivity. It is intended that the generic analysis will strip bare the floor plans down to its fundamental morphological properties by using a spatial analysis system known as the Space Syntax methodology. The Space Syntax methodology was developed by architects in the University College London in the 1970s and 1980s to analyse spatial configurations of domestic and urban spaces and complex buildings by abstracting them into simpler graphical representations, which can then be interpreted in comparable terms. The ability of the houses to perform as accessible and inclusive homes will then be appraised using the Lifetime Homes Criteria, which was developed by the Joseph Rowntree Foundation and the Habinteg Housing Association in the United Kingdom as a checklist and set of guidelines to help architects and designers create adaptable homes a person can live in for their entire lifetime. The collation of the results produced a measure by which the potential ease of adaptability of a house could be determined.

LITERATURE REVIEW

Ageing and Society

Current global studies present a picture of ageing as a burden on the younger generation particularly when age-related health conditions and frailty of the older generation are taken into consideration. (Joshi 2011; Gibler et al, 2015; Pirinen, 2016; Rooney et al, 2015; Anderzhon et al 2012).

Neverthelesss, old age is celebrated and regarded with reverence and honour in traditional Nigerian society.

Different nations have differing attitudes towards taking care of the older kin. In countries in Southern Europe such as Spain, Portugal and Italy, for example, the family tends to be the main provider of housing for the older adults (Costa-Font, J et al 2007). This approach has its merits as Lund et al, (2010) stated that the social interaction due to co-residence with different family generations could arguably delay the onset of age-related disability. Nevertheless, living with the extended family is not universally desirable, and studies show a contrast amongst the older adults in countries in Western Europe like the UK, Germany, France, The Netherlands, Finland, Denmark etc., and the USA, Canada and Australia, where independent living is preferred (Gibler & Tyvimaa, 2015; Rooney et al, 2016). Unlike in Western societies, where an older person will not wish to be a 'burden' on their family and would strive for independent living, in sub-Saharan Africa (SSA), Aboderin and Hoffman (2015) remarked that independent living in SSA could be seen as "socially-tragic", and in that same vein of thought, the idea of institutional care would be regarded even more repugnant for it connotes abandonment and ostracism.

In Nigeria, as in most of Sub-Saharan Africa (SSA), irrespective of the social or economic status of an individual, tradition requires older people to be looked after by their younger kin (Dokpesi 2014). This implies a co-residence with the family. Oppong (2006) noted that whilst women tended to rely on lineal links through their children and grandchildren, older men tended to rely on lateral links thorough their partners for their old age care. As such, in relation to gender, there will have to be a difference in the way an older person's needs should be addressed.

Furthermore, current global patterns of national and international migration for economic reasons may be resulting new patterns of co-residence with non-kin. This has partly been attributed to the fact that the older person may not always be granted visas to join their families in the countries they may have emigrated to; and invariably the families may then have to resort to employing people to live with them, as a remedy against social and physical isolation, and for safety in event of an emergency situation, and /or for nursing care (Alber et al, 2010; de-Graft Aikins & Apt, 2016; Aboderin & Hoffman 2015). Even when the migration is within the same nation, the older person may still be reluctant to break up the social relationships that they had cultivated in the neighbourhoods and communities in which they had lived for decades, in exchange for integrating with their children's social network, particularly if they have no activity or stimulus to occupy their time. This is not exclusive to sub-Saharan Africa. Studies in Singapore and Finland found that older people become less adaptable to change the later they are required to make the transition, because they invariably become set in their ways, and resist the loss of control as they see it (Addae-Dappah & Khei 2001; Pirinen 2015). It has also been argued that this change of environment in old age could also have a disorienting and detrimental effect on their health and well-being,

and it may accelerate the onset of cognitive infirmities such as depression, dementia and Alzheimer's disease and ultimately death (Tomaka et al, 2006; Fayissa & Gutema, 2005; Ferrah et al, 2017).

Whilst an elderly person in Western Europe will consider "down-sizing" – i.e. moving to a smaller accommodation on retirement, (Gibler K M, Tyvimaa T, 2015), there is a tendency for the Nigerian retiree who had perhaps spent most of his/her youth and working life accumulating the finances to build a home for their future to more likely choose to "up-size" into accommodation probably larger than they had rented and lived-in, and if finances permit, would require to employ a small contingent of domestic staff to help manage the place. Notwithstanding the decision to age-in-place or relocate, to retire to a large residential property or to downsize to smaller accommodation, an individual's choice for any of these options will be limited if they experience challenges to their physical, mental and cognitive health.

The objective of this paper therefore is to make an assessment on some houses that Nigerian clients build for their retirement, and assess its capability to be inclusive and adapted for a person afflicted with age-related mobility, sensory and cognitive infirmities, and explore what barriers, if any, that would prevent them from ageing-in place.

Accessible, Adaptable, Inclusive, Universal Design and Ageing in Place.

According to the Washington Housing Survey (2010), '*accessible'* refers to the minimum dimensions required for space and architectural components, ironmongery etc., to comply with building codes for the disabled. '*Adaptable'* refers to alterations and modifications done to meet the needs of disabled people. 'Inclusive' means that there are no barriers between facilities. '*Universal Desig*n' seeks to go a step further and require that products, services and spaces should be designed to be barrier-free, i.e. accessible to all, and usable by all, and have visual appeal. With respect to housing, universal design wants spatial layouts, products, building components, appliances and technology should be designed to be accessible to all, whether with disabilities or not. In relation to housing, this means that people will be able to age-in-place, and not have to relocate.

Building Codes and Legislation

The Nigerian Building Code has very little information on inclusive environments and spaces in public space, and almost non-existent in domestic space. The South Africa National Building Regulations: Part S (2001) Facilities for Disabled Persons, has more robust guidelines. In the UK, government legislation in form of the Equalities Act 2015 (formerly the Disability Discrimination Act 1995), the Lifetime Homes Standards (LTHS), the Building Regulations Approved Document M 2- Access to and use of domestic buildings collectively give guidance to housing providers on how to provide accommodation to cater for the needs of active elderly and frail elderly people.

The Equalities Act 2015 legislates for all forms of disabilities but does not prescribe how it is to be implemented. The Lifetime Home standards (LTHS) in the UK prescribed design features with regards to access, internal circulation, fixtures and fittings, that have to be incorporated in order to make houses adaptable in the future, such that a resident would not have to relocate in event of a future ailment. LTHS prescribes features such as level thresholds, structural support for hoists, shower cubicles, wheelchair circulation, grab rails, stairlifts, platform lifts, and ergonomic ironmongery and the like. The features tend to cater more for the physical impairment, and a study by Rooney et al (2016) highlighted the fact that sensory impairments such as blindness were not catered for. Deafness tended to be addressed with technology – strobbing lights, vibrating gadgets. The Building Regulations Approved Document M Part 1 provides guidelines for ramps, handrails, sanitary facilities for the physically impaired, and recommends tactile surfaces for the visually impaired. Cognitive impairments such as dementia and Alzheimer's Disease likewise constitute a greater challenge to cater for, particularly because they manifest in a spectrum. As such, designers have to employ a process of reiteration, whereby supporting features tend to be learned from post-occupancy situations, thus resulting in bespoke and retrospective recommendations such as was occurred in a scheme designed for sufferers of autism in Sheffield, UK (Beaver, 2003; Whitehurst, 2006).

The Lifetime Home Standards

In 1991, the Joseph Rowntree Foundation, an independent organisation working to inspire social change through research, policy and practice conceived of a set of design criteria for designers to ensure that new housing was accessible for disabled people for the lifetime of the building and its users. Formerly, the Building Regulations Approved Document M for access to and the use of buildings had covered areas such as accessibility and some aspects of sensory disability like blindness. However, the LTHS brought attention to features that had to be incorporated in the original design brief to ensure that people could 'age-in-place' and not have to relocate if they became infirmed, frail or disabled. In other instances, disabled people were encouraged to live independent lives as much as possible but with support and service in supported sheltered housing. Care support could consist of help with cleaning, meals-on-wheels, shopping, or intimate care such as assistance with bathing, dressing and feeding.

The sixteen design criteria guidelines for wheelchair accessible housing covered the following areas as follows:

1. Car Parking width
2. Approach to the dwelling from parking space i.e. distance, gradients, widths
3. Approach to all entrances
4. Entrances to be wide enough and have level thresholds

5. Communal stairs and lifts (widths, handrails, risers, wheelchair platform lifts, stairlifts)
6. Internal doorways and hallways
7. Circulation spaces
8. Living spaces at entrance levels
9. Potential for entrance level bed-spaces
10. Entrance level WC and shower drainage
11. WC and bathroom walls
12. Stairs and potential through-floor lift in dwelling
13. Potential for fitting of hoists and bedroom and bathroom
14. Bathrooms
15. Glazing and window handle heights
16. Location of service controls

Registered social landlords, especially housing associations incorporated the design criteria to develop their technical guidance for briefing their architects for new build, and adapting existing housing stock. In new-build schemes, the architect had a blank canvas, and all the criteria were included as much as possible. With the existing stock, whenever buildings came for maintenance or capital programme replacement, components such as ironmongery, fixed furniture, equipment and floor and wall finishes etc., were renewed with ones easier to operate by disabled and infirmed people. For instance, bath tubs could be replaced with level-access shower cubicles or wet rooms, adjustable height kitchen worktops for wheelchair users, door and window handles and locks that were easier for arthritic hands to operate, grab rails all around the bed, bathroom and kitchen and so on. In blocks of flats, communal adaptations consisted of hydraulic lifts, through floor platform chair lifts, and stairlifts, provided there was space for a landing for the lift, enough width for stairlifts and room for a lift pit and motor room. These adaptations enabled residents to remain in their homes for longer, and such that they did not have to relocate.

The space syntax methodology

The Space Syntax Methodology was based on the Space Syntax Theory formulated by Bill Hillier and Julienne Hanson of the University College London in the 1970s to 1980s. The theory states that social effects of design can be represented and measured from the connectivity in the spatial layout of domestic and urban spaces. Several tools were generated to measure and analyse spatial morphology (Hiller and Hanson, 1984). The system maps out floor plans based on the spaces and the connections called the Convex Map, and then transfers the pattern onto a connectivity graph called the justified graph.

The space syntax methodology analyses spatial configuration in terms of the pattern of connection between spaces, and the relative position of spaces to

others within the system by reducing floor plans to graphs indicating these properties, which can then be compared. As a tool, it serves to objectify space and its attributes, which is particularly useful in domestic space that can be laden with symbolism and subjectivity. (Ekundayo, O, 2007., Isaacs-Sodeye, F, 2012).

In order to ascertain and interpret the syntax (generative rules) of spatial configuration, two concepts of representation of permeability and visibility were introduced, namely, axiality and convexity. Axiality represents a line of vision and possibility of access, whilst convexity represents a space of occupation and field of vision (Fig 1 below). In elementary terms, people occupy space convexly and move from one space to another axially. Space syntax argues that it is possible to objectively assess the differences and similarities between the generated patterns in spatial configuration using these criteria, and these characteristics in themselves can represent and embody different social purposes.

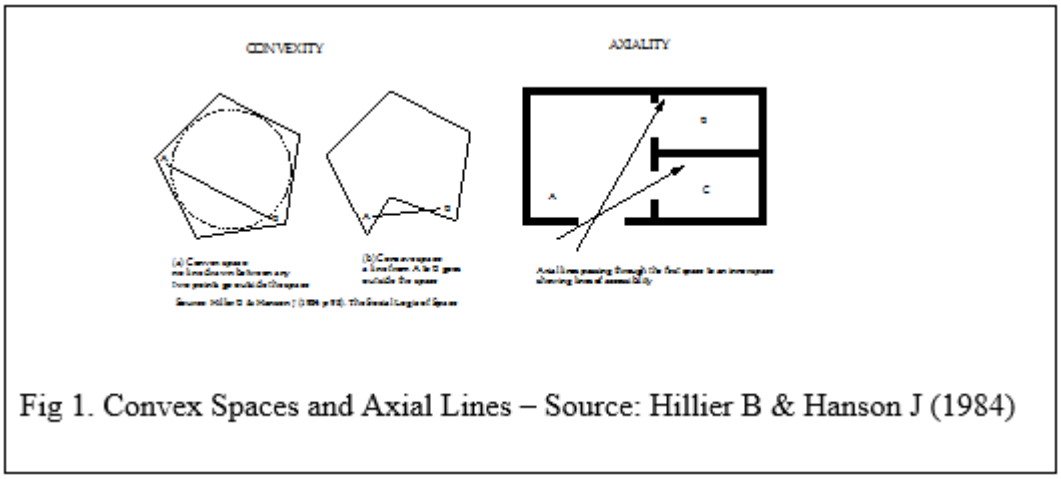


Fig 1. Convex Spaces and Axial Lines – Source: Hillier B & Hanson J (1984)

The Justified graph

Another space syntax analysis employed is the justified graph (j-graph for short). The justified access graph for interior premises is constructed by first representing the convex spaces with a circle, the connection with a line and the carrier space (usually the outside) as a circle with a cross. From the graph, the sequence of accessibility can be read, and can be interpreted as either transitional or continuous (i.e. leading to another space) or a dead-end. Fig 2 below illustrates this situation. The four plans have similar geometric and adjacency structure, but different accessibility graphs (Isaacs-Sodeye 2012).

From the graph of any given configuration, it is possible to assess the step depth of a space, connectivity and control. Step depth indicates the number of convex spaces that have to be traversed from a reference space to another. In Fig 2 above, space B is 2 steps from the entrance in Plans a, b and d, and 3 steps away in Plan c. Connectivity measures how many spaces are linked to any particular space. Also, Space A is linked to 3 spaces in Plans a and b, 2 spaces in Plan c, and 1 space in Plan d. Control measures how well a particular space permits or restricts accessibility to other spaces within the

overall system. Space A controls access to B and C in Plans a, b and c but not in d.

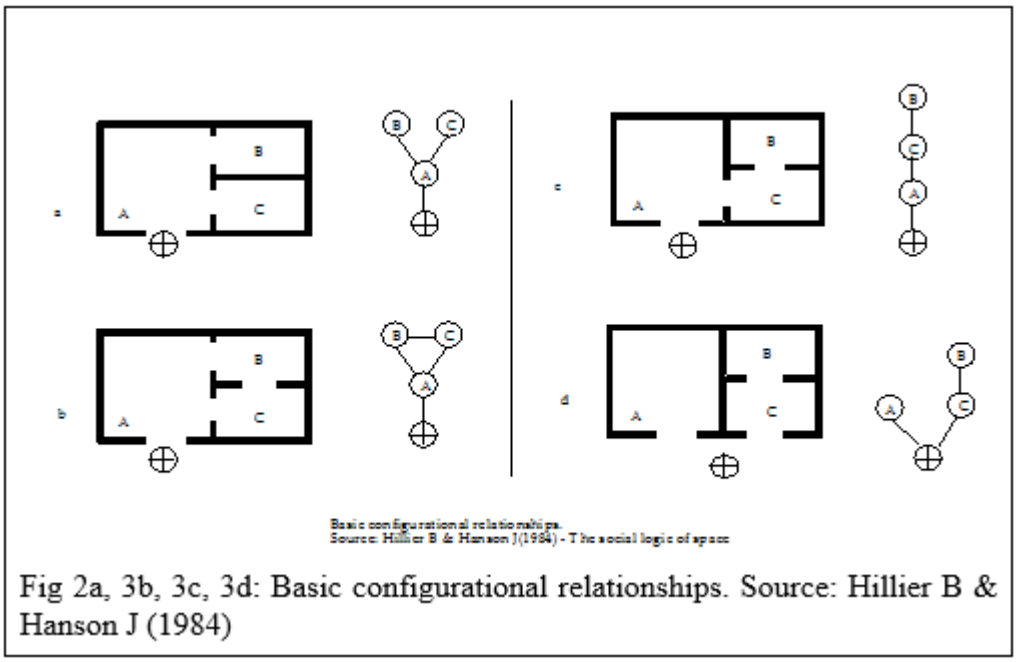


Fig 2a, 3b, 3c, 3d: Basic configurational relationships. Source: Hillier B & Hanson J (1984)

METHODOLOGY

The first stage in the analysis was to analyse a purpose-built accommodation for disabled elderly, using the Lifetime Homes Standards and the Space Syntax Tools, in order to establish a fundamental spatial benchmark or skeleton for design and comparison. It was used to assess the spatial and morphological characteristics of an adaptable home, purely as a spatial tool, and not for sociological comparison.

The second stage was to select a small group of Nigerian-based and Nigerian trained architects as survey participants. The architects had to have at least 15-20 years post-qualification experience, and be the principals in their own firms, thereby fully responsible for the decision-making process with regards to the Client brief and interpretation. The principal architects were asked to submit floor plans of houses that they had designed and built for private clients and developers for analyses using the Space Syntax tools and the Lifetime Homes checklist. The main criterion was that the houses had to be located anywhere in Nigeria, and it had to be a family accommodation, either as a single-family house or within a landlord-tenant complex.

For the qualitative data, each architect was then interviewed, guided by an open-ended questionnaire to ascertain the brief, the budget, the construction cost and the age of the Client. The architects and the firms have asked to remain anonymous, and the houses will only be identified by numbers and the location.

The result of the analyses is presented in the analyses and synthesis section.

ANALYSIS AND SYNTHESIS

The Benchmark/ Control Sample

A development consisting of 9 bungalows for disabled elderly people was built by Housing and Care 21 Housing Association in 2000 for her tenants. Ralph Grimshaw Court in Westgate-On-Sea, Kent is a Category 2 sheltered housing for the elderly; Category 1 being active elderly, and Category 2 being frail elderly. Sheltered housing is a terminology for accommodation where there is a resident warden on site to look after the residents, although they now tend to be referred to as "retirement" housing because the term "sheltered" has been said to be patronizing and one which implies vulnerability and dependence. Ralph Grimshaw Court has five –one bedroom bungalows and four – two bedroom bungalows. The second bedroom was to be the accommodation for a live-in carer or nurse.



Figure 4: Ralph Grimshaw Court, Westgate On Sea, Kent. Photographs from Housing and Care 21 website. http://www.housingandcare21.co.uk

The author of this paper was part of the project team for this scheme and worked closely with the architect and contractor for the entire duration.

The brief was to provide accommodation within a warden-controlled estate yet for independent living, with or without a live-in carer. Mobility and cognitive impairments were taken on board and the design criteria was as follows:

- It had to be a purpose-built accommodation for disabled elderly person or a couple where at least one of them had a disability.

- The disabled elderly person should be able to live independently.
- It should have a simple layout to help people with dementia
- The corridors must be wide enough to be accessible by a wheelchair user and accommodate a 1500mm diameter wheelchair turning circle.
- The doors must be wide enough for wheelchair access (926mm wide).
- It should have unbroken lengths of corridors for handrails
- Level access thresholds
- There should be no steps or changes in level within the internal circulation
- If there are staircases leading to upper floors, they must be wide enough to accommodate a stairlift or chairlift.
- Stairs to be straight flight or simple dog-leg with half-landing for ease of installation of a stairlift or chairlift.
- There should be direct vistas of adjoining spaces in order to help orientation
- There should be a direct vista of the toilet (WC) from the bed to help against incontinence
- Bathrooms and bedrooms should be adjacent in case a hoist may be installed to lift a bedridden person from their bed to the bathtub.
- If possible, install a level access shower
- If possible, install a bathtub with access from all sides for assisted bathing
- Provide accommodation for a live-in carer
- Adjustable height kitchen worktops and appliances.
- Car porch next to the entrance door.
- Lever taps for kitchen sink – for ease of operation especially arthritic hands
- Lever taps for bathroom and toilet washbasins
- Lever door handles
- Flashing lights connected to doorbells, alarms etc. for people with hearing difficulties.
- Emergency pull cords in all spaces connected to a monitoring phone line managed by a care manager.
- Movement sensors in rooms to detect signs of life
- Pressure sensors under carpets or rugs to detect signs of motion.

The floor plans were analysed using Space Syntax Convex Map, and then transferred onto the connectivity graph called the justified graph.

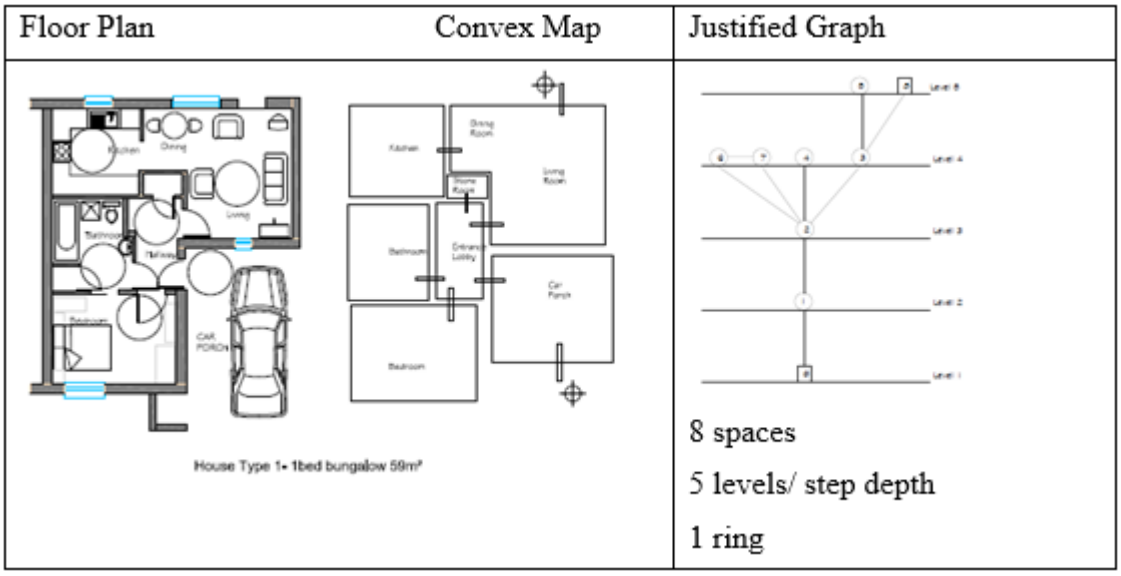


Figure 5 – Convex maps and Justified graphs of Ralph Grimshaw Bungalows

The justified graphs showed that the bungalows had a mainly tree structure with a local ring in the circulation connecting the bedroom, bathroom and hallway. Despite the open plan layout, the deepest space from the front door, which was the kitchen, was 5no step depths away.

The Nigerian Case Studies

For the Nigeria sample, 10 (ten) houses were selected by the architects and characterised as follows:

- The sites were in Lagos, Ibadan, Aba, Owerri and Shagamu, (all in South-East and South-West Nigeria).
- All the buildings were designed by Nigerian-trained and fully qualified architects who were based in and in full-time practice in Nigeria.
- Building have to have been completed, or in construction phase.
- The Client must be a private Client, i.e. not publicly funded or owned by an Institution
- The houses were single family dwellings – ranging from villas to self-contained flats
- The architects were interviewed guided by an open-ended questionnaire.

All the floor plans were also converted to convex maps and justified graphs in order to study them in comparable terms.

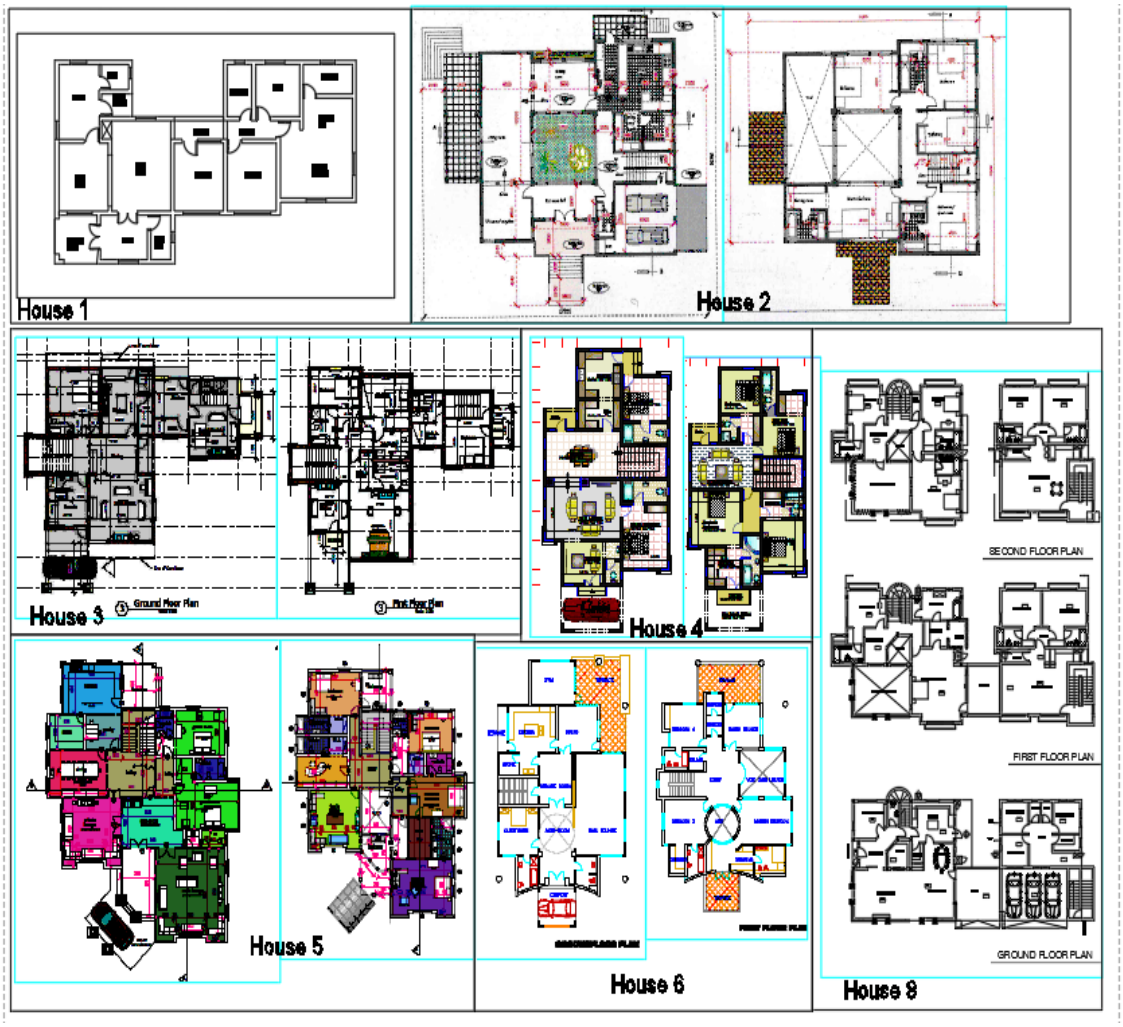


Figure 6: Floor plans

Each floor plan was checked for the features such as steps to the front entrance and steps within the circulation, width of corridors for wheelchair turning, level access thresholds, shower cubicles, vistas between bedrooms and bathrooms, width of stairs for a future stairlift, continuous lengths of walls for retrospective fixing of handrails, space for shower cubicle with the current bathroom and so on, and the potential for incorporating these features in the future.

From the j-graphs, the number of convex spaces ranged from 15 to 74, with an overall average of 36 in the Nigerian houses, compared to 8.5 for the benchmark house (Ralph Grimshaw). Similarly the number of levels houses ranged from 8 levels to 20 levels, with an average of 13 compared to 5 levels in the control house. Only 3 houses had a ring in the circulation. The other had a tree structure – i.e. a single sequence of circulation without an alternative sequence back to the original space. Seven of the Nigerian houses had 4 bedrooms, and the remaining three had five, six and seven bedrooms. The number of bathrooms ranged from 2 in two houses, to 3 in one house, 4 in five houses, 6 in one house and 7 in one house. Eight of the houses had more than one living room.

From the j-graphs, it can be seen that the main living room (blue) was at least 4 steps depths away from the front entrance (purple cross-hair), and the number of levels between the living room and the main bedroom (green) ranged from 3 in House 1 to 8 in Houses 2 and 3, whereas in comparison, the control houses had just one step. House 10 consisted of a block of self-contained flats, and the step depths between the living room and main bedroom ranged from 3 to 5.

Essentially, compared to the control houses, the Nigerian family houses appeared to be taken up with a lot of circulation and transition spaces, such as corridors, stairs, lobbies etc.

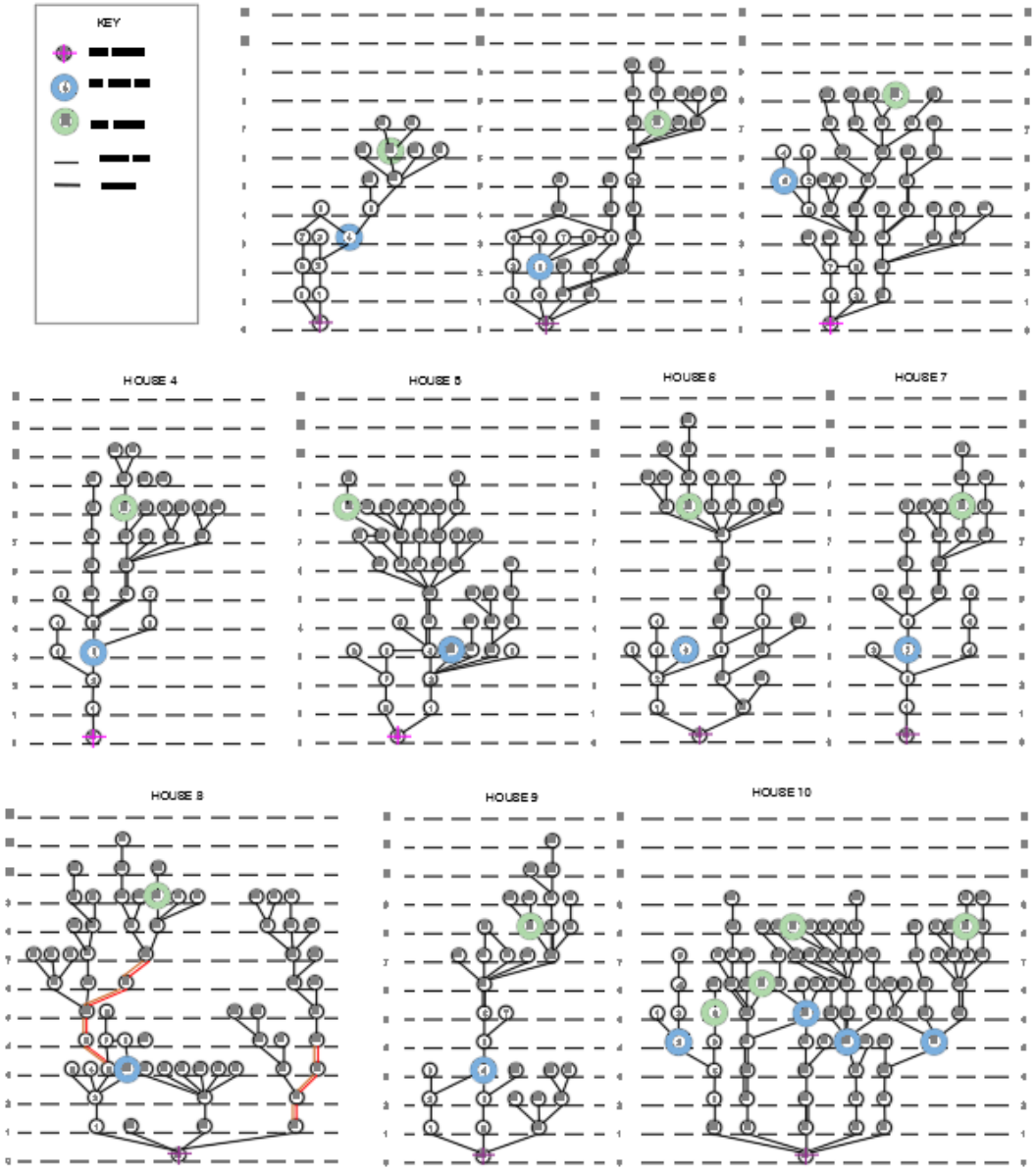


Figure 7: Justified Graphs

ANALYSIS

The ten Nigerian houses were compared against the control criteria based on Lifetime Homes Standards Guidelines and features on Ralph Grimshaw Court bungalows.

Analysis of houses against the accessible homes design criteria				HOUSE NUMBERS										For 10 houses
	CRITERIA	**RG1**	**RG2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**
Space Syntax	No of Convex Spaces	8	9	15	34	44	32	44	34	26	74	32	29	36.4
	Justified Graph Levels	5	5	8	11	14	15	13	12	12	20	13	15	13.3
	No of Rings	1	1	0	1	1	0	1	0	0	0	0	0	0.3
Construction Cost	NGN millions			10m	40m	35m	60m	100m	90m	40m	120m	50m	94m	
Description	No of living rooms	1	1	1	1	2	2	3	2	2	2	2	2	1.9
	No of bedrooms+ study	1	2	4	4	4	6	7	4	4	5	4	4	4.6
	No of bathrooms/shower rooms	1	1	2	3	4	6	7	4	4	2	4	4	4
	No of Floors	1	1	1	2	2	2	2	2	2	3	3	3	2.2
A	Client - 60+ years	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
B	Wheelchair-wide corridor -1100mm	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	
C	Wheelchair wide doorway - 900mm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
D	Continuous corridors for handrails	✓	✓	✓	✓	✗	✓	✗	✓	✓	✗	✗	✗	
E	Low or Level access thresholds to front door	✓	✓	✗	✗	✓	✗	✗	✓	✗	✓	✓	✗	
F	Internal steps	✗	✗	✓	✓	✓	✓	✗	✗	✓	✗	✗	✓	
G	Straight-flight stairs				✓									
H	Dog-leg stairs with wide landing				✓	✓	✓	✓	✓	✗	✓	✓	✓	
I	Open plan living-dining (orientation)	✓	✓		✗	✓	✗	✗	✗	✓	✓	✓	✗	
J	Direct link from dining to kitchen	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	
K	Direct vista from main bedroom to WC	✓	✓	✗	✓	✗	✓	✗	✗	✗	✗	✓	✓	
L	Space for level access shower	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	
M	Accommodation for live-in carer		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
N	Wheelchair turning circle in kitchen	✓	✓	✗	✓	✓	✓	✓	✗	✓	✗	✓	✓	
O	Wheelchair access bathroom	✓	✓	✗	✗	✗	✓	✓	✗	✓	✗	✓	✓	
P	Car porch next to entrance door	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	
Q	Space for future access ramp			✓	✗	✓	✗	✓	✓	✗	✗	✗	✓	
R	Elbow lever taps	✓	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	
S	Lever door handles	✓	✓	✗	✓	✗	✓	✗	✓	✓	✗	✓	✗	
T	Solid blockwork internal walls			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
U	Stud partition internal walls	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	
V	Possibility of platform lift				✗	✗	✗	✗	✓	✓	✓	✗	✗	
Green	Conducive	16	17	9	12	12	13	11	14	12	10	12	10	11.5
Red	Challenging			9	10	9	8	10	7	9	11	9	11	9.3
Grey	Not applicable	6	5	4		1	1	1	1	1	1	1	1	1.2
TOTAL	**Overall rating for disabled wheelchair and cognitive impairment adaptability**	**very high**	**very high**	**Med**	**Med**	**Med**	**Med**	**Low**	**High**	**Very Low**	**Low**	**Low**	**Very low**	
	Fixed layout: require major structural intervention							✓		✓	✓	✓	✓	5
	Possibility of modification - minor works			✓	✓	✓	✓		✓					5
	Possibility of retrospective installation of electronic aids and appliances			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10

Table 1: Spatial analysis of 10 Nigerian houses measured against the RG Bungalows

The 10 Nigerian houses' were appraised using LTHS criteria. The criteria that have significant effect on the structure are indicated in blue. Each building is then rated against each criterion as follows: red to represent areas of shortcomings, and green for areas of compliance. The summation of reds against greens for the criteria that will have the most consequences then determines whether the house would be conducive or challenging to adaptation. Essentially, the purpose is to measure the ease of circulation for wheelchair user including turning circles of 1500mm diameter, the

adjacency and connectivity of spaces for spatial orientation as a cognitive aid, the feasibility of installing vertical circulation, and the ease of making structural alterations such as the installation of a hoist, level access shower and ramps. Where the intervention would require major structural intervention such as widening corridors, breaking through floors and walls, the house was assessed to have shown rated as being a challenge to adaptation as a lifetime home, and where the intervention was of minor structural nature, then the house was ranked as conducive. House 1 is a bungalow and it ranked as highly conducive; 4 other houses ranked as medium, and 5 very large houses ranked as challenging.

RESULTS

From Table 1, it would appear that the houses have more conducive ratings than challenging. The wider question is whether this pattern was a random outcome or an intentional one, as the architects were not briefed to include disability aids in the property, nor is there legislation to prescribe such inclusion.

Spatial layout: Most of the houses had bedrooms with en-suite bathrooms and dressing rooms. The spatial configuration determined the ease of circulation from one space to the other. Open-plan layouts enabled wheelchair users to move from one place to other without obstruction posed by doors and corners. On the other hand, open-plan layouts can be disorienting for people with dementia, as the lack of walls does not give them a frame of reference to know where they are, and in what direction to move to.

In the Nigerian houses, open plan layouts only existed between the living and the dining rooms. The kitchen is almost always a separate space in Nigerian houses.

Structure: The use of cement sand blockwork for external and internal walls made the building layout more or less inflexible and not easily adaptable. None of the Nigerian architects in the study specified timber frame construction or plasterboard covered studwork because of the perceived susceptibility of wood based materials to rot, damp, condensation and wood boring termites.

In the same vein, the upper floors tend to be constructed of reinforced concrete blocks, not necessarily due to a requirement to support wide spans, but it because it had always been a practice employed in construction in the country. As a result, any future plan to carry out alterations to walls or floors like installing a through-floor platform lift, or hoists through walls from the bedroom to the bathrooms would be a major structural intervention.

Horizontal circulation: Several schemes used internal steps between the living room and dining room as an architectural space-defining element. Others had steps from the front porch to the entrance door. Internal steps, besides staircases, will constitute an obstacle for a person with mobility

problems, or a wheelchair user. The solution will be to install a ramp. The Nigerian National Building Code Section 7.16 stipulates a recommended gradient of 1:12 with a maximum gradient of 1:8. However, this gradient has been found to be too steep for a mechanical wheelchair user to operate unaided. The UK Approved Document M and the South Africa National Building Regulations Part S stipulate a minimum gradient of 1:15, and this has been found to be preferable, however it would require a horizontal distance 2700mm for every riser of 180mm in order to accommodate the ramp.

Vertical circulation: Only 1 of the 10 study houses was a bungalow. All the others were two and three-storey buildings, and vertical circulation was mainly dog-leg stairs with a half-landing, and a landing at top and bottom of the run of stairs.

Stairlifts and wheelchair chairlifts can be installed provided the stairs are wide enough to accommodate them, and there is landing space of a minimum of 1500mm x 1500mm at the top and bottom of the flight to park them when not in use. Unfortunately, almost all the stairs had the landing as part of the corridor either at the top or the bottom of the flight, and did not set it back to accommodate the stairlift.

Through floor platform lifts travel straight from one floor to the other. Some houses had internal atria that could be used to house the lift. However, a wheelchair platform lift and occupant is estimated to weigh about 225kg, and this means that structure needs to have the capacity to support both the live and dead load.

Infrastructure – Plumbing and mechanical services: The Nigerian National Building Code does not give guidance on domestic shower rooms. However, the UK Approved Document M (2010), and the South-Africa Part S National Building Regulations stipulate that a shower room for a disabled wheelchair user should measure at least 2200mm deep by 2000mm wide. If it is going to have a WC in it the size will increase to 2500mm wide by 2400mm deep. This allows the wheelchair user to transfer unaided from the wheelchair to the WC and to the shower seat. 8 of the 10 study houses had enough space to accommodate shower room on plan. However, because the floor is made up of reinforced concrete, it may not be possible to have the natural falls in the screed to provide drainage to the shower drainage outlet.

None of the architects used elbow lever taps for the sinks or wash basins. Elbow lever taps are easier for people suffering from arthritic joint problems in their hands to operate. Such components can be fitted retrospectively.

Infrastructure – Electrical services: Electrical fittings such as emergency alarms, movement sensors, flashing lights for door bells for the hearing impaired are found in sheltered and supported housing as part of the management features. These items can be fitted retrospectively on surface-mounted electrical trunking if needed, provided the incoming electrical circuit board has enough capacity to take the additional load.

Ironmongery: Lever door and window handles are most comfortable for disabled users to operate as all that is required is to lift the lever up or down. These components may be fitted retrospectively, but it is there is the likelihood that the new ironmongery may not be compatible with the mechanism that operates the hinges, espagnolette bolts and locks. Therefore the entire door or window may need to be replaced. Provided the width of the door and window meet the appropriate sizes, there will be no requirement for a structural alteration to the lintel, so this can be done without much difficulty. Components such as grab rails next to beds and WCs, or anywhere where a person would have to rise from a sitting position can also be fitted retrospectively, but it would have to be drilled into solid block walls.

DISCUSSION AND CONCLUSION

In order to apply these elements into housing development in Nigeria, it is best done at the briefing stage to the architect. Building construction in cement-sand blockwork and reinforced concrete floors and steel frame structure systems are not easily adaptable without considerable expense.

Clients generally tend to brief their architect to design a property suitable for their current needs, and rarely consider a future where they could suffer afflictions in old age. The only exception will be if they had a relative who was afflicted with some disability, sensory or cognitive impairment, or chronic health condition and would require the installation of disability aids, but even then, such features will be restricted to the private chambers of the afflicted person, and rarely would the entire house be adapted to support those disabilities.

The architects in the study claimed that a general ambivalence, and perhaps antipathy of clients towards disability issues will hinder them from prescribing or even suggesting accessible and inclusive features in their designs, and it stands to reason that no architect will wish to alienate their clients. For example, despite the risk of slips, falls and serious injury at home, several clients desired features such split levels, marble stairs; glossy ceramic floor finishes in their homes. This also suggests that even in houses that ranked as conducive for potential adaptability, it would appear that this has been achieved by accident and not by design.

Whilst on one hand, it will be beneficial for public perception and attitudes to change in the need to develop inclusive homes, it is perhaps even more crucial on the other hand that the current Nigerian National Building Codes keep abreast of current and evolving technical design guidelines and regulations, and seek to introduce legislation that promotes the incorporation of inclusive space standards and components in order to ensure the future-proofing of domestic homes.

Until such a time when attitudes will change and when policy and legislation will protect the vulnerable, architects in practice and in education can be pro-active and take the initiative and creatively incorporate inclusive, accessible and adaptable elements in their designs.

The limitation of this study is that it has focused only on the architects and designers viewpoint. The users and clients were not interviewed. It is intended that future study will include the viewpoint of users and clients and their families, particularly those with infirmed elderly.

In conclusion, growing old is inevitable, but ageing is not an impairment, and as such no one would have to be excluded from the access and use of space and facilities, least of all, in their own homes if the potential for adaptability is inherent in the design. It therefore makes sense to plan inclusive domestic spaces in Nigeria, because planning for the special needs of the elderly is planning for our future selves.

REFERENCES

Aboderin, I (2010). Poverty in old age in sub-Saharan Africa: examining the impacts of gender with particular reference to Ghana: In S. Chant (d), *International Handbook of Gender and Poverty*. (pp. 215-219). Cheltenham, GB: Edward Elgar.

Aboderin, I & Hoffman, J. (20150. Families, intergenerational bonds and aging in sub-Saharan Africa. *Canadian Journal on Aging/ La Revue Canadienne du viellissement,* 34: 282-289.

Addae-Dappah K, Khei Mie Wong G (2001)- Housing and the elderly in Singapore: Financial and Quality of life implications of ageing in place. *Journal of Housing and the Built Environment*; June 2001; 16 (2), 153-178.

Avers, D., Brown, M., Chui, K., Wing, R., Lusardi, M (2011) – Use of the Term "Elderly". *Journal of Geriatric Physical Therapy*: 34 (4),153-154.

Alber, Erdmute., Haberlein, T., Martin, J (2010)- Changing Webs of Kinship: Spotlights on West Africa. Africa *Spectrum,* Vol. 4, No 3, Continuities, Dislocations and Transformations: 50 Years of Independence in Africa, pp. 43-67. Published by Institute of African Affairs at GIGA, Hamburg/ Germany. URL: http://www.jstor.org/stable/41336265

Anderzhon, J.W; Hughes, E; Judd, S; Kiyota, E; Wijnties, M (2012)- *Designing for Aging*. International case studies of building and program, John Wiley and Sons.

Beaver, C (2006) – Designing Environments for children and adults with Autistic Spectrum Disorder. Paper delivered at the 2nd World Autism Congress and Exhibition.

The Building Regulations 2010 Approved Document M- Volume 1: Dwellings. Access to and use of buildings.

Costa-Font J, Elvira D, Mascarilla M O (2009) – Ageing in Place. Exploring Elderly People's Housing Preferences in Spain. *Urban Studies* 46(2),295-316

De-Graft Aikins, A and Apt, N.A (2016) – Aging in Ghana. Setting Priorities for Research, Intervention and Policy. *Ghana Studies*. Volume 19, 2016

Dokpesi, A. O. (2015). The future of Elderly Care in Nigeria: Borrowing a Leaf from a Foreign Land. *Ageing International*. 40 (2), 81-97.

Dutton, R (2009) – 'Extra Care' Housing and People with Dementia: A scoping Review of the Literature 1998-2008. A Housing 21 Report commissioned by the Housing and Dementia Research Consortium and funded by the Joseph Rowntree Foundation. URL: www.housingLIN.org.uk/Topics/browse/HousingExtraCare/Evaluation

Ekundayo, O.O (2007) Status, Solidarity and Social Mobility in Domestic Space. A comparative study of kitchens, cooking and culinary practice in Ile-Ife, Nigeria. unpublished PhD Thesis held at Senate House, University of London

Eskay, M., Onu, V., Igbo, J.N., Obiyo, N., Uguwanyi, L (2012) – Disability within the African Culture. *US-China Education Review* B 4 :473-484. www.files.eric.ed.gov.

Fayissa B & Gutema P (2005) – The Determinants of Health Status is Sub-Saharan Africa. *The American Economist*, 49 (2),60-66

Federal Republic of Nigeria National Building Code. 2006. Ministry of Housing and Urban Development, Abuja. Published by Alexis Nexis. Butterworths.

Ferrah, N; Ibrahim J E, Kipsaina C, Bugeja L (2017) – Death following recent admission into nursing home from community living: A systematic review into the transition process. *Journal of Aging and Healthy*. 1-21. Journals.sagepub.com/home/jah

Frye,A (2015) – Planning for our future selves: The mobility needs of an ageing population. Conference Paper. Research Gate. https://www.researchgate.net/publication/301955837

Gibler K M, Tyvimaa T (2015). Middle-Aged and Elderly Finnish Households considering moving, their preferences and potential downsizing among changing life course and housing career. *Journal of Housing for the Elderly*, 29:4 373-395.

Housing 21, Technical Design Guide (2000). Housing and Care 21 Housing Association.

Hanson, J. (1998) *Decoding Homes and Houses:* Cambridge University Press.

Hanson, J. (2001) – From Sheltered Housing to Lifetime Homes: an anatomy of - UCL Discovery http://www.discovery.ucl.ac.uk/3851/1/3865.pdf

HelpAge International (2012). Ageing in the Twenty-First Century. A Celebration and A Challenge. United Nations Population Fund (UNFPA), New York and HelpAge International, London

Hillier, B. and Hanson, J. (1984) The social logic of space, edn. Cambridge: Cambridge University Press.

Isaacs-Sodeye F.O (2012). The Kitchen in Domestic Space: A comparative study of kitchens, cooking and culinary practice in Ile-Ife, Nigeria. Edited by Laryea, S., Agyepong, S.A., Leiringer, R. and Hughes, W., Proceedings – 4th West Africa Built Environment Research (WABER) Conference, Abuja, Nigeria, pp 589- 605.

Joshi, A.K (2011) – Globalization and Ageing in India. *The International Journal of Social Quality*, 1 (1),33-44

Lifetime Homes Design Guide (2011). Habinteg

Lund, R; Nilsson, C J; Avlund K (2010) – Can the higher risk of disability onset among older people who live alone be alleviated by strong social relations? A longitudinal study of non-disabled men and women. *Age and Ageing.* 39 (3); 319-326

National Population Commission, Nigeria. National and State Population analyses of the 2006 Census.

National Building Regulations of the Republic of South Africa. Part S: Standards Electrical, Mechanical and Architectural Guideline for the Design of Accessible Buildings (Facilities for Disabled Persons). Department of Public Work. 2001

Nigeria Trend Analysis: Challenges and Opportunities of the Demographic Shift and its link to stunting an outlook to 2030. (March 2016). Central & West Africa Report. Inter-Agency Regional Analysts Network. An ACF and IRIS Initiative. IRIS – Instituit De Relations Internationales et Strategiques. ACF International.

Nicholson, A-M; Cameron, C; Mountford, N (2009) – Design Principles for Extra Care Housing. Housing Learning and Improvement Network (LIN) Factsheet no 6 Report. URL: http://www.housinglin.org.uk/AboutHousingLIN/

Oppong,C (2006) – Familial roles and social transformations: Older men and women in sub-Saharan Africa. *Research on Aging*. 28 (6) 654-668

Pirinen A (2016) – Housing Concepts For and By the Elderly: From Subjects of Design to a Design Resource. *Journal of Housing for the Elderly* 30:4, 412-429.

Rooney C, Hadjri K, Rooney M, Faith V, McAllister K, Craig C (2016) Meeting the Needs of Visually Impaired People living in Lifetime Homes. *Journal of Housing for the Elderly.* 30(2),132-140.

Sanderson, W.C., Scherbov, S (2013) – The Characteristics Approach to the Measurement of Population Aging. *Population and Development Review*. 39 (4),673-685.

Sango, P (2013) – Visible but Invisible: People living with disability in Nigeria. Posted November 12, 2013. Centre for Learning Disabilities in Nigeria. Downloaded 12.07.2017. www.books2africa.org

Tomaka, J, Thompson S, Palacios R (2006) – The Relation of Social Isolation, Loneliness and Social Support to Disease Outcomes among the Elderly. *Journal of Aging and Health*, 18(3), 359-384.

University of Iowa Clinical Law Program (2010) – The Washington Court Housing Survey: A study of Accessibility and Universal Design in Affordable Housing – Executive Summary. *Journal of Affordable Housing and Community Development Law*, 19 (2), 191-204.

Whitehurst T (2006). Evaluation of features specific to an Autistic Spectrum Disorder (ASD) designed living accommodation. In- Designing living and learning environments for children with autism. Client: Sunfield Research Institute.

APPENDIX

Table 2: Sample questionnaire administered to the architect for each development

Name			Position	
Company (Address)				
House ……	Location			
Brief: What did the Client ask for, and what did you consider in your design?				
House description	Age range of Client	30-45	46-60	60 and above
	Purpose (tick all that apply)	Rental market	Family home	To sell off
Projected construction cost/ budget				
Sample Questionnaire				

DEVELOPMENT OF FRAMEWORK FOR APPLICATION OF ERGONOMICS IN BUILDING CONSTRUCTION IN NIGERIA

AbdulHafeez Ibrahim[1]

[1]*Department of Building, Faculty of Environmental Design, Ahmadu Bello University, Zaria – Nigeria*

Construction work is physical in nature and ergonomic hazards are silently reducing the productivity of construction workers in the building industry. Work related musculoskeletal disorder has been identified as a drain to construction productivity which is threatening the existence of an industry already affected by shortage of skilled craftsmen. Studies have indicated that the building construction industry have not adopted ergonomics practices. The aim of the research is to develop a framework for application of ergonomic practices in building construction in Nigeria with a view to improving health and safety management. The objectives are to: (1) Identify and rank the ergonomically hazardous trades/activities in building construction. (2) Examine the ergonomics practices adopted by construction companies for preventing ergonomics hazards in building construction. (3) Impact of implementing ergonomics on workers' productivity. (4) Identify and evaluate the barriers to adoption of ergonomics in building construction process. (4) Identify and assess strategies to enhance the application of ergonomic in building construction in Nigeria. (5) Develop a framework for improving the application of ergonomics in building construction. The study will adopt both qualitative and quantitative methods with questionnaire, site observation and interview. Targeted respondents include designers, construction managers, craftsmen, and unskilled labourers working on construction sites in Nigeria. This paper concludes that ergonomics is still an emerging phenomenon in health and safety management in construction in both developed and developing countries. Therefore, there is a need for further promotion and adoption of ergonomic practices in health and safety management in the industry.

Keywords: application, building, construction site, ergonomics, framework

INTRODUCTION

Even with the immense contribution of the construction industry to economic growth, the frequency and severity of accidents and ill health pose great concern to stakeholders in the industry. Methods of work, materials

[1] mscenv10656@gmail.com

Ibrahim, A. (2017) Development of framework for application of ergonomics in building construction in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 565-578.

used, tools, equipments and workplaces vary between workers, construction projects and countries, with resultant health and safety risks (Van der Molen *et al.,* 2005).

The construction industry has earned a reputation of being dangerous because of the high incidence of accidents and deaths that occur on the construction site around the world (Ajayi and Thwala 2015, Sass and Smallwood, 2015; Huang and Hung, 2015). Mahmoudi *et al.,* (2014); Muiriri and Mulinge, (2014); Olutuase, (2014) all submitted that one in every six accidents occur in construction sites around the world. The situation is even worse in developing countries like Nigeria. According to Loiselle and Werna (2014) the risk associated with construction work is estimated to be six (6) times greater in developing countries.

Construction work is physically demanding (Ray and Teiser, 2012). The nature of construction work helps to explain why injuries such as strains, sprains, and work-related musculoskeletal injuries, are so prevalent and are the most common on construction site; Smallwood and Haupt (2005) asserted that hundreds of workers are being injured and rendered permanently disabled on construction sites. Execution of tasks by construction workers require lifting heavy loads, performing repetitive tasks, frequent bending and twisting of the body; working above shoulder-height; working below knee-level; manual handling of heavy and irregular-sized loads; adopting awkward work postures, working in confined and cramped spaces, holding the same position for long, forceful exertion and working under hot and cold temperatures Smallwood and Ajayi, 2007; Smallwood and Haupt, 2009; Muriri and Mulinge, 2014) which are inherent health and safety risks and unfavourable ergonomic practices. That is why it is being said that construction itself is a problem in ergonomics (Smallwood, 2004). These factors can result in injuries or problems involving the tendons, muscles, or nerves which may develop to Musculoskeletal disorders (MSDs). MSDs are injuries and disorders of the soft tissues (muscles, tendons, ligaments, joints, and cartilage) and nervous system. They can affect nearly all tissues, including the nerves and tendon sheaths, and most frequently involve the arms and back.

The high prevalence of work related musculoskeletal disorders and the growing urge to improve health and safety in construction have led to introduction of new philosophies such as ergonomics. Ergonomics is one of the strategies in preventing musculoskeletal injuries and improving health and safety in construction (Al-Swaity and Enshassi, 2012; Sass and Smallwood, 2015). Ergonomics is the study of the work environment (workstation tools and equipment, job demand pace of work, furniture) in relation to human characteristics, capabilities, and limitation to increase human efficiency and overall well-being of an individual. The basic premise of ergonomics is that job demands should not exceed workers' capabilities and limitations to ensure that they would not be exposed to work stresses that can adversely affect safety and health as well as productivity (Hecker et al., 2006; Mroszczyk, 2007; Jaffar, Abdul-Tharim, Mohd-Kamar, and Lop, 2011). The objective of ergonomics is therefore to provide a safe and

productive workplace to the worker's comfort to fulfil the goals and objectives of the organization. Ergonomics in construction deals with many issues, starting with the individual working (artisan and construction labourer) to their physical work environment, tools and equipment, working methods and expanding out to include the entire construction site, project planning, work organisation and work task.

There is need for better ergonomics in preventing injuries (musculoskeletal disorder MSD's, Cumulative trauma and repetitive strain injuries) from taking place. The National Institute for Occupational Safety and Health (NIOSH) suggests using principles of ergonomics to redesign tools, equipment, materials, and work processes to reduce WMSD and back-injuries in construction.

Many challenges have been experienced in implementing ergonomics in construction unlike in the manufacturing industry. The premise for this study comes from the need for construction companies to adopt ergonomics in health and safety management of construction for their workers.

STATEMENT OF RESEARCH PROBLEM

Building construction activities expose workers to numerous ergonomic challenges or hazards. (Smallwood and Ajayi, 2007; Smallwood and Haupt, 2009; Muriri and Mulinge, 2014; Kim, 2017). Which causes them to be ill, experience stress, experience work related musculoskeletal disorder, experience injuries, being absent from work and in some cases death (Willian, 2005; Smallwood and Ajayi, 2007; Ekpeyong and Iyang, 2014; Ajayi and Thwala, 2015; Sass and Smallwood 2015).

The construction industry provides an environment that increases the risk of workers to sustaining work-related musculoskeletal disorders. Musculoskeletal Disorder is the most common work-related problem in the construction industry (Ahankoob and Charehzehi, 2013; Ajayi and Thwala, 2014). According to Yelin *et al.*, (1999) 90% of disabled older construction workers had work related musculoskeletal disorder. Rosecrance (2000) also declare that 58% of experienced construction workers have experienced WMSD. Even apprentices and young construction workers are not exempted, because work related musculoskeletal disorder begins in the early life of a construction worker. A study by Merlino *et al*. (2003) reported a prevalence rate of 54.8% and Rosecrance (2000) observed a 30% prevalence rate of work related musculoskeletal disorder among apprentices.

Findings by Ajayi and Thwala (2012) indicated that the manner in which construction activities are executed in Nigeria's construction industry adversely affects the health and safety of construction workers, as it precipitates into ergonomic injuries. Adeyemi *et al.,* (2014) found that more than 51% of postures by construction workers was classified harmful, showing the need for implementation of ergonomics in construction industry in Nigeria. Ajayi, Joseph, Okunlawon, and Odunjo (2015) '*Assessed the impact of musculoskeletal injuries on construction workers in Nigeria'* and

confirmed that it has a negative impact on their productivity. Ergonomic hazards therefore pose great hazard to the health and safety of workers

Most studies on ergonomics have looked into ergonomic risk factors and interventions (Albers *et al*., 2014, Jafar *et al*., 2011, Altharim, *et al.,* 2012). Rwamamara (2005) studied the best practices in the Swedish Construction industry to prevent work related musculoskeletal disorders among construction workers. The study also identified ergonomics best practices in the construction work environment. One limitation of the study is that design for ergonomics was not considered, while Smallwood (2016) considered designers influence on construction ergonomics. One limitation of the study is that only Architects were considered, other designers who also have impacts on design (structural, mechanical and electrical designers) were omitted.

Ajayi and Thwala (2015) developed an integrated design model for construction ergonomics in Nigeria's construction industry. The study tried to integrate health and safety practitioners and the construction managers early in the design stage. In this study, only Architects were considered among designers. Structural, mechanical and electrical designers were not part of the study and construction ergonomics wasn't critically looked into. The adoptability of ergonomics practice among selected craftsmen in Abuja was investigated by Mustapha (2016), the study assessed adoption of ergonomic PPE, working methods and tools among selected craftsmen. The study was limited to craftsmen on small and medium construction sites.

Many construction forms around the world have a health and safety programme but only a few have been able to implement ergonomics. According to Kim (2017) only a third of US construction companies ranging in size from 6 to 3,000 have an ergonomic program. Ergonomics has also not been applied in the construction industry in the Middle East (Damaj, Fakhreddine, Lahoud and Hamzeh, 2016). Glimskar (2014) added that innovations to reduce Musculoskeletal Disorder have not been successful. People, companies and organizations have found it difficult to adopt and use ergonomics interventions for injury prevention. Ibrahim, Mustapha and Abdulazeez, (2017); Ibrahim and Smallwood (2017); Tasiu (2016) have all found low adoption of ergonomics on building construction sites in Nigeria and have suggested that further research be carried out on how to enhance adoption of ergonomics in building construction. Kim (2017) also posits that there is little research on the actions or specific messages that can move the construction industry to adopt ergonomic practices, equipments, and policies. This suggests the need for development of framework for adoption of ergonomics by construction firms.

AIM AND OBJECTIVE

The aim of the research is to develop a framework for enhanced application of ergonomics in building construction in Nigeria with a view to enhancing health and safety management. The specific objectives are to:

1. Identify and rank the ergonomically hazardous trades/activities in building construction.
2. Examine the ergonomics practices adopted by construction companies for preventing ergonomics hazards in building construction.
3. Impact of implementing ergonomics on workers' productivity.
4. Identify and evaluate the barriers to adoption of ergonomics in building construction process.
5. Identify and assess strategies to enhance the application of ergonomic in building construction in Nigeria.
6. Develop a framework for improving the application of ergonomics in building construction.
7. Validate the framework

JUSTIFICATION FOR THE STUDY

The increasing number of occupational disease and illness in construction triggered the shift from accident prevention to preventing occupational illness. Even with the numerous studies and policies on health and safety, the number of injuries and ill health has continued to increase in construction worldwide. This shows that there is a gap in health and safety management in construction. It is evidently clear that health and safety on construction sites cannot be achieved by the use of personal protective equipments alone; working methods, work organisation and the technology used on construction site also have significant effect on health and safety of construction workers which is under ergonomics.

A number of researches have investigated the impact of ergonomic workplace interventions. Nelson and Silverstein (1998); Tittiranonda *et al*., (1999); Amick *et al*., (2003); Robertson (2003); Galinsky *et al*., (2007): Robertson *et al*., (2003); Choobineh, (2011); and Amick *et al*., (2012) have all shown positive effects on reducing Musculoskeletal Disorder. Ergonomics adoption has a huge potential as an enabler of quantitative and qualitative benefits in the construction industry. Ergonomic resolutions have contributed to preventing injuries and fatalities and facilitate safety and health practices for the construction workers (Entzel, Albers and Welch, 2007; Hess, Weinstein, and Welch, 2010). According to Albers and Estill (2007) the best way to reduce WMSD is to use the principle of ergonomics to redesign tools, equipments, materials and work processes. While it appears difficult to empirically prove financial benefits of significant magnitude, a study by Smagz (2005) have shown that ergonomics implementation on construction site has reduced long-term costs, reduced injuries, reduced lost workdays, lowered workers compensation expenses and improved overall production efficiency and quality therefore affecting the project execution positively.

There is also the need to seek ways to improve health and safety management on the construction site and the industry as a whole because the image of the industry, of being dangerous and risky, might scare potential workers who the industry needs. It is also important to protect the current stock of craftsmen and artisans which the industry is lacking right now both in quantity and quality.

SCOPE AND DELIMITATION

The study would only cover large to medium sized building construction companies. The reason for also studying large and medium organizations is based on the fact that work environment and health issues are generally dealt with professionally in large and medium organizations than smaller ones. Abuja being the capital of Nigeria was selected because it has high number of large and medium building projects. Both Indigenous and multinational construction companies execute most of their projects in Abuja (Kadiri, Nden, Avre, Oladipo, Edom, Samuel and Ananso, 2014). This study is also limited to building construction only; dams, roads and bridges are excluded.

THEORETICAL FRAMEWORK

This work can be related to the 19th century work of Taylor (1909) in Drucker (1981), on how traditionally, work creates injuries, fatigue, strain, dulls the faculties and wears out the body'. Taylor's scientific theory was about the need to study tasks, to organize, plan and find the optimum method of carrying out the task, providing the tools and the right information to enable workers to 'greatly increase the output of man without materially increasing his effort.

The principle of wellbeing of workers (1921) by Vladimir Bechterev and Vladimir Nikolgevich also shows the need for organisation of work process that would yield maximum efficiency with minimum health hazards, absence of fatigue, guarantees the good health and all round personal development of people. Construction work is very physical in nature, which in turn has effect on the human body. The method of work, tools and equipments, working environment, all have an impact on the health of the worker. There is need to consider how to eliminate physical strain and damage to the human body by not 'doing work the wrong way'.

According to the human factor theory of accident causation, capability of the worker, environmental factor, workers incompatibility with workstation and inappropriate activities have significant impact on accidents. This study considers musculoskeletal injuries as accident. The study aims to eliminate ergonomics risk factors in construction thereby eliminating musculoskeletal injuries which is prevalent in construction.

According to Smith and Sainfort (1989); Westgaard and Winkel (1997) every construction workplace can be characterised by the planning or work organisation carried out, the technology used, the work tasks performed, the

physical work environment, as well as the individuals carrying out the various work tasks. Rwanmamara (2005) posits that performance or quality suffers and/or more injuries occur when the connections between them are broken or out of balance, therefore ensuring that these connections are balanced is important. Most occupations contain one or more *tasks* required for performance.

Conceptual framework

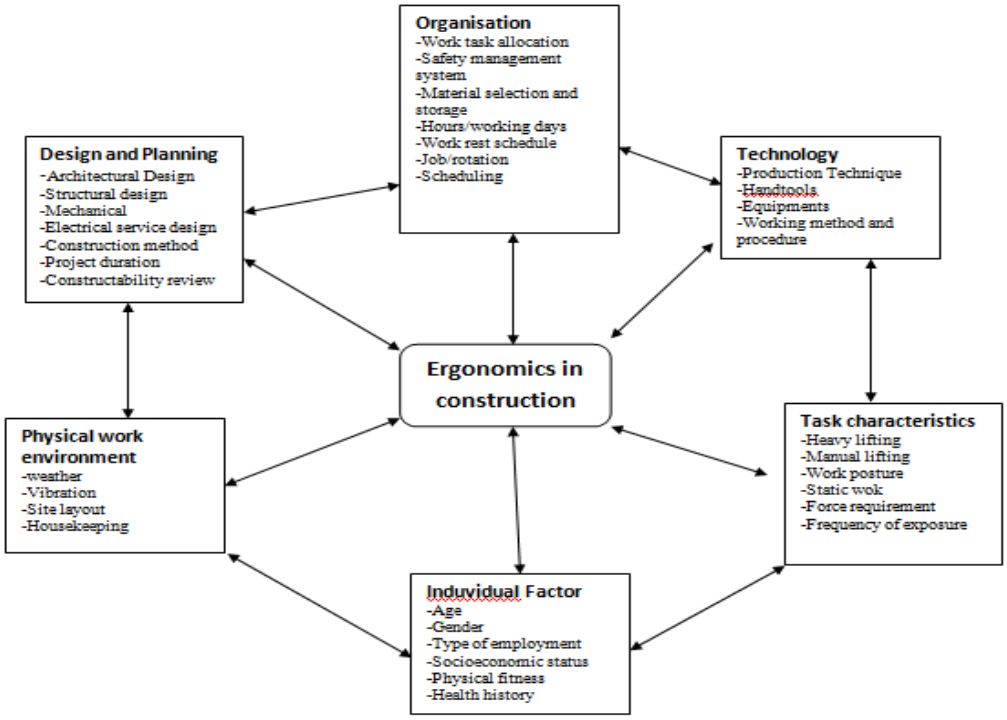


Figure 1: A conceptual framework for ergonomics in the building construction process (Adapted from Rwanmamara, 2005)

All *individuals* enter the work environment with a variety of inherent and learned strengths and weaknesses. These include cultural background, age, gender, language skills, general health status, motivation, skill level, notions about how to perform the work required and ways of interacting with co-workers, supervisors and management. The ability to accomplish tasks and the load on the individual accomplishing the tasks are often determined by *the technology* being used and *Work environment*. The *organisation's* culture determines the level of safety attained, and management's commitment or non-commitment to safety. This conceptual model takes into account both internal and external factors.

RESEARCH METHODOLOGY

The main interest of this research and the research questions it set out to finding solutions to ergonomic hazards in building construction which could be achieved by applying ergonomics and ergonomic principles. It is against this background that this research intends to address the following research questions.

1. What are the most ergonomically hazardous trades/Activities in building construction and their interventions?
2. What are the ergonomics interventions/principles for building construction?
3. What specific area or processes of building construction requires ergonomic interventions?
4. Is ergonomics implemented on building construction sites and to what extent?
5. What are the factors impeding the effective implementation of ergonomics in the building industry?
6. What strategies can enhance the application of ergonomic in building construction?

This research will adopt the mixed method (quantitative and qualitative research). The method is also known as triangulation or convergent method where both quantitative and qualitative research methods are used to enjoy both the strength and assets of both methods and neutralize their liabilities (Byman, n.d; Dezin, 1970; Cresswell and Plano, 2007). Webb *et al*., (1960); Bouchard (1976); Dezin (1978); Creswell and Clark (2011) are advocates of this research method to develop a more robust understanding of a problem and enhance confidence in the ensuing findings.

Accordingly, Creswell and Plano (2011) convergent parallel mixed methods involve the collection, analysis, and merging of both quantitative and qualitative results concurrently. In the convergent mixed methods, the researcher analyses both the quantitative and qualitative data set separately and independently from each other and subsequently merge the results.

Quantitative phase

Questionnaire design

Questionnaires to be administered will look into application of ergonomics in design while studying ergonomics among designers the study would also look into;

1. Importance of ergonomics during the various project phases;
2. Frequency at which designers and construction managers consider construction ergonomics on various design and construction related aspects;
3. Extent to which various design and construction related aspects impact on construction ergonomics;
4. Potential of various aspects to contribute to an improvement in construction ergonomics.
5. Factors affecting ergonomics adoption.

Checklist

A checklist designed by the centre for construction and training will be adopted for the study. It will also help to identify areas and processes of building construction that requires ergonomic interventions. It will look at material handling on site, tools, ergonomics risk factors, production pressure, training and hazardous work for musculoskeletal disorder.

Qualitative phase

In the qualitative research phase, interview and case study approach will be used.

Observations/case studies

Yin (1994) argues that case research and survey methods are better suited than other techniques for analysing contemporary events. Case study research is superior to survey methods at answering "why's" and "how's" because the case analysis can explore more deeply into motivations and actions than structured surveys. Thus, this is the reason why the case studies were chosen as an investigative tool in the research study. Direct observation of the activities on the construction site would be used to achieve objective three (assessing ergonomics practice on construction sites). The assessment of practice of ergonomics will be based on construction work planning, work organisation, construction methodology, production techniques and production equipment, physical work environment and the use of personal protective equipment. The case study's approach has been used by Damaj, Fakhreddine, Lahoud, Hamzeh (2016) and Rwammamara (2005) in studying ergonomics implementation on construction sites.

Interview

The interview is a method of data collection, which allows for a conversation between the interviewer and the respondents on those issues that relate to the problems of a research. A semi-structured, but in-depth interview will be conducted with the tradesmen, site/ construction manager on issues relating to challenges and drivers to implementing ergonomics on building construction sites.

Research population and sample size

Research Population

The study population of construction companies were drawn from a database of construction companies fully registered with Federation of Construction Industry (FOCI). FOCI have over 60 years of construction experience in Nigeria. Members of FOCI are committed to providing and maintaining a safe and healthy workplace for all staff. There are 79 members in FOCI as at May 2017.

Sample size

The sampling size was determined based with the formula below considering the fact that the targeted population is known. (Kish, 1965) showed that the sample size can be calculated by using the following equation for 94% confidence level

$$n = \frac{n^1}{[1+\left(\frac{n^1}{N}\right)]} \text{.....1}$$

Where:

n = sample size from finite population

n^1 = sample size from infinite population = $\frac{S^2}{V^2}$

Where S^2 is the variance of the population elements and V^2 is a standard error of sampling population, S= 0.1 to 0.5 and V = 0.06

N = total number of population, S= 0.5 was chosen

$n^1 = \frac{S^2}{V^2}$ = 69.44, N= 79

$n = \frac{69.44}{[1+\left(\frac{69.44}{79}\right)]}$ = 37

Adding 20% for non response the sample size will be adjusted to Forty Four (44)

ANALYSIS OF DATA

The qualitative data to be generated from the interview will be sorted, coded and re-organised according to cases and questions to identify patterns and relationships between categories. The interview will be analysed using content analysis. The deductive approach will be adopted for analysis. This involves constant comparative analysis after the interview data have been sorted and coded to generate knowledge about any common pattern. This method is mostly suitable for larger samples of interviews, with the same series of questions being asked.

The quantitative data would be analysed using descriptive data analysis. Descriptive analysis would include; frequency, percentage, mean and factor analysis.

To ensure the validity and reliability of the study, selection of respondents and participants will be purposeful; therefore, only relevant participants will be involved. Findings will be verified by cross-checking with the participants and self-reflections. The framework will also be validated. Effort will be made to ensure that all results, which will emanate from the study, are true evidence that provided convincing conclusions.

Research programme

In achieving the aim and objectives of the research the proposed research programme is divided into four broad stages. The first stage will be to review literature. The second stage will be the main work while the third stage will entail developing and validating the frame work. Stage four will cover the summary, conclusion and recommendation from the study.

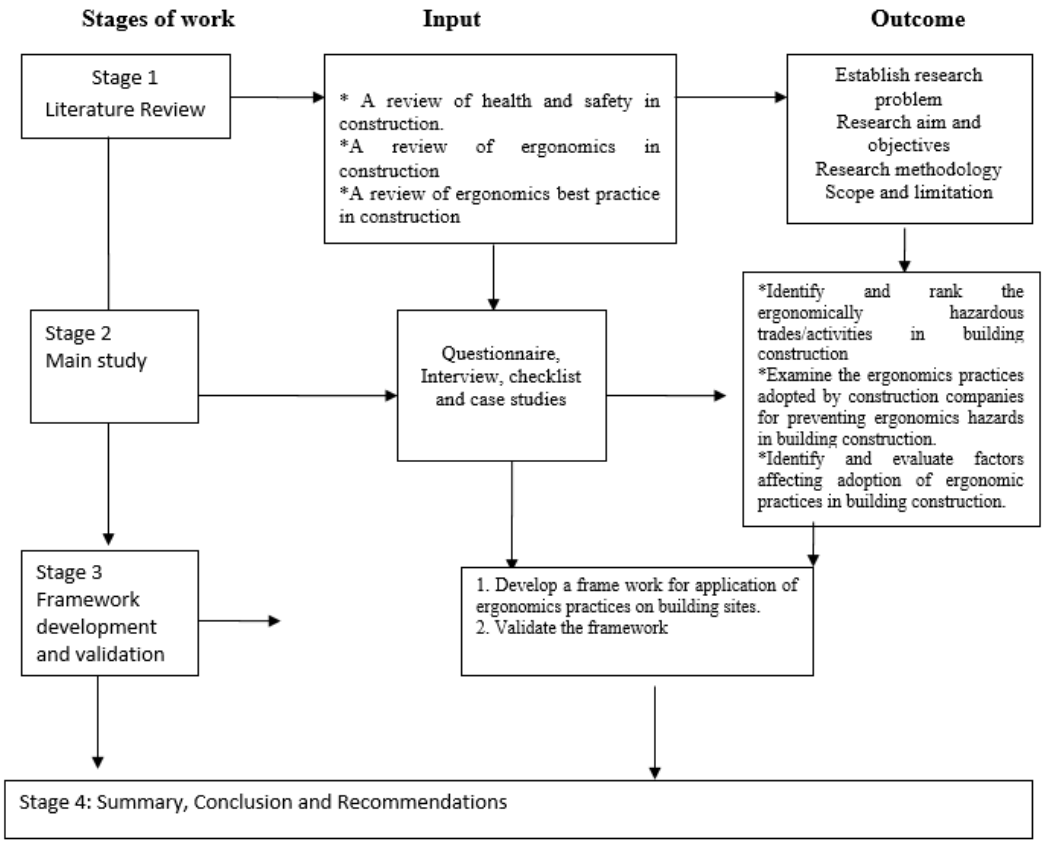


Figure 2: Research Programme

CONCLUSION

As seen above the study is in progress. However, owing to the danger of Musculoskeletal disorder to construction productivity and the lack of adoption of ergonomics practices in building construction, it is justified to carry out this research to develop a framework for adoption of ergonomic practices in the building construction industry with a view to enhance ergonomic implementation in health and safety management practices and improve the health and safety of workers in the industry.

Adoption of ergonomic practices should translate into improving workers morale, increasing efficiency and productivity which should also translate into achieving the project aim of timely completion, within cost and achieving quality, based on the prescribed specification at the first attempt.

This paper concludes that ergonomics is still an emerging phenomenon in health and safety management in construction both in developed and developing countries. Therefore, there is a need for further promotion and adoption of ergonomic practices in health and safety management in the industry.

REFERENCES

Abdul-Tharim, H., Jaffar, N., Lop, N. S & Mohd-Kamar. I. F. (2011) Ergonomic Risk Controls in Construction Industry- A Literature Review, *Procedia Engineering* 20, 80-88

Adeyemi, O., Adejuyigbe, S., Akanbi, O., Ismaila, S. & Adekoya, A. (2013). Enhanced Ergonomics Training; A Requisite to Safe Body Postures in Manual Lifting Tasks Global. *Journal of Researches in Engineering Industrial Engineering,* 13(6).

Ahankoob, A & Charehzehi, A. (2013) Mitigating ergonomic injuries in construction industry. *IOSR Journal of Mechanical and Civil Engineering, 6(2), 36-42.* Retrieved from www.iosrjournals.org/ccount/click.php?id=2402

Ajayi, O.O, Joseph J.O, Okunlawon, S.A & Odunjo,O.O (2015). Assessement of the impact of musculoskeletal injuries on construction workers in Nigeria. *International Journal of Civil Engineering, Construction and Estate Management* 2(3).

Ajayi, O., & Thwala, W. (2015). Developing an Integrated Design Model for Construction Ergonomics in Nigeria Construction Industry. *African Journal of Applied Research*, 1(1).

Albers, J.T & Estill, C.F. (2007). *Ergonomics for construction workers.* National Institute for Occupational Safety and Health Ergonomics for Construction Workers DHHS (NIOSH) Publication No. 2007–122.

AlSwaity, A and Enshassi, A (2012). *Construction ergonomics related to safety*. Proceeding of the 4th International Engineering Conference – Towards engineering of 21st century. Retrieved from research.iugaza.edu.ps/files/2147.PD

Amick, B.C., Robertson, M.M., DeRango, K., Bazzani, L., Moore, A., Rooney, T.&, Harrist, R. (2003). Effect of office ergonomics intervention on reducing musculoskeletal symptoms. Spine (Phila Pa. 1976) 28, 2706-2711.

Brynman, A. (n.d) Triangulation. Lecture note. Department of Social Sciences. Loughborough University

Choobineh, A, Motamedzade, M, Kazemi,M, Moghimbeigi, A & Pahlavian, A. H. (2011) The impact of ergonomics intervention on psychosocial factors and musculoskeletal symptoms among office workers *International Journal of Industrial Ergonomics*, 41, 671-676

Creswell, J.W. and Clark, V.L.P. (2011). *Designing & conducting mixed methods research.* 2nd edition. California: Sage publications, Inc.

Damaj, O., Fakhreddine, M., Lahoud, M., Hamzeh, F. (2016). Implementing Ergonomics in Construction to Improve Work Performance. *In: Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction,* Boston, MA, USA, sect.11 pp. 53-62,

Denzin, N. K. (1970). *The Research Act in Sociology.* Chicago: Aldine.

Dezin. N.K (1978). *The research act.* 2nd ed. Newyork. McGraw-Hill.

Ekpenyong, C. E & Iyang, C. I. (2014). Associations Between Worker Characteristics, Workplace Factors, and Work-Related Musculoskeletal Disorders: A Cross Sectional Study of Male Construction Workers in Nigeria. *International Journal of Occupational Safety and Ergonomics*, 20(3), 447–462.

Entzel P, Albers J, & Welch, L. (2007) Best practices for preventing musculoskeletal disorders in masonry: Stakeholder perspectives. *Applied Ergonomics 38,* pp 557-566.

Galinsky, T., Swanson, N., Sauter, S., Dunkin, R., Hurrell, J., & Schleifer, L., (2007). Supplementary breaks and stretching exercises for data entry operators: a follow upfield study. *American Journal of Industrial Medicine.* 50, 519-527.

Hecker, S.F., Gambatese, J., & Weinstein, M. (2006). Designing for construction safety in the US. Progress, needs and future directions. *Proceedings IEA 2006 Congress*, July 10-15, Maastricht, Netherlands.

Jaffar, N., Abdul-Tharim, A. H., Mohd-Kamar, I. F., & Lop N. S. (2011). A literature review of ergonomics risk factors in construction industry. *Procedia Engineering.* pp 89– 97

Kadiri, Z. O., Nden, T. Avre, G. K., Oladipo, T. O., Edom, A., Samuel, P. O. & Ananso, G. N (2014). Causes and Effects of Accidents on Construction Sites (A Case Study of Some Selected Construction Firms in Abuja F.C.T Nigeria). *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).* 11(5): 66-72.

Kayunba, A. (2013). Construction work and occupational safety and health. *African Newsletter on Occupational Health and Safety*, 23(3).

Kim, I. (2017). The Role of Ergonomics for Construction Industry Safety and Health Improvements. *Journal Ergonomics,* 7(2) DOI: 10.4172/2165-7556.1000e166

Loiselle, C. D and Werna, E (2014) "The Construction Sector- Overcoming the Challenges". ILO/ UN Global Compact Webinar. International labour organisation Geneva.

Mahmoudi, S., Ghasemi, F. Mohammadfam, I. & Soleimani, E. (2014). Framework for Continuous Assessment and Improvement of Occupational Health and Safety Issuesin Construction Companies. *Safety and Health at Work*, 5, 125-130

Merlino, L.A., Rosecrance, J. C., Anton, D., & Cook, T. M., (2003). Symptoms of musculoskeletal Disorder among apprentice construction worker. *Applied occupational and environmental hygiene,* 18, 57-64

Muiruri, G. & Mulinge, C. (2014). *Health and Safety Management on Construction Projects Sites in Kenya. A Case Study of Construction Projects in Nairobi County*. Proceedings of FIG Congress 2014 Engaging the Challenges Enhancing the Relevance Kuala Lumpur, Malaysia 16-21 June.

Olutuase, S.O. (2014). A Study of Safety Management in the Nigerian Construction Industry. *IOSR Journal of Business and Management.* Vol 16(3). Pp 1-10.

Ray, S. J & Teizer, J. (2012). Real-time construction worker posture analysis for ergonomics training. *Advanced Engineering Informatics, 26*. pp 439–455.

Robertson M. M., Ciriello, V M. & Garabet, A.M (2003). Office ergonomics training and a sit-stand workstation: Effects on musculoskeletal and visual symptoms and performance of office workers. *Applied Ergonomics* 44 73-85

Rosecrance, J. C., Porszasz, J., Cook, T., Anton, D., Frekees, E., & Karacsony, T. Musculo skeletal disorder among journey level construction in Hungary. Proceeding of IEA 2000/HFE 2000, 461-463.

Sass, C, & Smallwood, J. (2015). The role of ergonomics in green building. Proceedings of the 19th Triennial congress of the IEA, Melbourne 9-14 August.

Smagacz, J. A. (2004) Ergonomics in Construction Better, Faster and Cheaper: *Ergonomic Improvements for a Better Construction Business Presented at the 2004 AIHce May 2004 Atlanta, GA.*

Smallwood, J.J. (2004). The Influence of clients on contractor health and safety (HEALTH AND SAFETY). In *Proceedings of the ARCOM 2004 Conference*, vol. 2, Edinburgh, United Kingdom, 1–3 September.

Smallwood, J and Ajayi, O. (2007). The impact of training on construction ergonomics knowledge and awareness. *Ergonomics SA* 1.

Smallwood, J.J. and Haupt, T.C. (2009). *Construction ergonomics; perspective of female and male production workers.* Proceeding of the 25th Association of Research in Construction Management conference. Pp 1263-1271.

Smith, M.J and Sainfort, P.C. (1989). A balance theory of job design for stress reduction. *International Journal of Industrial Ergonomics*, 4, pp. 67-79.

Van der Molen, H.F., Sluiter, J.K., Frings-Dresen, M.H.W., (2006). Is the use of ergonomic measures associated with behavioral change phases? *Ergonomics* 49 (1), 1–11.

Webb, E.J, Donald, T.C, Rachad, D.S & Lee, S. (1960). *Unobstructive measures; Non reactive research in social sciences*. Chicago Rad McNally.

Willlam, M A. S (2005). An Investigation into the Ergonomics of the Western' Cape Construction Industry. A Masters thesis in the University of Capetown, South Africa.

Westgaard, R.H, Winkel, J. (1997). Ergonomic intervention research for improved musculoskeletal health: A critical review. *International Journal of Industrial Ergonomics 20, 463-500.*

Yelin, E.H., Trupin, L.S, and Sebesta, D.S., (1999), Transitions in employment, morbidity and disable among persons aged 51 to 61 with musculosketal and non-musculosketal conditions in U.S., 1992-1994, Arthritis and Rheumatism, 42, 769-779

EFFECT OF GRANITE, WASHED AND UN-WASHED GRAVEL AGGREGATE SIZES ON ENGINEERING PROPERTIES OF CONCRETE

Ogunbiyi, M. A.[1], Olawale, Simon O.[2], Ajayi, Oluwaseyi[3]
[1, 2 & 3] *Department of Civil Engineering, Osun State University, Osogbo, Osun State, Nigeria*

This study shows clearly that concrete gives the highest compressive strength for 14mm and 19mm sizes of granite (coarse aggregates) considered by the study. Un-washed gravel exhibits the lowest compressive strength probably due to impurities imbedded therein that may lower the strength of the concrete. 14mm sized granite (aggregate) out–performed the 19mm sized aggregate; this signifies that the smaller the size of the aggregate, the higher the compressive strength of concrete. The study finds that fine and coarse aggregates in concrete should be evenly distributed. The fineness modulus for sharp sand, washed gravel, un-washed gravel and granite obtained are; 2.51, 3.12, 3.30 and 3.33 respectively. Conclusively, as noted above, this study recommends the use of 14mm (grain size) granite as coarse aggregate especially in structural concrete (1:2:4) for higher strength consideration.

Keywords: CS (Compressive Strength) , GRN (Granite), SG Specific Gravity) , UNWG (un-washed Gravel) , WG (washed gravel)

INTRODUCTION

Coarse aggregate is an essential component of concrete production and its size has tremendous effect on the workability and mechanical properties of the concrete. Apart from a binder e.g. Portland cement in concrete, aggregates are the most essential ingredients in concrete. Aginam et al (2013), postulates that aggregates are classified as fine and coarse aggregates depending on their size ranges. The fine aggregate is a size smaller than 5mm (0.2 in) and less while typically coarse aggregate sizes are larger than 4.75mm (5mm in British Code).

[1] mosesogunbiyi@gmail.com
[2] olawales@hotmail.com
[3] holuwhaseyihajai@gmail.com

Ogunbiyi, M. A., Olawale, S. O. and Ajayi, O. (2017) Effect of granite, washed and un-washed gravel aggregate sizes on engineering properties of concrete *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 579-588.

A maximum size up to 40mm is used for coarse aggregate in most structural applications, while for mass concreting purposes such as dams; sizes up to 150mm may be used (theconcreteeportal.com/agg_prop). It has been established by other authors, that aggregate type and size affect the engineering properties of concrete especially the compressive strength. Neville (2003) in his work shows that increasing the maximum grain size of aggregate lowers the water demand for any desired level of workability. This is as a result of the decrease in the water/cement ratio (w/c), thereby increasing strength. It is also known that increasing the aggregate size excessively may lead to several detrimental effects and cause a decrease in strength. Such effects include a decrease in bonding between coarse aggregate and cement paste increased heterogeneity in the concrete and elevated propensity for diagonal-cracking. Granite, a plutonic acidic igneous rock is characterized with a specific gravity between 2.63 to 2.75, water absorption of less than 1% and compressive strength between 77 and 130 Mpa. These characteristic data vary dramatically depending on the sources as asserted by Shetty (2010).

In many developing countries such as Nigeria, local builders employ river washed gravels as coarse aggregates in the production of concrete. These aggregates are used mostly in an unwashed state. Invariably, when there are impurities such as clay or other forms of soils in these gravels, the tendency not to attain the design strength is high leading to weak and inadequate construction. There is constant stream of news on building collapse from time to time in Nigeria. One of the suspected contributory factors is the abuse of gravels in the production of concrete. The focus is always to maximize profit at the expense of quality. It is not clear at the moment what size of coarse aggregate will result to optimum concrete strength keeping other ingredients constant. Therefore, the aim of this study is to investigate how different coarse aggregates with varying grain sizes affect the engineering properties of concrete.

MATERIALS AND METHOD

Materials

The materials used in this present study, includes; ordinary Portland Cement (OPC), Clean Portable Water (Drinkable), Sharp sand, Granite, Washed and Un-Washed Gravel. The Cement is established to pass through standard ASTM 786-96, ASTM C136/C136M and AAHTO No.T 27 Sieve Analysis of Fine and Coarse Aggregates. The water quality was established based on specifications. Sieve analysis was carried out to establish the uniformity of the aggregates.

Method

The concrete produced for this study is of mix design of 1:2:4, having 0.6 water cement ratio. The specimen size of 150mm x 150mm x 150mm cubes were produced and cured for 7, 14, 21 and 28 days before being tested for compressive strength in accordance with ASTM C39/C39M Standard test method for Compressive Strength of Cylindrical Concrete Specimens. In

addition, during the production of the test specimens, workability tests such as slump tests etc. were carried out to determine the extent of how workable is each batch of produced concrete.

RESULTS AND DISCUSSION

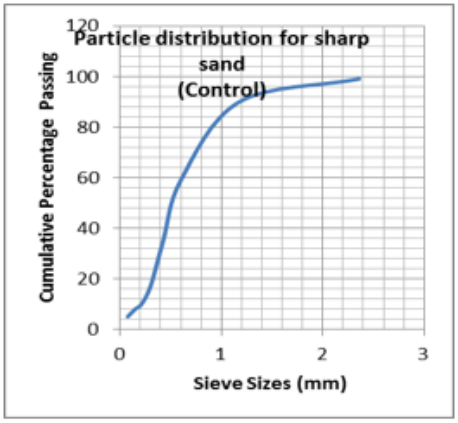


Figure 1: Control for Normal Particle Size Distribution for Fine Aggregate.

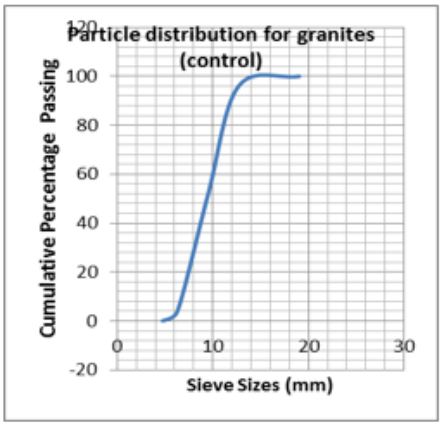


Figure 2: Control for Normal Particle Size Distribution for Coarse Aggregate.

Figure 1 and 2 above serves as control particle size distribution sieve test for fine and coarse aggregates (Granite) respectively. Employed by this study to determine the even particle distribution of the study aggregates.

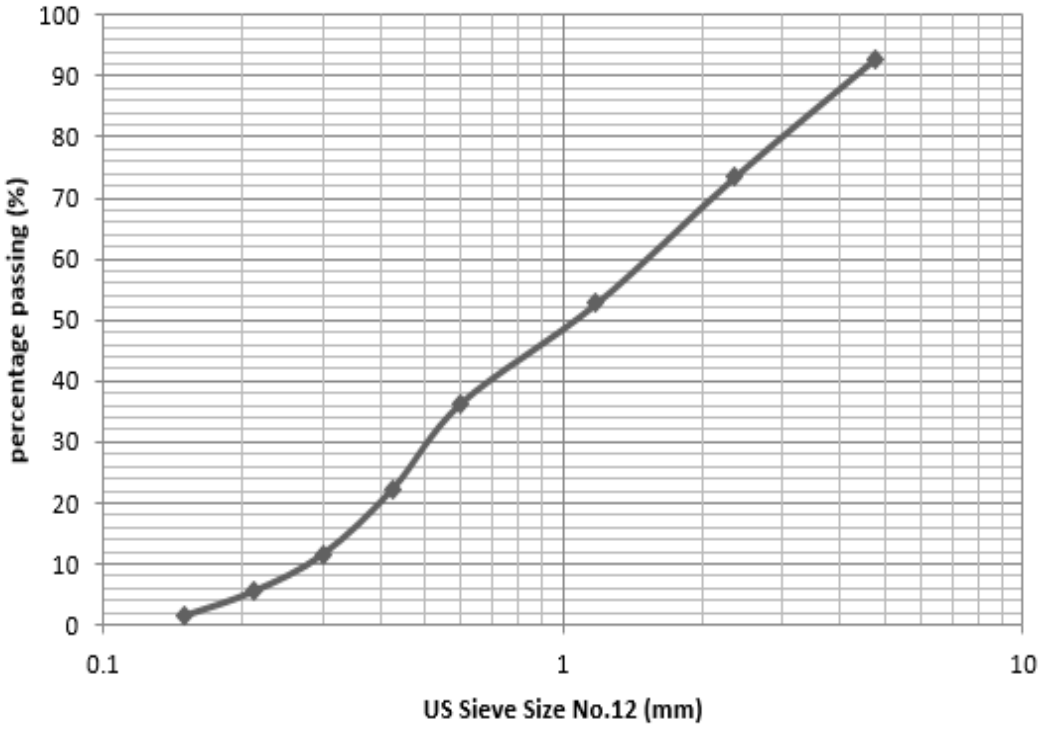


Figure 3: Graph for study particle size distribution for fine aggregate



Figure 4: Graph for study particle size distribution for coarse aggregate granite

Figure 3 and 4, above is the particle size distribution graph for fine and coarse aggregates used in this study and it compares favourably to the control graph; it indicates that the aggregate size is evenly distributed.



Figure 5: Graph for study particle size distribution for coarse aggregate, washed gravel



Figure 6: Graph for study particle size distribution for coarse aggregate, un-washed gravel

Figures 4, 5 and 6 above depict the graph of the particle size distribution of the coarse aggregates; granite, gravel and unwashed gravel employed in this study and compare favourably with the control which translates to even distribution of the particle sizes.

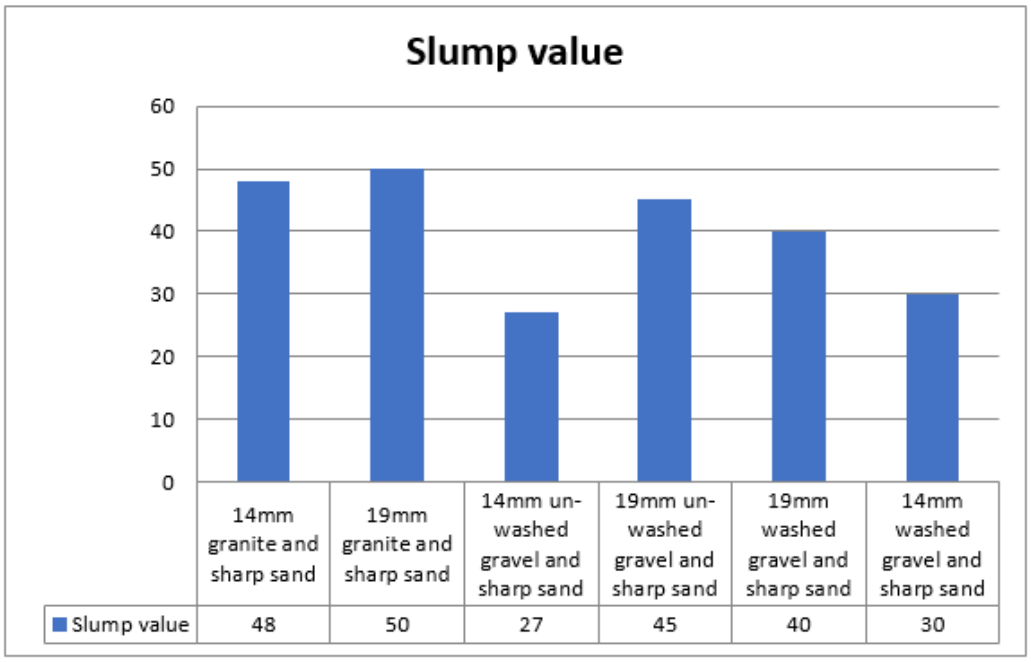


Figure 7: Result of Slump test for the various aggregate sizes

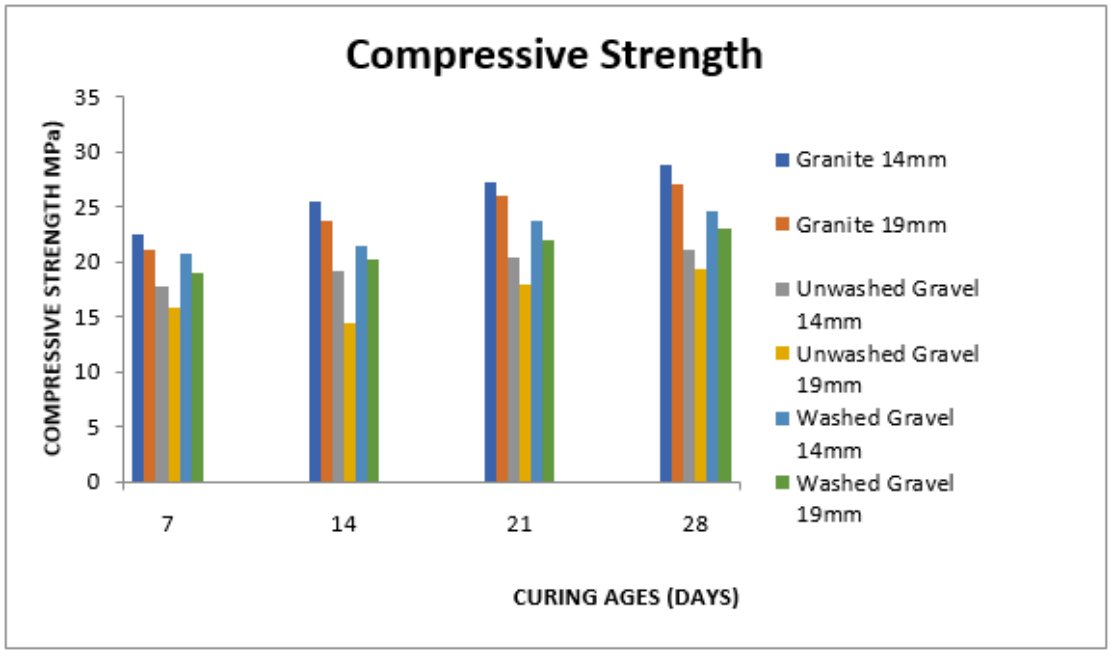


Figure 8: Comparative Compressive Strength Test Results for the different aggregate sizes

Figure 7 and 8 shows the results of the slump test and compressive strength carried out by the study. The listed tables from Table 1- classification of coefficient of uniformity by BS 812 classifying the Cu at different number grades; tables 2 and 3 depict the study Cu and Cc obtained for both fine and coarse aggregates employed by the study. Tables 4, 5, 6 and 7 represent the value of moisture content obtained for both fine and coarse aggregates respectively. While tables 8-11 represent the specific gravity of the aggregates employed by the study. Table 12, depicts the result of the slump test for the concrete mix using the various sizes of fine and coarse aggregates accordingly. Table 13 is the BS 1881: Part 102, 108 Methods for determination of Slump used as a control (see appendix).

CONCLUSION

Compressive strength of concrete is an essential engineering property of concrete in terms of load-bearing, mix proportion, water cement ratio and curing of concrete in the consideration for use in construction application. It is also influenced by varying conditions ranging from concrete constituents, type and sizes of aggregates employed. Based on the results of this study, the following conclusions can be deduced:

1. 14mm coarse aggregate of granite, washed and un-washed gravel performed best for slump test in concrete design 25 and mix ratio 1:2:4 than aggregate size 19mm of the same texture and grade.
2. 14mm coarse aggregate size gave the highest compressive strength during crushing for the same mix ratio than the concrete with 19mm grain size.

3. The study shows that at higher strength ranges concretes containing the smaller maximum-size aggregates generally develop the greater strengths.

REFERENCES

Aginam, C.H., Chidolue, C.A., Nwakire, C (2013). Investigating the effects of coarse aggregate types on the compressive strength of concrete; International Journal of Engineering Research and Application; 2013, 3, 1140-1144.

American Society for Testing and Measurement: Standard Test Methods for Sieve Fine and Coarse Aggregates Analysis; ASTM C136/C136M-14, ASTM International, West Conshohocken, PA, 2014.

American Society of Testing and Measurement: Standard Test Method for Fineness of Hydraulic Cement and Raw Materials by the 300μm (No. 50), 150μm (No. 100), and 75μm (No. 200) Sieves by Wet Method; ASTM C786-96, ASTM International, West Conshohocken, PA, 2014.

American Society of Testing and Measurement: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; ASTM C39/C39M, ASTM International, West Conshohocken, PA, 2017.

British Standard Institution: Methods for determination of slump; BS 1881: Part 102, 108 London, 1983.

British Standard Institutions: Methods for determination of particle size distribution; BS 812: Part 103, London, 1985.

James, T., Malachi, A., Gagzama E. W., Anametetemfok V. (2011). Effects of curing methods on the compressive strength of concrete: Nigeria Journal of Technology; 2011, 3(3), pp. 14-20.

Neville, A.M. (2003). Properties of Concrete, 4th Edition, Pearson Education, Delhi.

APPENDIX

Table 1: BS 812, Classification Standard for Coefficient of Uniformity (Cu)

Coefficient of uniformity	
Cu = 1	Poorly graded
Cu < 4	Uniformly graded
Cu > 4	Well graded

Table 2: Results of Cc (Co-efficient of curvature) and Cu (co-efficient of uniformity) obtained by the study fine aggregate

Sample	D10-diameter corresponding to 10%	D30-diameter corresponding to 30%	D60–diameter corresponding to 60%	Cc-coefficient of curvature (mm)	Cu-coefficien of uniformity (mm)
Sharp sand	0.3	0.5	1.5	0.6	5.0

Table 3: Cc (Coefficient of Curvature) and Cu (Coefficient of Uniformity) obtained by the study for coarse aggregates

Sample	D10-diameter corresponding to 10%	D30-diameter corresponding to 30%	D60–diameter corresponding to 60%	Cc-Coefficient of curvature (mm)	Cu-Coefficient of uniformity (mm)
Granite	9.0	14.2	18.0	1.2	2.0
Un-washed gravel	8.7	12.4	18.6	1.0	2.1
Washed gravel	9.5	14.4	17.8	1.2	1.9

Table 4: Natural Moisture Content for Fine Aggregate with average moisture content = 1.63%

Samples	Weight of container	Weight of container + sample (g)	Weight of sample (g)	Weight of Oven dried sample (g)	Moisture content (%)
A	23.4	73.20	49.80	48.80	2.05
B	20.1	73.80	53.70	52.8	1.70
C	23.4	76.80	53.40	52.80	1.14

Table 5: Natural Moisture Content for Granite with average natural moisture content = 0.68%

Sample No.	Weight of container	Weight of container + sample (g)	Weight of sample (g)	Weight Oven dried sample (g)	Moisture content (%)
Ag	20.1	92.9	72.8	72.2	0.83
Bg	23.2	97.2	74.0	73.3	0.54
Cg	23.8	99.2	75.4	74..8	0.67

Table 6: Natural Moisture Content for washed gravel with average natural moisture content = 0.53%

Samples	Weight of container	Weight of container + sample (g)	Weight of sample (g)	Weight of Oven dried sample (g)	Moisture content (%)
Aw	23.10	120.00	96.90	96.40	0.52
Bw	23.40	115.70	92.30	91.80	0.55
Cw	23.20	122.60	99.40	98.90	0.51

Table 7: Natural Moisture Content for Un-washed gravel with average natural moisture content = 0.81%

Samples	Weight of container	Weight of container + sample (g)	Weight of sample (g)	Weight of Oven dried sample (g)	Moisture content (%)
A	24.00	122.00	98.00	97.00	1.03
B	24.00	136.00	112.00	111.20	0.72
C	24.00	112.00	88.00	87.10	0.69

Table 8: Specific Gravity of Fine Aggregate

Samples	Weight of Container (g)	Weight Sample + Container (g)	Weight of SSD Sample (g)	Weight of Oven dried Sample	BSG_{OD}	BSG_{SSD}	ASG	Abs (%)
A	23.1	97.20	74.10	73.20				
B	20.0	92.50	72.50	71.90				
Total			146.60	145.10				
			146.60 (S)	145.10 (A)	2.62	2.65	2.69	1.03

Table 9: Specific Gravity of Granite

Samples	Weight of Container (g)	Weight of container + SSD sample (g)	SSD Sample (g)	Oven dry(g	Weight o sample ir water	BSGOD	BSDSSD	ASG	Abs (%)
A	23.1	136.7	113.6	112.6	65.7	2.35	2.37	2.40	0.89
B	20.1	142.6	122.5	121.4	74.6	2.53	2.56	2.96	0.91
C	23.4	138.8	115.4	114.3	68.5	2.44	2.46	2.55	0.96
Mean						2.44	2.46	2.64	0.92

Table 10: Specific Gravity of Washed Gravel

Sample	Weight of Container (g)	Weight of Container + SSD Sample (g)	SSD Sample (g)	Oven Dry (g)	Weight of Sample in water	BSGOD	BSDSSD	ASG	Abs (%)
Ag	23.2	168.0	144.8	143.4	90.1	2.62	2.65	2.69	0.98
Bg	23.2	163.1	139.9	138.3	85.8	2.56	2.59	2.63	1.16
Cg	23.1	178.8	155.7	154.0	98.7	2.70	2.73	2.78	1.10
Mean						2.63	2.67	2.70	1.08

Table 11: Specific Gravity of Un-Washed Gravel

Sample	Weight of Container (g)	Weight of container + SSD $ampl (g)	SSD Sample (g)	Oven dry (g)	Weight of Sample in Water	BSGOD	BSDSSD	ASG	Abs (%)
Ag	24.0	186.0	162.0	159.0	102.0	2.65	2.70	2.78	1.89
Bg	24.0	176.0	152.0	148.0	97.0	2.72	2.76	2.90	2.70
Cg	24.0	186.0	162.0	156.0	101.0	2.56	2.66	2.84	3.85
Mean						2.64	2.70	2.84	2.81

Table 12: Results of Slump Test for different Aggregate sizes showing workability of test Concrete

Concrete Sample	Slump(mm)	Workability
14mm granite and sharp sand	48	Low Workability
19mm granite and sharp sand	50	Medium Workability
14mm un-washed gravel and sharp sand	27	Low Workability
19mm un-washed gravel and sharp sand	45	Low Workability
19mm washed gravel and sharp sand	40	Low Workability
14mm washed gravel and sharp sand	30	Low Workability

Table 13: BS 1881: Part 102, 108; Methods for Determination of Slump

Degree of workability	Slump value	Uses
Very low	0-25	Dry mixes, use in road construction
Low	25-50	Low workability mixes, used for foundation with light reinforcement
Medium	50-100	Medium workability mixes
High	100-175	High workability concrete, for section with congested reinforcement

EFFECT OF PLASTICIZERS ON PROPERTIES OF CONCRETE WITH PIT SAND: CASE STUDY FROM AKURE, NIGERIA

Lekan Makanju Olanitori[1] and Moses Philips Otuaga[2]

[1,2]*Department of Civil Engineering and Environmental, Federal University of Technology, Akure, Ondo State, Nigeria*

Concrete is a composite material made from sand, coarse aggregate, cement and water. The strength of concrete is affected by the type of the sand, coarse aggregate, cement and water/cement ratio. The lower the water/cement ratio, the higher the concrete strength. Therefore, the focus of this research work is making concrete at the lowest possible water/cement ratio while maintaining a high workability, with the usage of plasticizer. In this research work, Rheobuild 561M super-plasticizer was used. The nominal ratio of 1:2:4 concrete mix was used for mix proportioning of the concrete. The water cement ratio of 0.5 was used to study the effect of this super-plasticizer on various properties of concrete. The dosage of the super-plasticizer was increased from 5.5ml to 55ml per 13.88kg of cement at the rate of 5.5ml. The results of the various tests carried out showed substantial improvement in the properties of concrete after the addition of super-plasticizer into the concrete mix. The improvement in the properties of concrete such as the strength due to the usage of plasticizer, means that the cross-section of the structural members, such as slabs, beams and columns can be reduced, which will produce a lighter structure, therefore give way for the possibility of reduction in the size of the foundation. Hence the usage of plasticizers enhanced the production of economic structure, without compromising safety.

Keywords: cement, coarse aggregate, compressive strength, Rheobuild, sand, super-plasticizer,

INTRODUCTION

In the present day construction industry in Nigeria, concrete has emerged as the most common building material. Hence careful consideration must be given to factors that affect its strength (Olanitori, 2006). The constituent materials are: cement, fine aggregate, coarse aggregate and water. Concrete is a very variable material, having a wide range of strengths (Mosley, Bungey, & Hulse, 2007). Concrete generally increases its strength with age.

[1] lekanolanitori@gmail.com

[2] otuagamp@yahoo.com

Olanitori, L. M. and Otuaga, M. P. (2017) Effect of plasticizers on properties of concrete with pit sand: case study from Akure, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 589-598.

The precise relationship will depend upon the type of cement used. Some codes of practice allow the concrete strength used in design to be varied according to the age of the concrete when it supports the design load. BS 8110 (1997) does not permit the use of strength greater than 28 – day value in calculations. It is important that the aggregates for making concrete be clean of all sorts of impurities (Olanitori, 2006). Aggregates for concrete are usually specified to comply with requirements of BS 882 (1992), which gives test for suitable aggregate.

However, the quality of concrete produced depends on the quality of its constituent materials and their mix ratios, the higher the percentage of clay/silt content of sand, the lower the characteristic strength (Olanitori and Olotuah, 2005). In order to mitigate the effect of clay/silt content of sand on the strength of concrete produced from it, there is need to increase the cement content of the concrete, depending on the clay/silt percentage (Olanitori, 2006). Olanitori (2012) determined the cost implication of mitigating the effect of clay/silt content of sand using mathematical models.

In his work, Olanitori (2006), noted for a concrete produced from sand with for 4% clay/silt content, with mix ratio 1:2:4, 4% cement increment is needed such that the compressive strength of the concrete is not less than 20N/mm^2. Also, concrete of mix ratio 1:2:4, produced from sand with 5%, 6%, 7%, 8%, 9% and 10% clay/silt content, will need, 14%, 20%, 24%, 32%, 40% and 50% cement increment respectively, so that the compressive strength of concrete is not less 20N/mm^2. This method of mitigating the effect of silt content of sand on the characteristic strength of concrete can be very expensive for sand with high silt content.

Also, Olanitori (2006), suggested the washing away of the silt content of sand as a means of mitigating its effect on concrete strength. The characteristic strength of the concrete produced from the washed sand was 25.5 N/mm^2, which is about 27.5% higher than the targeted strength of 20 N/mm^2.

Olanitori (2012), evaluates the cost implication of mitigating this reduction effect of the type of sand used on concrete strength. The extra cost incurred in the production of 1m^3 of concrete (using mix ratio 1:2:4) in terms of washing the sand free of clay/silt is 22.5%, while that of cement increment is between 2.22% and 27.75% depending on the percentage of clay/silt content of sand. Mathematical models, which can be used to estimate the cost implication of this mitigation, were derived.

The above percentages for the mitigation of the effect of silt content of sand on concrete is very high for the washing method and also high for cement increment if the percentage of the silt content is very high, hence there is the need to find alternative method of the mitigation. Hence the aim of this research work is to determine the effect of RHEOBUILD 561M plasticizers on the strength of concrete. The objectives of this work is to determine if RHEOBUILD 561M plasticizer can used to mitigate the effect of silt content of sand on the strength of concrete and also determine the optimum dosage in ml per kg of cement.

LITERATURE REVIEW

Admixtures are chemicals, added to concrete, mortar or grout at the time of mixing, to modify the properties, either in the wet state immediately after mixing or after the mix have hardened. They can be a single chemical or a blend of several chemicals and may be supplied as powders but most are aqueous solutions because in this form they are easier to accurately dispense into, and then disperse through the concrete (Dransfield, 2003). The active chemical is typically 35–40% in liquid admixtures but can be as high as 100% (e.g. shrinkage-reducing admixtures) and as low as 2% (e.g. synthetic air-entraining admixtures). In most cases the added water from the admixture is not sufficient to require a correction for water–cement ratio (Dransfield, 2003).

Admixtures are usually defined as being added at less than 5% on the cement in the mix but the majority of admixtures are used at less than 2% and the typical range is 0.3% – 1.5%. This means the active chemicals are usually present at less than 0.5% on cement or 0.02% on concrete weight. The dosage may be expressed as litres or kg per 100 kg of cement, and cement normally includes any slag, pulverized fuel ash (pfa) or other binders added at the mixer (Dransfield, 2003).

Admixtures are not the same as additives, which are chemicals pre-blended with the cement or a dry cementitious mix. Neither are they the same as additions, which are added at the mix. Type I additions are essentially inert, e.g. limestone powder or pigments. Type II additions are pozzolanic or latent hydraulic binders such as pfa or silica fume (Nevile, 2010).

Plasticizers or water-reducers are admixtures used for three purposes (Nevile, 2010): to achieve a higher strength by decreasing the water/cement ratio at the same workability as an admixture-free mix; to achieve the same workability by decreasing the cement content so as to reduce the heat of hydration in mass concrete and to increase the workability so as to ease placing in inaccessible locations.

The increase of SP type of plasticizer content by up to 1.2% in concrete with cement, after 7 and 28 days of hardening increases the density and accordingly the compression strength of the specimens (Nagrockiene, Pundiene and Kicaite, 2013). In their work, Malagavelli and Paturu (2012) noted that, workability and compressive strength of concrete increases with the use of super plasticizers, the average slump of measuring workability of concrete with super plasticizer is near to the designed value of the concrete, and that the average 56 days compressive strength of M30 concrete by using super plasticizers is increased by 11.69% compared to concrete without the super plasticizers.

Also, Nanak J Pamnani *et al*, (2013), in their noted that the usage of Super-Plasticizers for Self Compacted Concrete, increase the compressive strength of concrete. Dumne (2014) determined that usage of super-plasticizer and fly ash yields good workable mix in addition to increase in compressive strength marginally.

PROBLEM STATEMENT/ RESEARCH QUESTION

The prescribed and designed mix methods of concrete mix prescription have not been producing concrete that meets the targeted strength. Methods such as increase in cement content of concrete mix and, washing of the sand to remove its silt content will produce a concrete that is very costly. Hence there is the need to find alternative method of this mitigation. Hence the focus of this research work is to determine the effect of RHEOBUILD 561M plasticizers on the strength of concrete and determined if it can used to mitigate the effect of silt content of sand on the strength of concrete.

MATERIALS AND METHODS

The materials used for this research were Portland cement, sand, granite, water and Rheobuild 561M. The fine aggregate used for the study was collected within Akure metropolis and the coarse aggregate was crushed rock, granite, of particle size 12.7mm – 20mm collected from Johnson quarry asphalt company along Akure – Owo express road, Ondo State. Portable water was used during mixing. The cement used for the study was ordinary Portland cement which was locally obtained in Akure, Ondo state.

The tests carried out on the fine and coarse aggregates were particle size distribution, specific gravity, aggregate impact value and aggregate crushing value. Slump test was carried out on fresh concrete, while compressive tests were carried out on the hardened concrete.

The mix ratio used for the production of the concrete used for this work was 1:2:4 and 0.5 water/cement ratio. For the production of 12 concrete cubes which is 3.375×10^{-3} m^3, the quantity of materials needed are 13.88 kg of cement, 27:7.6 kg of sand and 55.52 kg of granite, while 6.94 kg or 6940×10^3 ml of potable water was added. The plasticizer was added at the rate of 0.1% of the amount of cement for each mix concrete. Hence for concrete with mix ratio of 1:2:4 and of volume 3.375×10^{-3} m^3, the quantity of cement needed was 13.88 kg, therefore the quantity of the plasticizer was added at the rate of 5.55 ml.

Total number 120 cubes were cast and cured by immersion in water. The cubes were removed from water 24 hours before testing. These cubes were divided into ten equal groups which contained 12 cubes each. The first group of 12 cubes was called the control concrete cubes, and these cubes did not contain any plasticizer. 5.55 ml of plasticizer was added to the concrete mix of the second group, while 11.1 ml was added to the concrete mix of the second group. 16.65 ml, 22.2 ml, 27.75 ml, 33.3 ml, 38.85 ml, 44.4 ml and 49.95 ml was added to concrete mix of 3rd, 4th, 5th, 6th and 7th groups respectively. Three cubes from all the groups were crushed at 7th, 14th, 21st and 28th respectively.

RESULTS AND DISCUSSION

The results of the sieve analysis are presented in Table 1. From Table 1, the percentage of clay/silt retained on 75μm is 17.2%, which is greater than the 4% stipulated in the code.

Table 1: Sieve Analysis for Sand

Sieve size	Weight Retained (g)	Weight Passing (g)	Cumulative Retained (g)	Percentage Retained (%)	Percentage Passing (%)
4mm	0.4	500	0.4	0.08	99.92
3mm	0.8	499.6	1.2	0.16	99.76
2.36 mm	1.0	498.8	2.2	0.2	99.56
1.7mm	0.7	497.8	2.9	0.14	99.42
1.18 mm	8.1	497.1	11.0	1.62	97.8
600μm	64.0	489.0	75.0	12.8	85.0
500μm	9.0	425.0	84.0	1.8	83.2
425μm	14.0	416.0	98.0	2.8	80.4
212μm	136.0	402.0	234.0	27.2	53.2
150μm	77.0	266	311.0	15.4	37.8
75μm	86.0	189.0	397.0	17.2	20.6
Pan	103.0	103.0	500	20.6	0.00
Total	500	0.0	-	100	-

Hence the sand fails the standard set by the code and not fit for construction in its present form. The results of specific gravity test, aggregate impact value test, aggregate crushing value test and slump tests are given in Table 2.

Table 2: Results of tests on aggregates and fresh concrete

Test	Sand	Granite	Fresh concrete
		Value	
Aggregate impact value (%)	-	21.6	
Aggregate crushing value (%)	-	27.88	
Specific gravity	2.55	2.65	
Slump (mm)			30

The aggregate impact value (AIV) and aggregate crushing value (ACV) of 21.6% and 27.88% are within the standard range of 18% – 21% and 27% – 30% respectively, hence the granite is fit for construction work. Also from Table 2, the slump for fresh concrete is 30 mm, hence the slump is workable and good for construction.

The results of the compressive tests on the concrete cubes at 7th, 14th, 21st and 28th day are presented in tables 3 to 12

Table 3 shows the results of the compressive test carried out on the control concrete cubes, while Tables 4 to 12 show the results of the compressive

tests carried out on the experimental cubes with varying quantities of plasticizer from 5.55 ml to 49.95 ml.

From Table 3, the average compressive strength of the control cubes at the 28th day is 4.63 N/mm^2. Also from Tables 4 to 7, the average compressive strength of the experimental cubes are 7.56 N/mm^2, 8.85 N/mm^2, 10.26 N/mm^2 and 12.82 N/mm^2 respectively. From Tables 8 to 12, the average compressive strength of the experimental cubes are 14.14 N/mm^2, 16.27 N/mm^2, 19.4 N/mm^2 18.48 N/mm^2 and 16.31 N/mm^2 respectively.

Table 3: Results of the compressive concrete test for the Control Experiment

Curing age (days)	Cube 1 Crush test		Cube 2 Crush test		Cube 3 Crush test		Average Comp. Strength (N/mm^2)
	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	
7	8.00	99.00	8.40	74.10	8.10	85.30	3.83
14	8.20	105.30	7.80	100.10	8.10	95.10	4.45
21	7.70	97.70	8.10	128.70	8.45	116.40	5.08
28	7.80	100.70	7.90	110.70	8.10	100.80	4.63

Table 4: Results of the compressive concrete test for the 5.5 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1 Crush test		Cube 2 Crush test		Cube 3 Crush test		Average Comp. Strength
	Weight (kg)	Load (kN)	Weight (kg)	Load kN	Weight (kg)	Load (kN)	(N/mm^2)
7	8.40	92.80	8.30	90.30	8.50	100.40	4.20
14	8.20	135.50	8.45	111.50	8.60	148.55	5.86
21	8.00	150.30	8.30	140.40	8.50	149.40	6.52
28	8.40	165.80	7.90	175.10	8.30	169.20	7.56

Table 5: Results from the compressive concrete test for the 11.1 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1 Crush test		Cube 2 Crush test		Cube 3 Crush test		Average Comp. Strength
	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	(N/mm^2)
7	8.20	115.40	8.35	104.10	8.50	105.85	4.82
14	8.80	152.60	8.25	147.20	8.30	125.50	6.30
21	8.35	165.20	8.45	148.30	8.50	159.00	7.0
28	8.45	205.20	8.60	170.80	8.35	221.38	8.85

Table 6: Results from the compressive concrete test for the 16.8 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1 Crush test		Cube 2 Crush test		Cube 3 Crush test		Average Comp. Strength
	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	(N/mm²)
7	8.40	122.60	8.20	210.00	8.10	128.50	6.83
14	8.10	150.10	8.20	157.30	8.18	166.40	7.02
21	8.20	198.40	8.30	174.40	8.35	158.00	7.86
28	8.30	235.90	8.25	250.30	8.80	206.35	10.26

Table 7: Results from the compressive concrete test for the 22.2 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1	Crush test	Cube 2	Crush test	Cube 3	Crush test	Average Comp. Strength
	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	(N/mm²)
7	8.60	205.40	8.58	234.80	8.25	185.50	9.27
14	8.35	225.80	8.55	245.70	8.45	229.15	10.38
21	8.20	202.40	8.15	277.70	8.45	289.20	11.40
28	8.60	316.40	8.25	322.20	8.50	226.90	12.82

Table 8: Results from the compressive concrete test for the 27.8 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1	Crush test	Cube 2	Crush test	Cube 3	Crush test	Average Comp. Strength
	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	(N/mm²)
7	8.30	158.30	8.80	226.40	8.70	256.80	9.50
14	8.00	182.60	8.10	290.00	8.65	255.70	10.79
21	8.55	212.60	8.70	323.10	8.30	332.40	12.86
28	8.55	230.30	8.70	346.00	8.45	378.00	14.14

Table 9: Results from the compressive concrete test for the 33.3 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1 Crush test		Cube 2	Crush test	Cube 3 Crush test		Average Comp. Strength
	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	Weight Load (kg)	(kN)	(N/mm²)
7	8.30	245.00	8.70	270.40	8.15	213.60	10.8
14	8.00	255.60	8.45	270.50	8.50	307.54	12.35
21	8.20	300.80	8.25	345.60	7.90	352.60	14.8
28	8.00	400.40	8.65	330.20	8.50	367.64	16.27

Table 10: Results from the compressive concrete test for the 38.85 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1	Crush test	Cube 2	Crush test	Cube 3	Crush test	Average Comp. Strength
	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	(N/mm²)
7	8.80	280.40	8.30	324.40	8.75	224.50	12.29
14	8.85	365.80	8.20	326.00	8.55	277.50	14.36
21	8.30	355.40	8.70	380.00	8.55	365.40	16.31
28	8.70	430.60	9.10	458.20	8.85	420.70	19.40

Table 11: Results from the compressive concrete test for the 44.4 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1	Crush test	Cube 2	Crush test	Cube 3	Crush test	Average Comp. Strength
	Weight (kg)	Load (kN	Weight (kg)	Load (kN)	Weight (kg)	Load (kN	(N/mm²)
7	8.45	254.80	8.25	255.30	8.65	268.20	11.53
14	8.50	285.4 (	8.30	290.30	8.50 289.50		12.82
21	8.70	340.30	8.70	339.60	8.50	355.20	15.33
28	8.60	422.50	8.75	404.50	8.55	420.70	18.48

Table 12: Results from the compressive concrete test for the 49.95 ml application of admixture per 13.88 kg ordinary Portland cement

Curing age (days)	Cube 1	Crush test	Cube 2	Crush test	Cube 3	Crush test	Average Comp. Strength
	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	Weight (kg)	Load (kN)	(N/mm²)
7	8.90	209.50	9.01	218.10	8.50	218.90	9.58
14	9.00	261.40	8.90	259.80	8.30	260.50	11.58
21	9.10	323.20	8.90	330.50	8.35	329.70	14.57
28	8.70	365.20	5.20	350.30	8.40	385.20	16.31

The results from the tables 4 to 12 show that the average compressive strength of the concrete cubes increases as the quantity of the plasticizer increases, up to the optimum quantity of 38.3 ml with the corresponding average compressive strength of 19.4 N/mm². Table 13 shows the summary of the average compressive strength of cubes at 28th day with varying quantities of plasticizer

TABLE 13: Summary of the average compressive strength of cubes at 28th day with varying quantities of plasticizer

Q (ml)	0	5.55	11.1	16.65	22.2	27.75	33.3	38.85	44.4	49.95
A.C.S (N/mm^2)	4.63	7.56	8.85	10.26	12.82	14.14	16.27	19.40	18.48	16.31

In their work, Nagrockiene, Pundiene and Kicaite (2013), recorded 14% to 72% increment in the strength of concrete, using sand with zero silt content, depending on the type of cement and super-plasticizer used at 28th day, while Malagavelli and Paturu (2012), recorded 8.6% to 22.4% increment in the strength of concrete, for sand with zero silt content, depending on the type super-plasticizer used at 28th day. However, for this research work, with sand with 17.2% silt content, about 319% increment was recorded using Rheobuild 561M super-plasticizer, at the optimum dosage of 38.85 ml per 13.88kg of cement at 28th day.

CONCLUSION AND RECOMMENDATION

i. Based on the experiments conducted, the following conclusions are drawn.

ii. Addition of super-plasticizer into concrete mix, have incremental effect on the compressive strength.

iii. Super-plasticizers are to be tested in the laboratory to determine the optimum dosage before using in the mass concrete applications.

iv. It is cheaper to use super-plasticizer to mitigate the effect of silt content of sand on concrete strength, than the washing and cement increment methods.

v. It is recommended that super-plasticizer should be used in order to improve the quality of concrete, both at fresh and hardened states.

REFERENCES

British Standards Institution (1992): BS 882:1992. *Specification for Aggregates from Natural Sources for Concrete.* London, BSI.

British Standards Institution (1997): BS 8110-1:1997. "Structural Use of Concrete: Part—I: Code of Practice for Design and Construction". London, BSI.

Dransfield, John (2003): Admixtures for concrete, mortar and grout. In: Newman, J. and Choo, B.S., (eds.) "*Advanced Concrete Technology: Constituent Materials".* Amsterdam, Elsevier. Pp 4/3 – 4/4.

Dumne, S.M. (2014): Effect of Super-plasticizer on Fresh and Hardened Properties of Self-Compacting Concrete Containing Fly Ash. **"***American Journal of Engineering Research*" 3 (3), 205-211.

Malagavelli, V, Paturu, N.R. (2012): Strength and Workability Characteristics of Concrete by Using Different Super Plasticizers. "*International Journal of Materials Engineering*"" 2 (1),7-11

Mosley, W.H., Bungey, J.H, and Hulse, R, (2007). "*Reinforced Concrete Design*" 6th Edition. London. Book-Power with Palgrave Macmillan.

Nagrockiene, D, Pundiene, I and, Kicaite, A. (2013): The effect of cement type and plasticizer addition on concrete properties. "*Construction and Building Materials*" 45: 324 – 331.

Neville A.M. and Brooks J.J. (2010)." *Concrete Technology*" 2nd Edition. England. Pearson Education Limited.

Olanitori L.M and Olotuah A.O. (2005). The Effect of clayey Impurities In Sand on the Crushing strength of Concrete (A case study of sand in Akure Metropolis, Ondo state, Nigeria). In: Dr. C.T. Tam, Prof. K.C.G. Ong and Dr. T.H. Tan (eds). "*30th Conference on Our World in Concrete and Structures" 23-24 August 2005*, *Singapore*. Singapore, CI-Premier PTE Ltd. pp373 – 376.

Olanitori L.M. (2006): Mitigating the Effect of Clay Content of Sand on Concrete Strength. "*31st Conference on Our World in Concrete and Structures*" 15-17 August 2006. Kuala Lumpur, Malaysia. E.L.J Ming (ed.). Pp 344-352.

Olanitori, L.M. (2012): Cost Implication of Mitigating the effect of Clay/Silt Content of Sand on Concrete Compressive Strength. "*Journal of Civil Engineering and Urbanism"*. 2 (4),143 – 148.

Pamnani, N.J., Patel, P.D., Verma, A.K. and Pitroda, J. (2013). Comparison and Optimization of Dosage of Different Super-Plasticizers for Self Compacted Concrete Using Marsh Cone. "*International Journal of Engineering and Innovative Technology"* 2 (8), 79 – 82.

EFFECT OF SMALL TRANSVERSE SERVICE HOLES ON FLEXURAL STRENGTH OF REINFORCED CONCRETE SLENDER BEAMS

Lekan Makanju Olanitori[1] and Taiwo Oladayo Tifase[2]
[1,2]*Department of Civil Engineering, Federal University of Technology, Akure, Ondo State, Nigeria*

The provision of both transverse and longitudinal openings in floor beams helps to facilitate the passage of utility pipes and service ducts. Researches into the behaviour of deep beams with holes were extensively carried out. However, research into the behaviour of slender beams is rare and attracts little attention. Hence, the focus of this research work is to investigate the effect of small service holes on the flexural strength of reinforced concrete slender beams. A total number of ten beams were cast, with concrete grade of C13.02. The cross -sectional dimensions of the beams were 100mm x 150mm, with an effective span of 560mm. The tested beam consisted of two control beams. The experimental beam consisted of eight beams, four of the beams are with 20mm service hole (two at the centre and two at 220mm from both ends), and while the other four had 25mm service holes (two at the centre and two at 220mm from both ends). The reinforced concrete beams were cured by immersion in water in curing tank and tested at 28th day. One of the control beams was subjected to point load at the centre, while the second one was subjected to load at third points. The experimental beam with hole at centre were subjected to point load at the beam centre, while those with holes at support were subjected to load at third points. The study shows that there was decrease in the flexural strength of the beams due to the effect of the holes. The decrease in the flexural strength of the beam with hole at the centre was between 39.62% and 42.64%, while that of the beam with the hole at support is between 6.0% and 14.67%. Hence it is recommended that service holes should be located near the supports as practicable as possible.

Keywords: slender beam, concrete, compressive strength, control beam, service hole

INTRODUCTION

The provision of both transverse and longitudinal openings in floor beams helps to facilitate the passage of utility pipes and service ducts. From a

[1] lekanolanitori@gmail.com
[2] tifasholadayo@yahoo.com

Olanitori, L. M. and Tifase, T. O. (2017) Effect of small transverse service holes on flexural strength of reinforced concrete slender beams *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 599-606.

practical point of view, openings in concrete members are means of accommodating utility services in building structure. This results not only in a more systematic layout of pipes and ducts, but translates into substantial economic savings in the construction of a multi-storey building. The web openings of the beam result in the decrease of flexural and shear strengths, flexural stiffness, and the increase in the deflection of the beam. Therefore the reinforcement at the opening is needed to ensure the proper strength and stiffness of the beams (Mansur *et al*., 1985).

Opening corners are subject to high stress concentration that may lead to cracking, unacceptable from aesthetic and durability viewpoints. The reduced stiffness of the beam may also give rise to excessive deflection under service load and result in a considerable redistribution of internal forces and moments in a continuous beam. Unless special reinforcement is provided in sufficient quantity with proper detailing, the strength and serviceability of such a beam may be seriously affected (Mansur and Tan, 1999a).

Usually in modern building construction, service pipes and ducts are placed underneath the beam soffit and, for aesthetic reasons, are covered by a suspended ceiling, thus creating a dead space. Passing these ducts through transverse openings in the floor beams instead of below or above the member leads to a reduction in the dead space and results in a more compact design (Mansur and Tan, 1999b). For small buildings, the savings thus achieved may not be significant. But for multi-storey buildings, any saving in story height multiplied by the number of stories can represent a substantial saving in total height, length of air-conditioning and electrical ducts, plumbing risers, walls and partition surfaces, and overall load on the foundation.

From economic point of service ducts can bring about a lot of savings, however, structurally, if not properly planned, service ducts can compromise the structural integrity of building. Therefore, the aim of this research work is to investigate the effect of small service holes on the strength characteristic of reinforced concrete slender beams, which are the most common type of beam being encountered in structures, and modify the present design equations and detailing procedures if necessary.

LITERATURE REVIEW

The exact analysis of reinforced concrete deep beam is a complex problem and the presence of web openings aggravates the situation. Deep beams are defined as members loaded on one face and supported on the opposite face so that compression struts can develop between the loads and the supports. Their clear spans are either equal to or less than four times the overall member depth, or regions with concentrated loads within twice the member depth from the face of the support (ACI 318-2008), whereas the Euro Code 2 (BS EN 1992-1-1:2004) defines a deep beam as a member whose span is less or equal to 3 times the overall section depth.

Circular and rectangular openings are the most common types in practice. When the size of opening is concerned, many researchers use the terms

small and large without any definition or clear-cut demarcation line. From a survey of available literature, it has been noted that the essence of such classification lays in the structural response of the beam. When the opening is small enough to maintain the beam-type behavior, or in other words if the usual beam theory applies, then the opening may be termed as small opening. Those that prevent beam-type behavior to develop are termed large opening. Thus, beams with small and large openings need separate treatments in design (Mansur and Tan, 1999b). Based on the research work reported in the literature, there were comprehensive treatments of openings under bending and shear, addressing the major issues concerning structural design of deep beams (Mansur and Tan, 1999b). It has been shown that the design of beams with large openings can be further simplified by maintaining its rationality and upholding construction economy (Mansur and Tan, 1999b).

Mansur and Tan (1999b), considered circular and square (or rectangular) in shape opening as small if $d \leq 0.25\ h$ (where d is depth of square or rectangular openings or the diameter of a circular opening) and otherwise, it is classified as large opening. Therefore, analysis and design of a beam with small openings may follow the similar course of action as that of a solid beam.

Though the strut and tie model (STM) is effective for the design of D-Regions of deep beams, however, the method has not yet been widely implemented due to many reasons such as the difficulty in fixing an optimum truss configuration for a given structural member with given loading, and the complexity and approximation of the solution and the inability of the STM to predict the failure modes of deep beams, Tan *et al*. [2003] and Yang *et al*. [2006].

Mansur *et al* (2006), examined the STM for the analysis of reinforced concrete beams that contain geometric discontinuities in the form of a transverse circular opening in the web. By comparing the theoretical predictions concerning the ultimate strength, mode of failure and the proportion of applied shear carried by the chord members above and below the opening show good agreement with test results. Also, Mansur *et al* (2006) noted that the truss model also explains clearly the role of diagonal reinforcement in relieving concrete distress at the throat section by transferring a significant amount of applied shear across the discontinuity.

In his study of the behaviour of reinforced concrete deep beams with web openings using the finite element method, Mohamed *et al* (2014), shows that web openings crossing the expected compression struts should be avoided, and the depth of the opening should not exceed 20% of the beam overall depth and that reinforcement distribution should be in the range of 0.1 – 0.2 beam depth for simply supported deep beams.

For beams with opening, the ultimate strengths were decreased by 12%, 22% and 41% for beams containing opening at distance L/2, L/3 and L/6 from the edge respectively (Aziz, 2016). Also, the change in opening locations from the centre towards the edge lead to decrease the carrying capacity for

about 29%. Presence of openings leads to concentrated of stress around their hollow and caused decreasing in the load carrying capacity. As a result, when the location of web opening moved toward of edges (supports), the ultimate shear strength decreased (Aziz, 2016).

In their work (Vivek and Madhavi, 2016), noted that the presence of large openings in reinforced concrete beams requires special attention in the analysis and design phase because of the reduction in both strength and stiffness of the beam and excessive cracking at the opening due to high stress concentration.

PROBLEM STATEMENT/ RESEARCH QUESTION

Beams with span/depth ratios of about four or less are categorized as deep beams. Researches into the behaviour of deep beams with holes were extensively carried out. However, research into the behaviour of slender beams is rare and attracts little attention. Hence, the focus of this research work is to investigate the effect of small service holes on the strength characteristic of reinforced concrete slender beams, which are the most common type of beam being encountered in structures. Therefore, the aim of this research work is to investigate and determine the effect of small service holes on strength characteristics of reinforced concrete slender beams.

MATERIALS

The materials used for this research work are Portland cement, sand (4.75mm), crushed granite (12mm), water and reinforcing bars, clean water. The concrete grade to be used is 13.02 N/mm^2, while that of reinforcing bar is 410 N/mm^2.

Control and experimental beams (eight beams)
Two numbers of beams were used as control beam (beam without holes), while the total number of experimental beams (beams with service holes) were eight. Four of these beams with 25mm service holes (two at the center and two at 220mm from both ends), while the other four has 20mm service holes (two at the center and two at 220mm from both ends).

The beams specifications and materials strength characteristics are as given below:

Beam: 100mm x150mm x 1000mm; effective span $l_e = 560mm$; $f_{cu} = 13.02\ N/mm^2$; $f_y = 410\ N/mm^2$; $d = 125mm$; Reinforcing bar = 2Y10; As = 157 mm^2.

Loading of the beams
The beams were given two types of loadings. The first point load was applied at the point of maximum moment (center) for the Beam with service hole at the center, while the second loading was a two symmetrical point load applied at 200mm apart, and at a distance of 180 mm from the supports.

Equipment

The equipment used for this research work was:

a) Loading Frame or Loading Machine and (b) Dial Gauges.

Tests on the beams

The tests were carried out in accordance to AASHTO 177. The control beams were subjected to increasing load under the flexural machine. As the load increased, cracks occurred in the most highly stressed zone. The cracks developed from the point of application of load, and spread outwards to form multiple cracks. As the load increased, the cracks increased in width until the beam failed. Table shows details of the beam specimens, while results of the beams tests are presented in Tables 2 to 6.

Table 1: Details of beam specimens

S/N	X-sectional Dimension (mm)	Main Bar	Shear bar	Hole diameter	Position of hole	Loading arrangement
B1	100 x 150	10mm	10mm	-	-	At centre
B2	100 x 150	10mm	10mm	-	-	Third points
B3	100 x 150	10mm	10mm	20mm	At mid-span of beam	At centre
B4	100 x 150	10mm	10mm	20mm	At mid-span of beam	At centre
B5	100 x 150	10mm	10mm	20mm	At the supports	Third points
B6	100 x 150	10mm	10mm	20mm	At the supports	Third points
B7	100 x 150	10mm	10mm	25mm	At mid-span of beam	At centre
B8	100 x 150	10mm	10mm	25mm	At mid-span of beam	At centre
B9	100 x 150	10mm	10mm	25mm	At the supports	Third points
B10	100 x 150	10mm	10mm	25mm	At the supports	Third points

RESULTS AND DISCUSSION

The results of the tests carried out on the control beams are presented in Table 2. From the table, B_1 which was loaded with a point load at the centre failed under a 68 kN load, while B_2 which was loaded at third points failed under a 75 kN load. The bending moments (B.M) at failure are 9.52 kNm and 10.50kNm for B_1 and B_2 respectively.

From Table 3, B_3 and B_4 which were loaded with a point load at the centre failed under a 40.10 kN and 42.00 kN load respectively, while B_5 and B_6 which were loaded at third point failed under a 68.00 kN and 73.00 kN load respectively. The B.M at failure were 5.61 kNm, 5.88 kNm, 9.52 kNm and 10.22 kNm for beams B_3, B_4, B_5 and B_6 respectively.

Table 2: Results of flexural test on Control Beams.

Beam no	Weight (kg)	Position of load	Load at failure (kn)	Bending moment (knm)
B1	43.40	beam centre	68.00	9.52
B2	43.50	third points	75.00	10.50

Table 3: Results of flexural test on Experimental Beam with 20mm service holes.

Beam no	Weight (kg)	Position of hole	Position of load	Load at failure (kn)	Bending moment (knm)
B3	43.50	Centre	beam centre	40.10	5.61
B4	42.70	Centre	beam centre	42.00	5.88
B5	44.20	supports	third points	68.00	9.52
B6	44.00	supports	third points	73.00	10.22

Table 4: Results of flexural test on Experimental Beams with 25mm service holes

Beam No	Weight (kg)	Position of hole	Position of load	Load at failure (kn)	Bending moment (knm)
B7	43.70	Centre	beam centre	39.00	5.46
B8	43.50	Centre	beam centre	39.00	5.46
B9	40.60	supports	third points	65.00	9.10
B10	41.3	supports	third points	63.00	8.82

Table 5: The comparison of estimated ultimate load and actual load of the experimental beams

Beam no	Estimated ultimate load (f_{eul}) kN	Actual Ultimate load (f_{aul}) kN	$\left(\frac{F_{AUL} - F_{EUL}}{F_{EUL}}\right) \times 100$ %
B_1	45.57	68.00	49.22
B_2	71.21	75.00	5.32
B_3	45.57	40.10	-12.00
B_4	45.57	42.00	-7.83
B_5	71.21	68.00	-4.51
B_6	71.21	68.50	- 3.81
B_7	45.57	39.00	-14.42
B_8	45.57	39.00	-14.42
B_9	71.21	65.00	-8.72
B_{10}	71.21	63.00	-11.53

From Table 4, B_7 and B_8 loaded with a point load at the center failed under 39.00 kN load. While beam B_9 and B_{10} which were loaded at third point failed under a 65.00kN and 63.00kN load respectively. The B.M at failure for B_7, B_8, B_9 and B_{10} were 5.46 kNm, 5.46 kNm, 9.10 kNm and 8.82 kNm for the respective beams.

From Table 5, the estimated ultimate load (F_{EUL}) for beams B_1 and B_2 are 45.57kN and 71.2kN respectively, while the actual ultimate load (F_{AUL}) were 68.00kN and 75.00kN for beams B_1 and B_2 respectively. These values show an increment of 49.22% and 5.32% of F_{AUL} over the F_{EUL} for beams B_1 and B_2. Also from Table 5, there were decrease of 12%, 7.83% and 4.51% of F_{AUL} over the F_{EUL} for beams B_3, B_4 and B_5 respectively. While there was an increment of 2.51% for B_6. Likewise for beams B_7, B_8, B_9 and B_{10}, there were decrease of 14.42%, 14.42%, 8.72% and 11.53% of F_{AUL} respectively over that of the F_{EUL}.

Table 6: Effect of Size of Hole on Strength Characteristics of Beam

Beam Loaded at Centre				Beam Loaded at Third Points			
Beam no	Ultimate load $F(kN)$	$\left(\frac{F_{CONTB}-F_{EXPB}}{F_{CONTB}}\right)x100\%$		Beam no	Ultimate load $F(kN)$	$\left(\frac{F_{CONTB}-F_{EXPB}}{F_{CONTB}}\right)x100\%$	
		Actual %	Average %			Actual %	Average %
Ultimate load of control beam B_1 = 68.00 kn				**Ultimate load of control beam B_2 = 75.00 kn**			
B_3	40.10	41.00	39.62	B_5	68.00	9.33	9.00
B_4	42.00	38.24		B_6	68.50	8.67	
B_7	39.00	42.64	42.64	B_9	65.00	13.33	14.67
B_8	39.00	42.64		B_{10}	63.00	16.00	

For beam loaded at the centre with point load, Table 6 shows that beams (B_3 and B_4) with 20 mm diameter holes and beams (B_7 and B_8) with 25mm diameter holes have an average value of 39.62% and 42.64% reduction effect on the ultimate load respectively. This means increasing the diameter of the hole at the centre from 20 mm to 25 mm (25% increment) have reduction effect of about 3.02% when loaded with a point at the centre. Also for beam loaded at third points, Table 6 shows that beams (B_5 and B_6) with 20mm and beams (B_9 and B_{10}) with 25mm diameter holes have an average value of 9.0% and 14.67% reduction effect on the ultimate load respectively. Hence for beams with holes at supports and loaded at third points, 25% increment of the diameter of the hole from 20 mm to 25 mm have a reduction effect of 8.67%.

CONCLUSIONS

From the discussion of results above, the following conclusions can be made:

1. There is general increase in the ultimate load of the beams without holes when compared with the estimated one.
2. For beams with 20mm hole at the centre and equally loaded at the centre with a point load, there is an average decrease of 9.9% of actual ultimate load when compared with the estimated one, while for beam with 25mm hole at the centre and equally loaded at the centre, there is an average decrease of 14.42% of actual ultimate load when compared with the estimated one.
3. For beams with 20mm holes near the supports and loaded at third points, there is an average decrease of 4.16% of actual ultimate load when compared with the estimated one, while for beam with 25mm at the supports and loaded at third points, there is an average decrease of 10.13% of actual ultimate load when compared with the estimated one.
4. The decreasing effect of size of hole at the centre on strength characteristics of beam loaded at centre is 39.62% to 42.64%, while that loaded at third points is 9.0% to 14.67%.

5. Increasing the diameter of hole from 20mm to 25mm had 3.02% and 8.67% reduction effect on the control beam, for beam loaded at centre with a point load and that loaded at third points respectively.

RECOMMENDATIONS

Based on the above conclusions, the following recommendations can be made.

1. Since there is increase in the ultimate load of beams with service holes when compared with the estimated one, hence there is no need to modify the existing design equations of beam for flexure.
2. Service holes must be located near the supports of beams, since the effect of hole located close to the support on strength characteristics of beam is reduced when compared with holes located at the center.

REFERENCES

American Concrete Institute (2008). ACI Committee 318: 2008. *Building Code Requirements for Structural Concrete and Commentary*. Farmington Hills, MI. American Concrete Institute.

Aziz, A.H. (2016). Experimental and Theoretical Evaluation for Effect of Openings Locations on Shear Strength of RC Beams. *Journal of Engineering and Development*, 20 (1), 1 – 15.

British Standards Institution (2004). BS EN 1992-1-1:2004: *Design of Concrete Structures, Part 1-1: General Rules and Rules for Buildings*. London, BSI.

Mansur, M.A., Tan, K.H., and Lee, S.L. (1985). A Design Method for Reinforced Concrete Beams with Large Openings. *Journal of the American Concrete Institute, Proceedings*, 82 (4),517 – 524.

Mansur, M.A., and Tan, K.H. (1999a). Effects of creating ab opening in existing beams. *ACI Structural Journal*, 98 (3), 407 – 415.

Mansur, M.A., and Tan, K. (1999b). *Concrete Beams with Openings: Analysis and Design*. Boca Raton, CRC Press.

Mansur, M. A., Tan, k. and Weng W. (2006). Analysis of Concrete Beams with Circular Web Openings using Strut and Tie Models. *Malaysian Journal of Civil Engineering*.18 (2). 89-98

Mohamed, A.R., Shoukry, M.S., and Saeed, J.M. (2014). Prediction of the Behavior of Reinforced Concrete Deep Beams with Web Openings using the Finite Element Method. *Alexandria Engineering Journal*, 53 (2), 329 – 339.

Tan, K.H., Tong, K., and Tang, C.Y. (2003). Consistent strut-and-tie modeling of deep beams with web openings, *Mag. Concr. Res*.55 (1),572–582.

Vivek, R. and T. Ch. Madhavi, T. Ch. (2016). Behaviour of reinforced Concrete Beam with Web Openings. *ARPN Journal of Engineering and Applied Sciences*. 11 (9),5993–5995.

Yang, K.H., Eun, H.C., and Chung, H.S. (2006). The influence of web openings on the structural behavior of reinforced high-strength concrete deep beams. *Engineering. Structures*, 28, (13) 1825–1834.

EFFECTS OF QUADRICEPS MUSCLE FATIGUE ON BALANCE CONTROL AND FALLS INJURIES FOLLOWING REPETITIVE SQUAT LIFTING TASK IN CONSTRUCTION WORKERS

Maxwell Fordjour Antwi-Afari[1], Heng Li[2], JoonOh Seo[3] and Arnold Yu Lok Wong[4]

[1,2,3]Dept. of Building and Real Estate, Hong Kong Polytechnic Univ., Room No. ZN1002, Hung Hom, Kowloon, Hong Kong SAR

[4]Dept. of Rehabilitation Sciences, Hong Kong Polytechnic Univ., Room No. ST512, Hung Hom, Kowloon, Hong Kong SAR.

Quadriceps muscle fatigue has been perceived as a discomfort/pain injury associated with repetitive squat lifting task, however, its effect on balance control remains unexamined. The objective of this study was to evaluate the effect of quadriceps muscle fatigue on balance control following repetitive squat lifting task. Ten healthy male participants (27 ± 3.4 years) conducted an upright stance for 15 seconds with vision occlusion on a stable and an unstable support surface on a force plate before and immediately after the fatigue of the quadriceps muscles induced by repetitive lifting with 15% of participant's maximum lifting strength. Each participant's centre of pressure (CoP) parameters on the force plate [i.e., sway area, antero-posterior (A/P) and medio-lateral (M/L) directions of root mean square (RMS), A/P and ML mean velocity (MV), A/P and M/L median frequency (MF)] were measured to assess balance control. Our results showed that quadriceps muscle fatigue: (1) significantly increase all CoP parameters (i.e. poorer balance control); (2) has more profound adverse effect on maintaining the balance on an unstable surface as manifested by increased M/L and A/P directions of MV and MF. Overall, the current findings suggest that quadriceps muscle fatigue may impair balance control in the frontal and sagittal planes, which may increase the risks of fall injuries.

Keywords: balance control, construction worker, fall injuries, postural task, quadriceps muscle fatigue, repetitive squat lifting

[1] maxwell.antwiafari@connect.polyu.hk
[2] heng.li@polyu.edu.hk
[3] joonoh.seo@polyu.edu.hk
[4] arnold.wong@polyu.edu.hk

Antwi-Afari, M. F., Li, H. I., Seo, J. and Wong, A. Y. L. (2017) Effects of quadriceps muscle fatigue on balance control and falls injuries following repetitive squat lifting task in construction workers *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 607-615.

INTRODUCTION

Fall injuries and fatalities continue to pose a significant burden to the construction industry. In Hong Kong, fall injuries contributed to more than 47% of the total fatal incidents (Chan et al., 2008). Moreover, the Hong Kong Occupational Safety and Health (HKOSH) reported that there were 3,332 fall injuries and 37 fatalities that occurred in the construction industry, which accounts for 19.68% of fatalities across all industries in 2013 (HKOSH, 2014). Loss of balance is the major cause of slip, trip, and falls injuries (Glazner et al., 2005). While several studies have investigated the impacts of extrinsic factors (such as unstable surfaces, carrying heavy weights, and awkward working postures impairment) on workers' balance control (Hsiao and Simeonov, 2001), no study has investigated the effect of intrinsic factors (e.g. localized muscle fatigue) on balance control, which may result in occupational fall injuries. While fatigue of lower extremity muscles at knee or ankle has been thought to impair balance and to increase the risk of falls injuries (Corbeil et al., 2003), the impact of construction-related task on lower limb muscle fatigue and subsequent balance control has not been explored. A good understanding of this impact can help develop relevant fall prevention interventions for the construction industry.

LITERATURE REVIEW

While the risks of fall injuries can be mitigated by the ergonomic design of the working environment, balance control is inherently far more complex and relies upon the coordination of multiple sensory systems (visual, vestibular, and proprioception/somatosensory), the motor system and central nervous system (Horak, 2006). Balance control is an essential construction workers' physical ability that needs to be examined following fatiguing repetitive squat lifting task. Specifically, repetitive squat lifting task has been demonstrated as a significant risk factor for musculoskeletal disorders (apparently through muscle fatigue) in industrial occupational settings (e.g., construction, ergonomics) (Straker, 1997). In construction, certain construction works (e.g. rebar works) are physically demanding, and often require repetitive manual lifting of heavy weights in awkward postures (e.g. squat and/or stoop) (Buchholz et al., 2003). For instance, typical rebar work tasks include: i) preparing rebars (e.g. pulling rebars from the stack, cutting or bending rebars); and ii) assembling rebars (e.g. lifting, placing and tying rebars) (Saari and Wickström, 1978). Chan et al. (2012) have reported that rebar workers in Hong Kong spend 30% of their work time preparing rebars and 70% assembling them. Both tasks require repetitive rebar lifting and heavy weight handling in awkward postures. Quadriceps muscle fatigue has been perceived as a discomfort/pain injury associated with repetitive squat lifting task (Hagen and Harms-Ringdahl, 1994; Antwi-Afari et al., under review). Although several studies have examined the effect of localized muscle fatigue on balance control, they usually used simple repetitive segmental movement to cause fatigue of plantar flexors and dorsiflexors muscles (Lundin et al., 1993; Gribble and

Hertel 2004a; Yaggie and McGregor, 2002; Corbeil et al., 2003). Lundin et al. (1993) found that isokinetically induced fatigue to the plantar flexor and dorsiflexor of the ankle created a significant increase deficit in balance control. Some studies examined the relation between balance control and quadriceps muscle fatigue using an isotonic single-leg squat (Ballantyne and Shields, 2010), or isometric contraction (Vedsted et al., 2003), which were fatiguing tasks unrelated to the construction industry. Against this background, the objective of the current study was to evaluate the effect of quadriceps muscle fatigue on balance control following a repetitive squat lifting task that was comparable to construction work. It was hypothesized that quadriceps fatigue induced by a simulated repetitive squat lifting task would impair balance control.

RESEARCH DESIGN AND METHODS

Participants

Ten healthy male participants between the ages of 22 to 32 (mean = 27, SD = 3.40) years, were recruited to participate in the study. Participants were included if they had: (1) no history of lower extremities injury; (2) no history of any neurological, vestibular disorders or other conditions affected balance. All participants provided their informed consent in accordance with the procedure approved by the Human Subject Ethics Subcommittee of The Hong Kong Polytechnic University (reference number: HSEARS20160719002).

Experimental procedure

This study involved a single visit, where balance control was assessed before (pre-fatigue/baseline) and immediately after (post-fatigue) performing a simulated repetitive squat lifting task. At the beginning, participants were allowed to practice a squat lifting posture (Straker, 2003) for few seconds. For the balance tests, participants were assessed under two postural task conditions (stable vs. unstable), where two 15 s trials of quiet standing as still as possible with feet together were collected. This duration was considered adequate for stability and reliability of center of pressure (CoP) parameters (Doyle et al., 2005). The two balance tasks included: eyes closed standing on stable surface (ECS) and eyes closed standing on foam surface (ECF). The purpose of using these postural tasks during quiet upright stance was to evaluate the effect of muscle fatigue on balance control during different support surfaces (Bisson et al., 2010). The order of the postural tasks was randomized. These postural tasks required the eyes and ears of each participant to be occluded with a smart non-transparent goggle (ANSI Z 136, USA) and headphone (CE EN 352, Australian standard) respectively.

A repetitive lifting cycle (lifting and lowering) at 10cycles/min were performed by participants using a squat lifting posture with a submaximal weight of 15% of maximum lifting strength (MLS) placed inside a wooden box (30 × 30 × 25 cm height). In order to determine the MLS of the submaximal weight of each participant, an isometric strength testing device (Chattecx Corporation, USA) was used. The highest value of two trials with

2 min break between trials was assumed to be the participant's MLS after they achieved their perceived lifting strength using a squat lifting posture. The lifting cycle started from the floor to a bench at the waist level, rest for about 3 seconds (without losing contact with the box) and then lowered it down to the floor. To standardize the lifting cycle, an audio signal of a metronome was used. Quadriceps fatigue was determined as the inability to complete a lifting cycle with verbal encouragement. The force plate platform was positioned adjacent the lifting task set up to minimize the time interval between the fatiguing lifting tasks and the CoP measurements.

Data collection and Statistical analysis

The CoP data were collected using a force plate (KISTLER Instrumente. AG, Winterthur, Switzerland) at 50 Hz sampling rate. The changes in CoP displacements before and after fatigue were quantified with two balance trials using MATLAB 7.9 software (Matlab, The MathWorks Inc., MA, USA). The CoP data were low passed filtered with a second-order Butterworth filter (10Hz). The CoP parameters measured included: sway area; root mean square (RMS); mean velocity (MV); and median frequency (MF). With regards to RMS, MV, and MF CoP parameters, this study computed separately for their anterior/posterior (A/P) and medial/lateral (M/L) directions. A detailed explanation of these time and frequency domain CoP parameters can be found in previous studies (Lafond et al., 2004).

After assuring the normality of data by using Shapiro-Wilk, separate two-way (2 × 2) analyses of variance (ANOVA) with repeated measures were used with independent variables: postural tasks (ECS vs. ECF) and effect of fatigue (pre- vs. post-fatigue) for each CoP parameter. In the presence of significant interactions, post hoc pairwise comparisons were conducted with Bonferroni adjustment. All statistical analyses were analyzed by the Statistical Package for the Social Science (SPSS) version 20.0 (IBM, USA). Statistical significance was set at $p < 0.05$.

RESULTS

Table 1 presents the results of mean and standard deviations of pre- and post-fatigue and postural balance trials of each CoP parameter following repetitive squat lifting task. Significant main effect of fatigue was found for each CoP parameter ($p < 0.001$), but not postural task on balance control (Table 1). Significant interactions of A/P RMS ($F = 16.75$, $p = 0.003$, $\eta_p^2 = 0.65$), M/L MV ($F = 6.92$, $p = 0.027$, $\eta_p^2 = 0.44$), A/P MV ($F = 12.67$, $p = 0.006$, $\eta_p^2 = 0.59$) and A/P MF ($F = 17.55$, $p = 0.002$, $\eta_p^2 = 0.66$) were found for postural task by fatigue (Table 1). Post hoc analyses revealed that at the ECS postural task condition, all CoP parameters were significantly (all $p < 0.01$) greater at the post-fatigue than the pre-fatigue. Similarly, all CoP parameters revealed significantly (all $p < 0.01$) increased balance control at post-fatigue compared to pre-fatigue during the ECF postural task condition. In all pairwise comparisons, both the A/P and M/L directions in

the RMS, MV, and MF found similar increase in balance control after fatigue.

Table 1. Mean (SD) of pre- and post-fatigue fatigue and postural tasks in all CoP parameters

CoP parameter	Postural task	Pre-fatigue	Post-fatigue	Postural task *p* value	Fatigue *p* value	Postural task × fatigue *p* value
Sway area	ECS	1.02 (0.81)	7.28 (4.54)	0.420	0.000[b]	0.431
	ECF	2.94 (1.95)	7.55 (3.72)			
M/L root mean square	ECS	0.19 (0.17)	0.79 (0.39)	0.214	0.000[b]	0.091
	ECF	0.27 (0.30)	1.13 (0.47)			
A/P root mean square	ECS	0.34 (0.20)	1.15 (0.34)	0.075	0.000[b]	0.723
	ECF	0.35 (0.37)	1.83 (0.73)			
M/L Mean velocity	ECS	3.02 (1.45)	8.01 (2.75)	0.001[a]	0.000[b]	0.027[c]
	ECF	12.13 (7.06)	20.39 (6.91)			
A/P Mean velocity	ECS	6.30 (1.80)	12.54 (3.32)	0.000 [a]	0.000[b]	0.006[c]
	ECF	15.75 (7.20)	27.07 (6.25)			
M/L Median Frequency	ECS	0.48 (0.16)	0.99 (0.39)	0.000 [a]	0.000[b]	0.003[c]
	ECF	1.02 (0.19)	1.48 (0.41)			
A/P Median Frequency	ECS	0.82 (0.18)	1.23 (0.36)	0.000 [a]	0.000[b]	0.002[c]
	ECF	1.28 (0.11)	1.95 (0.02)			

Note: M/L = Medial/Lateral; A/P = Anterior/Posterior; and MLS = Maximum Lifting Strength. [a]Indicates that there was a significance difference between postural tasks. [b]Indicates that there was a significance difference between fatigue. [c]Indicates that there was a significance interaction between postural tasks and fatigue.

DISCUSSION OF RESULTS

This study evaluated the effect of quadriceps muscle fatigue on balance control following a simulated repetitive squat lifting task. Our results found that: (1) quadriceps muscle fatigue significantly increased swaying of body as compared to baseline; (2) postural tasks on unstable support surfaces significantly increase M/L MV, A/P MV, M/L and A/P MF as compared to stable surfaces, and (3) quadriceps muscle fatigue significantly increased both time-distance and frequency domain parameters associated with balance control in both the M/L and A/P directions. Collectively, the findings of this study suggest that increased quadriceps muscle fatigue may impair balance control in the frontal and sagittal planes. It has been reported that an increase in balance sway has been used as a surrogate measure of individuals' balance ability, and there is evidence that risks of fall injuries are related to increased balance control (Yaggie and McGregor, 2002; Corbeil et al., 2003).

The increases in CoP parameters alongside quadriceps muscle fatigue implies impaired balance control, which may subsequently result in the risk of fall injuries (Yaggie and McGregor, 2002). Our results were consistent

with the finding of previous studies that found increased balance control with the quadriceps muscle fatigue (Maffiuletti et al., 2007; Mokha et al., 2012). Maffiuletti et al. (2007) reported impaired quadriceps muscle fatigue as the torque loss during a voluntary isokinetic (50 maximal contraction at 180°/s) and an electro stimulated (40 Hz) isometric protocol (5 mins, 10% of the maximal torque). Mokha et al. (2012) demonstrated a deficit of quadriceps muscle fatigue after participants performed an isotonic long-arc resisted with a 10-lb weight attached to each foot. In the present study, participants conducted repetitive squat lifting posture with both feet while lifting a weight of 15 kg until subjective fatigue. Although the current experimental protocol was different from other fatiguing quadriceps muscle tasks which are unrealistic to construction workers, the overall findings were similar with an increase in CoP parameters after fatigue.

In addition, our results found a greater balance impairment related to muscle fatigue was more profound on unstable surfaces than stable surfaces. It is well known that the three sensory systems are involved in maintaining balance control: visual, vestibular, and proprioceptive (somatosensory) (Horak, 2006). In the present study, both visual and vestibular systems could not contribute to the measured increased in CoP parameters because participants had their vision and hearing occlusion during the balance tests (Stoffregen et al., 2000). As such, one potential explanation for the increase in balance deficit found in this study was related to a decrease in muscle proprioceptive input with fatigue (Yaggie and McGregor, 2002). Yaggie and McGregor (2002) reported impaired balance control of the plantar flexors and dorsiflexors following isokinetic fatigue of the ankle. Similar to the present study, the repetitive squat lifting posture could lead to greater displacement of the whole-body center of mass (COM) during quiet standing, which may demand an increase in CoP displacement to maintain the COM within the reduced base of support.

In the present study, the effect of quadriceps muscle fatigue found significantly increase in the MV and MF CoP parameters with similar increases in both A/P and M/L directions. Previous studies have reported that the time domain feature of CoP MV is the most accurate balance parameter for sensory information related to balance control (Kiemel et al., 2002; Jeka et al., 2004). Jeka et al. (2004) explained that even though the sensory systems are all related to velocity-sensitive information, the changes that occurred in the velocity variable were mainly caused by proprioception impairment of the fatigued quadriceps muscles. These changes could further explain why the effect of quadriceps muscle fatigue was more pronounced for the M/L and A/P MV. In addition, it appears that balance control in the M/L and A/P direction is affected more substantially by fatigue of proximal musculature at the hip, quadriceps, and knee than the distal musculature of the ankle (Gribble and Hertel, 2004a). Although the present study only reported on quadriceps muscle fatigue on balance control, the importance of M/L and A/P directions on balance control have been demonstrated by the association between frontal and sagittal instability, and the risks of fall injuries (Corbeil et al., 2003).

CONCLUSIONS AND RECOMMENDATIONS

This study evaluated the effects of quadriceps muscle fatigue on balance control following a simulated repetitive squat lifting task. Our results showed that the effect of (1) quadriceps muscle fatigue significantly impair balance control following repetitive squat lifting task, (2) quadriceps muscle fatigue significantly decrease in the CoP velocity, which was mainly caused by proprioception impairment in the reduced base of support. Overall, the findings of this study suggest that increased quadriceps muscle fatigue may impair balance control around the frontal and sagittal planes and that may increase the risks of fall injuries. The current findings suggest that interventions (e.g., intermittent rest periods, exoskeletons, cranes etc.) should be adopted to minimize the quadriceps muscle fatigue of construction workers who are involved in repetitive squat lifting task. Despite the promising results, the current study was limited by the relatively small sample size and a simulated work task in a laboratory, future field research should be conducted to evaluate the impacts of other muscle fatigue (e.g. lower-back muscle) on the resulting balance of experienced rebar workers on construction sites.

ACKNOWLEDGEMENTS

The authors acknowledged the Department of Building and Real Estate of The Hong Kong Polytechnic University for funding this research.

REFERENCES

Antwi-Afari, M. F. Li, H. Edwards, D. J. Pärn, E. A. Seo, J. and Wong, A. L. U. Identification of potential biomechanical risk factors for low back disorders during repetitive rebar lifting. *Construction Innovation,* Under-review.

Ballantyne, B. T. and Shields, R. K. (2010) Quadriceps fatigue alters human muscle performance during a novel weight bearing task. *Med. Sei. Sports Exerc*., 42(9), 17I2–1722.

Bisson, J. E. Chopra, S. Azzi, E. Morgan, M. and Bilodeau, M. (2010) Acute effects of fatigue of the plantarflexor muscles on different postural tasks. *Gait Posture,* 32, 482–486.

Buchholz, B. Paquet, V. Wellman, H. and Forde, M. (2003) Quantification of ergonomic hazards for ironworkers performing concrete reinforcement tasks during heavy highway construction. *American Industrial Hygiene Association Journal*, 64(2) 243-250.

Chan, A. P. C. Wong, F. K. W. Chan, D. W. M. Yam, M. C. H. Kwok, A. W. K. Lam, E. W. M. and Cheung, E. (2008) Work at height fatalities in the repair, maintenance, alteration, and addition works. *ASCE J. Constr. Eng. and Manag.* 134, 527–35.

Chan, A. P. C. Yam, M. C. H. Chung, J. W. Y. and Yi, W. (2012) Developing a heat stress model for construction workers. *Journal of Facilities Management*, 10(1), 59–74.

Corbeil, P. Blouin, J. S. Begin, F. Nougier, V. and Teasdale, N. (2003) Perturbation of the postural control system induced by muscular fatigue. *Gait Posture*, 18 (2), 92–100.

Doyle, T. L. Newton, R. U. Burnett, A. F. (2005) Reliability of traditional and fractal dimension measures of quiet stance centre of pressure in young, healthy people. *Arch. Phys. Med. Rehabil.,* 86, 2034–2040.

Glazner, J. Bondy, J. Lezotte, D.C. Lipscomb, H. and Guarini, K. (2005) Factors contributing to construction injury at Denver International Airport. *Am. J. Ind. Med*., 47, 27–36.

Gribble, P. A. Hertel, J. (2004a.) Effect of lower extremity muscle fatigue on postural control. *Arch. Phys. Med. Rehabil.,* 85, 589–92.

Hagen, K. B. and Harms-Ringdahl, K. (1994) Ratings of perceived thigh and back exertion in forest workers during repetitive lifting using squat and stoop techniques. *Spine*, 19, 2511–2517.

Hong Kong Occupational Safety and Health HKOSH. (2014) Occupational Safety and Health Statistics.

Horak, F. B. (2006) Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? *Age Ageing,* 35(Suppl 2), ii7–ii11.

Hsiao, H. and Simeonov, P. (2001) Preventing falls from roofs: a critical review. *Ergonomics*, 44 (5), 537–561.

Jeka, J. Kiemel, T. Creath, R. and Peterka, R. (2004) Controlling human upright posture: velocity information is more accurate than position or acceleration. *J. Neurophysiol*., 92 (4), 2368–2379.

Kiemel, T. Oie, K. S and Jeka, J. (2002) Multisensory fusion and the stochastic structure of postural sway. *Biol. Cybern,* 87, 262–277.

Lafond, D. Corriveau, H. Hébert, R. and Prince, F. (2004) Intrasession reliability of the center of pressure measures of postural steadiness in healthy elderly people. *Arch. Phys. Med. Rehabil*., 85, 896–901.

Lundin, T. M. Feuerbach, J. W. and Grabiner, M. D. (1993) Effect of plantarflexor and dorsiflexor fatigue on unilateral postural control. *J. Appl. Biomech*., 9, 191–201.

*Maff*iuletti, N. A. Jubeau, M. Munzinger, U. Bizzini, M. Agosti, F. De Col, A. Lafortuna, C. L. Sartorio, A. (2007) Differences in quadriceps muscle strength and fatigue between lean and obese subjects. *Eur. J. Appl. Physiol.,* 101, 51–59.

Mokha, M. Bateni, H. and Nuzzo, N. A. (2012) Effects of quadriceps fatigue on postural sway. *International journal of Athletic Therapy & Training*, 17 (3), 20–24.

Saari, J. and Wickstrom, G. (1978) Load on back in concrete reinforcement work. *Scandinavian Journal of Work*, *Environment and Health*, 4(1), 13–19.

Stoffregen, T. A. Pagulayan, R. J. Bardy, B. G. and Hettinger, L. J. (2000) Modulating postural control to facilitate visual performance. *Hum. Mov. Sci*. 19, 203–220.

Straker, L. (2003) Evidence to support using squat, semi-squat and stoop techniques to lift low-lying objects. *Int. J. Indust. Ergon.,* 31, 149–160.

Straker, L. M. (1997) A critical appraisal of manual handling risk assessment literature. *International Ergonomics Association Press*, Curtin University, Perth.

Vedsted, P. Larsen, A. H. Madsen, K. S. and Jogaard, G. (2003) Muscle performance following fatigue induced by isotonic and quasi-isometric contractions of the extensor digitorium longus and soleus muscles in-vitro. *Acta Physiol. Scand.*, 178(2), 175–186.

Yaggie, J. A. and McGregor, S. J. (2002) Effects of isokinetic ankle fatigue on the maintenance of balance and postural limits. *Arch. Phys. Med. Rehabil.*, 83 (2), 224–228.

EFFECTS OF SUGAR AS ADMIXTURE ON CONCRETE MADE WITH DIFFERENT BRANDS OF CEMENT IN NIGERIA

Mohammed Lawal Aliyu[1], Musa Aminu Alhaji[2] and Tukur Almustapha[3]

[1,2,3]Department of Building Technology, Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi state, Nigeria.

Hot weather, which is characterized by high ambient temperature and low relative humidity causes rapid setting of cement paste and difficulties during concreting. Admixtures that retard rapid setting of cement paste and modify workability of concrete are necessary to prevent fresh concrete from the adverse effects of hot weather. However, in Nigeria the retarding admixtures are imported and also expensive. Sugar is another substitute that has been established to be a retarder, but its effects varies with the chemical composition of cement. This paper aims to investigate the effects of sugar as a retarding admixture on concretes made with different brands of Portland cement produced in Nigeria. The brands of Portland cements used in the experiment were Bua, Dangote, and Sokoto cements. The concrete specimens were prepared using 0%, 0.06% and 0.1% additions of sugar by weight of cement. A nominal mix of 1:2:4 with w/c of 0.5 was used. The results revealed that concrete specimens made with Dangote and Sokoto cement exhibit better results in compressive strength at 0.06% at 28 days hydration period, therefore 0.06% proved to be the optimum dosage. While Bua cement recorded the higher compressive strength results at 0.1%. The results also indicated that the setting time of the cement pastes made with the cement brands increased when the optimum dosage of sugar was used. It is concluded that when an appropriate dosage of sugar was used it had the potential of increasing the setting time and strength properties of concrete.

Keywords: compressive strength, hot weather, OPC brands, setting time, sugar

INTRODUCTION

Concrete is a heterogeneous material which consists of a chosen mixture of binding materials such as lime or cement, well graded fine and coarse

[1] muhamadaliyulawal83@gmail.com
[2] aminumusaalhaji@gmail.com
[3] almustapha_t@yahoo.com

Mohammed, L. A., Musa, A. A. and Tukur, A. (2017) Effects of sugar as admixture on concrete made with different brands of cement in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 616-627.

aggregates, water and admixtures to produce concrete with special properties (Duggal, 2008). Khan (2006) opines that concrete is the most widely used construction material in the world and has gained a unique place in the construction industry. The most important characteristics of fresh and hardened concrete are workability, setting time, rate of strength development, ultimate strength, durability and impermeability of the concrete. The desired properties of fresh and hardened concrete can often be economically achieved through proper mixing of the ingredients, placing, and compacting. However, there are instances where the aforementioned properties may be adversely affected during the production of the concrete due to hot weather effect (Khan, 2006).

Furthermore, Okereke (2003) noted that extreme North East and North-Western parts of Nigeria such as Maiduguri, Yola, Sokoto, Birnin kebbi etc. are categorized as hot dry regions with temperature which ranges between 35 to 43°C with the low relative humidity of 40%. According to Ali et al. (2000) in hot dry zones, the climatic conditions are often harsh, characterized by high ambient temperature and low relative humidity. Thus, it is more difficult to control the water content of concrete mixes which is the most important factor in concrete making. It follows that hot weather generally introduces undesirable properties on concrete such as loss of slump, accelerated set, increased water demand and reduction in strength. These undesirable properties cause concreting problems and may lead to low durability (Ali et al., 2000). But, Rana (2014) opines that to offset the negative effects of hot weather on the cement paste of concrete certain admixtures which delay the setting of cement paste and modify workability of concrete are helpful in hot weather concreting. Hence, retarder admixtures are used to slow down the speed of the reaction between cement and water by affecting the growth of the hydration products and reducing the rate of water penetration to the cement particles (Myrdal, 2007).

Alsadey (2013) defined retarder admixture as a type of chemical admixture that delays the initial rate of reaction between cement and water and hence, retards the setting time of concrete and also lengthens the setting time and workability retention. It is particularly important for concreting in hot weather. A retarding admixture holds back the hydration process, leaving more water for workability and allowing sufficient time for the concrete to be placed, compacted and finished. Also, it stops the rapid set shown by tricalcium aluminate which causes false set of the cement paste (Abalaka, 2011b). However, in Nigeria the retarder admixtures are imported and also expensive. Sugar is another substitute that has been established to be a retarding admixture and also it is cheap and readily available as compared to other retarding admixtures (Rathi and Kolase, 2013), but its retardation effect depends on the chemical compositions of cement (Neville and Brooks, 2010). Because, cement with low tricalcium aluminate (C_3A) and alkali contents are easier to retard compared to cement with large amounts of these constituents (Myrdal, 2007). One explanation might be that at lower C_3A contents, smaller amounts of retarder are adsorbed, leaving larger amounts of the admixture to affect and retard the hydration of the C_3S

component. Therefore, which brand of cement in Nigeria can give an optimum results when sugar is used as admixture in it? Hence, this study assessed the effects of sugar as a retarder on the properties of concretes made with selected brands of Portland cement in Nigeria.

LITERATURE REVIEW

Retardation mechanism of sugar on cement hydration

Sugar causes cement set retardation by the following mechanisms:

1. Formation of complexes with calcium ions in solution, increasing their solubility and discouraging the formation of the nuclei of calcium hydroxide.
2. Precipitation around cement particles in this mechanism the sugar molecules reacts with one or more components of the cement to form a precipitate on the cement particles, imparting a low- permeability coating on the cement particles.

According to the first mechanism, when ordinary Portland cement is hydrated in sucrose solution, lime is solubilized and a sucrose calcium complex (R - O – Ca^{+} - OH) is formed in which Ca^{+} - OH group is attached to the five-membered ring (R) of the sucrose molecule. Such sucrose–calcium complex will be able to become absorbed on the growing calcium hydroxide nucleus. The adsorption of the complex on the calcium hydroxide nucleus will inhibit its growth as the calcium and hydroxyl ions will not be able to precipitate and hence the hydration slows down. Due to the slow hydration, no considerable amount of the hydration products giving rigidity to the cement paste will be formed and thus the concrete remains plastic for a longer time. The reason is because formation of the complexes increases the solubility of cement, i.e., increased concentration of Ca^{2+} $^{-}$OH, Si, Al and Fe in the aqueous phase of the cement pastes when hydrated in the presence of the sugar. Thus, the calcium ions and hydroxyl ions will accumulate in solution and will be unable to precipitate to form calcium hydroxide (Khan and Ullah, 2004).

According to the second mechanism, sugar interferes with the cement binding process in the concrete. A theory suggests that when concrete mixture contains sugar, the sugar molecules attach themselves to the hydrating cement and inhibit the chemical reactions involved in stiffening the concrete and hence the setting of cement paste is retarded (Otunyo et al., 2015). For this reason, sugar is known as a best retarder. Retarders increase the setting time of concrete. Refined white sugar is one of the best retarders (Greesan et al., 2014). In addition, Giridhar et al. (2013) states another mechanism known as coating theory (adsorption) in this mechanism the sugar molecules are adsorbed on the surface of cement particles. This thin layer of sugar around the cement particles acts as a diffusion barrier. Due to this diffusion barrier, it becomes difficult for the water molecules to reach the surface of the unhydrated cement grains and thus the rate of hydration of tricalcium silicate (C_3A) is retarded, and the dormant period is lengthened (Ramachandran, 1999).

Effects of sugar as retarding admixture on the properties of fresh concrete

Fresh concrete or plastic concrete is a freshly mixed material which can be moulded into any shape. The relative quantities of cement, aggregates and water mixed together control the properties of concrete in the wet state as well as in the hardened state (Shetty, 2009). According to Giridhar et al. (2013) sugar as a retarding admixture has a significant effect on the properties of fresh concrete.

Workability: The workability of concrete is affected by many factors including initial slump, type and amount of cement, temperature, relative humidity and presence of chemical admixtures (Gupta and Gupta, 2004). Also, Neville and Brook (2010) defined workability as the amount of useful internal work necessary to produce full compaction. The useful internal work is a physical property of concrete alone and is the work or energy required to overcome the internal friction between the individual particles in the concrete.

Retarding admixtures like sugar allow a reduction in water content of the concrete without affecting its workability (Greesan et al., 2014). The extent of reduction is even higher for mixes with higher slump values. In fact, the incorporation of a given dosage of a retarding admixture increased the slump by 30% (Maroliya, 2012). Also, Giridhar et al. (2013) investigated the effects of sugar and jiggery on the strength properties of concrete. The findings revealed that the workability increased by 50% at 0.1% addition of sugar as compared to the concrete sample. The compressive strength of concrete is enhanced by 12% at 28days. Alsadey (2013) pointed the good workability can be achieved by incorporating retarder in the concrete, which will delay the setting time and allow suitable compaction done without segregation. However, very high dosages of retarder admixture tend to impair the cohesiveness of concrete.

Setting times: Generally, retarding admixtures delay both initial and final setting time. The amount of retardation depends on the dosage of admixture used, the type of cement used, the amount of mixing water, and the temperature of the concrete (Greesan et al., 2014). In addition, Dransfield (2012) the delay of setting time usually prevents the formation of cold joints between deliveries of concrete. Even if workability has fallen to almost zero slump, fresh concrete that has not actually set can be vibrated into, and will bond with the preceding older pour.

Abalaka (2011b) undertaken a study on the comparative effects of cassava starch and simple sugar in cement mortar concrete. The study showed that the initial and final setting times increased with sugar content of 0.05% by weight of cement and concluded that sugar increased compressive strength at 28days by 3.62% at sugar concentration of 0.06%. Rana (2014) determined the effects of sugar on setting time and compressive strength of ordinary Portland cement paste. The research concluded that sugar of 0.07% by weight of cement improved the compressive strength by 4% and also delays the initial setting of cement paste for 3hours and 35minutes which

greater than 45minutes minimum values stipulated by BS EN 197-1 (2000). It can be said that sugar is very good retarding agent. Moreover, Khan and Baradan (2002) studied on the effects of sugar on setting time of various types of cements. The results revealed that sugar content of 0.15% limit extends the setting time of cement paste and also accelerated the cement setting at the percentage addition of 0.3% by weight of cement.

Effects of retarding admixture on the Compressive Strength of hardened concrete

The use of retarder and water reducer admixture allows a reduction in the amount of water in the mixture, and therefore a decrease in the water/cement ratio and an increase in compressive strength (Dias et al., 2010). However, Ramachandran (1999) asserted that this increase in strength is not only due to a reduction in water content, and also, Kumar (2015) opines that the reason for improvement of compressive strength by sugar is as a result of bonding within the concrete. Because sugar had good bonding property. Furthermore, (Rana, 2014) noted that the rate of strength gain after one day is also decreased due to the use of sugar as a retarding admixture in concrete. However, the compressive strength of concrete at 28 days age is higher as compared to the non- retarding concrete (Gupta and Gupta, 2012).

In research conducted by Suryawanshi et al. (2014) the experimental study on the effects of sugar powder on strength of cement. The findings reveal that sugar of 0.1% by weight of cement gives an increased in initial and final setting time and also at this percentage addition of sugar the compressive strength of the concrete has increased by 20% as compared with the reference sample. Similarly, Otunyo et al. (2015) established that the sugar has a significant effect on the compressive strength. The results showed that 0.05% addition of sugar increased the compressive strength to about 17% at 28 days hydration period. However, Alsadey (2013) noted that addition of retarders not able to increase the compressive strength of concrete, on the other hand, it reduces the strength significantly, and become worse when the dosages increase. The reason for this phenomenon is that addition of retarder to the concrete will delay the reaction of C_3S and C_3A. As a result, strength development is low. The situation varies only after 7 days from casting, where inclusion of retarder will slightly improve compressive strength at later age, but this only depends greatly upon the chemical composition of the cement. Also, some retarders, increase in dosage will increase the compressive strength for all ages (Alsadey, 2013).

MATERIALS AND METHODS

Materials

The materials that were used for this study includes: The selected Portland cement used in this research were Bua, Dangote and Sokoto cement brands which conformed to ASTM C150 (2005). They were obtained from accredited dealers in Kaduna metropolis, Nigeria. The Sucrose (table sugar) used as a retarding admixture in this experimental study was white crystalline solid

(Dangote sugar) soluble in water and was obtained from Samaru market, Zaria. Clean tap water was used for the experimental works. The quality of the water used was in conformity to the specification of BS EN 1008-2 (2002) which specified the use of water to be free from odour, colour, taste and impurities. Furthermore, the coarse aggregate used was crushed granite stones obtained from a single quarry site along Sokoto-Zaria road, opposite School of Aviation Technology Zaria. The aggregate was sieved using standard sieves and the one obtained in 10 and 20 mm sieves were used for the production of the test samples. The fine aggregate (sand) used was naturally, occurring clean sharp river sand. It was sieved using standard BS 4.75mm sieve size to remove impurities and only those that passed through the sieve was used for the samples production.

Specimens Production

The materials used were batched by weight and mixing was carried out with concrete mixing machine in the mix ratio of 1: 2: 4 with w/c ratio of 0.5. While the percentage of sugar was dissolved in water before adding to the mix water of the concrete. The mixing was carried out in accordance with B.S 1881- 125 (1986). Two different samples of concrete were produced using two different percentage additions of sugar for each brands of cement. These percentages were 0.06% and 0.1% of sugar by weight of cement and also 0% as a control. The cube specimens were cast by filling each cube mould in three layers each layer been compacted manually with 25 blows from a steel rod of 25 diameter before the next layer was poured. The size of cube mould used for the production of concrete specimens was 100 × 100 × 100 mm which conformed to BS EN 12390-1 (2000). A total of 81 cubes were cast and cured for hydration period of 3, 7 and 28 days.

In addition, samples of neat cement pastes made with the three cement brands were also prepared for the setting times test according to BS EN 196-3 (1987) standard. These samples were taken as control samples i.e. 0% addition of sugar. Then successive samples of cement pastes containing different dosages of 0.06% and 0.1% addition of sugar by weight of cement were also prepared and tested for the three brands of Portland cements used in this research. The tests were performed at two different temperatures at the normal laboratory room temperature of 27°C and at an oven temperature of 43°C – approximate maximum ambient temperature for Sokoto, Birnin Kebbi, Maiduguri and Yola etc.

RESULTS AND DISCUSSION

The Results of the Setting time test

The test results for initial and final setting times of various cement pastes made with brands of cement at two different temperatures are shown in Table 1. The result revealed that both the initial and final setting times increased continuously with increase in percentage additions of sugar by weight of cement at all the temperatures. Apart from Bua cement that showed decrease in setting time as the percentage addition of sugar increases. The initial setting times of the control pastes at 27°C for Bua,

Dangote and Sokoto cements were recorded as 100minutes, 111minutes and 125minutes respectively. Generally, at 43°C the control pastes recorded a decrease in the initial setting times by 38%, 40% and 25% for Bua, Dangote and Sokoto cements respectively when compared with the control pastes at 27°C. This effect could be attributed to the fact that higher temperature increases the internal temperature of hydration of the cement paste and thereby increasing the rate of chemical reaction, which in turn accelerates the setting time of the cement paste (Nensok, 2010).

Table 1: Comparison of the setting times of cement brands with percentage addition of sugar at two different temperatures

Setting time	Cement Brands	27°C			43°C		
		0%	0.06%	0.1%	0%	0.06	0.1%
Initial setting	Bua cement	100	254	147	62	188	51
(Minutes)	Dangote cement	111	270	320	60	75	165
	Sokoto cement	125	370	440	75	150	168
Final setting	Bua cement	180	377	198	110	261	150
(Minutes)	Dangote cement	201	363	465	123	180	225
	Sokoto cement	218	515	575	125	230	270

To overcome this effect of rapid decrease in setting times, 0.06% and 0.1% of sugar by weight of cement were added to all the brands of cement subjected to setting time test at 43°C. At 0.1% two brands of cement recorded the higher percentage increase in initial setting times more than at 0.06% addition of sugar. The percentages increase recorded were 175% and 124% for Dangote and Sokoto cements respectively, while Bua cement recorded a decrease in initial setting time of 49%, but recorded an increase of 88% at 0.06% addition of sugar. In addition, it can be observed that there was an increase in the final setting times in all the brands of cement as the percentage addition of sugar increases with Sokoto cement recorded the higher increase of 108% and Bua cement recorded lower increase of 80% when compared with the control pastes.

The increase in the setting times in all the brands of cement could be as a result of retarded hydration due to the presence of sugar. Because sugar increases the concentrations of calcium, aluminum and iron in concrete. The sugar molecules combine with these metals to form insoluble chemical complexes that coat the cement grains. Another reason for the extension of the setting time is adsorption of sugar molecules which acts as thin layer over the cement particles. Furthermore, Bua cement brand that showed a decrease in setting times as the percentage addition of sugar increases, the reason for this phenomenon could be the low content of tricalcium aluminate

C_3A as compared to the other brands of cement. This observation concurs with earlier findings by Myrdal (2007).

The Results of Compressive Strength Tests

Figure 1 shows the compressive strengths of each brand of cement at 3 days curing period. The compressive strengths of the control specimens made with Bua, Dangote and Sokoto cements are (14.2 N/mm^2), (11.8 N/mm^2) and (14.0 N/mm^2) respectively. It can be observed that there is an increase in compressive strengths by adding 0.06% of sugar in Bua and Dangote cements by 2.1% and 5.9% respectively, while Sokoto cement brand showed a decrease in compressive strength of 5.7%. Furthermore, at 0.1% addition of sugar only Bua cement showed an increase in compressive strength by 5.6% over the control specimen. All the remaining brands showed a decrease in compressive strengths. The compressive strengths of Dangote and Sokoto cements were decreased by 5.4% and 26.1% respectively when compared with the control specimens.

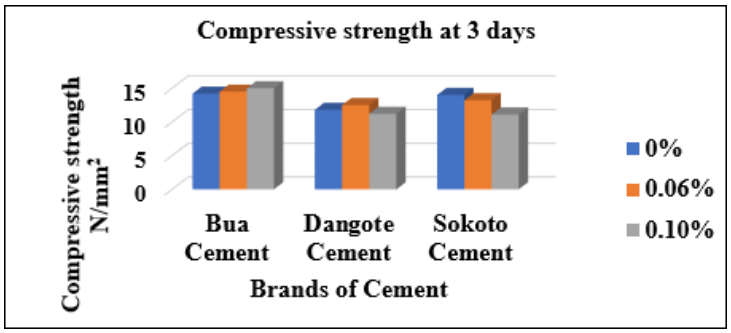


Figure 1 Relationship between the Compressive strengths of the Brands of cement and Percentage addition of sugar at 3 days curing period.

The decrease in the early age strengths in some cement brands could be attributed to the fact that the use of a sugar as admixture in concrete severely reduces the early strength of concrete. This observation concurs with the assertion made by (Neville, 2006). Another reason could be the delay in the reaction of tricalcium silicate (C3S) and tricalcium aluminate (C3A) caused by sugar molecules, resulting in low early strength development.

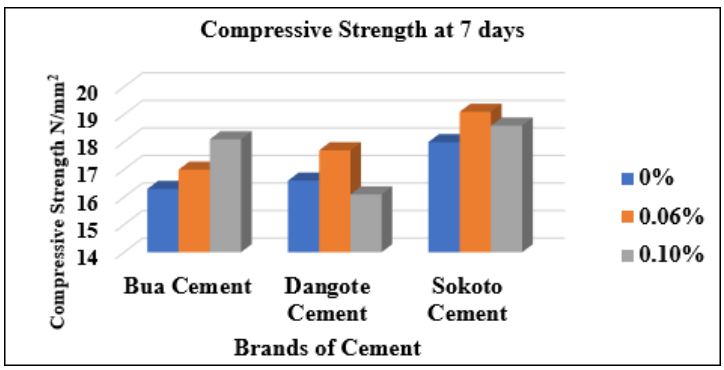


Figure 2 Relationship between the Compressive strengths of the Brands of cement and Percentage addition of sugar at 7 days curing period

Figure 2 presents the compressive strengths of each brand of cement at 7 days curing period. The compressive strengths of the control specimens made with Bua, Dangote and Sokoto cements are (16.3 N/mm^2), (16.6 N/mm^2) and (18.0 N/mm^2) respectively. It can be observed that there is an increase in compressive strength by adding 0.06% of sugar in Bua, Dangote, Sokoto and by 4.5%, 7.0% and 7.6% respectively over the control specimens. Furthermore, Figure 2 indicated an increase of compressive strength for Bua, Dangote and Sokoto cements at 0.1%.

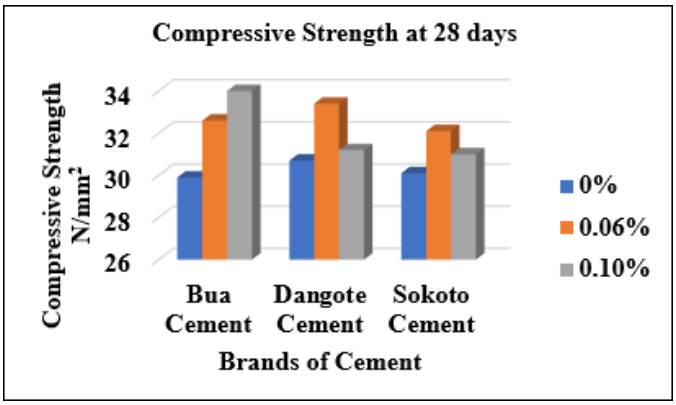


Figure 3 Relationship between the Compressive strengths of the Brands of cement and Percentage addition of sugar at 28 days curing period

Figure 3 shows the compressive strengths of each brand of cement at 28 days curing period. The compressive strengths of the control specimens made with Bua, Dangote and Sokoto cements are (29.9 N/mm^2), (30.7 N/mm^2) and (30.1 N/mm^2) respectively. It can be observed that there is higher increase in compressive strength by adding 0.06% of sugar in Bua, Dangote and Sokoto cements by 10.34% 8.8% and 6.6% respectively over the control specimens, while at 0.1% addition of sugar only Bua cement recorded higher increase in compressive strength by 21.4% over the control specimen. Therefore, 0.06% addition of sugar proved to be the optimum dosage for Dangote and Sokoto cements, while 0.1% is the optimum dosage for Bua cement. The reason behind the increase in compressive strengths could be related to the fact that when sugar is used as a set retarder in concrete, the early strength of concrete is reduced but beyond about seven days there is an increase in strength as compared with non-retarded concrete as a result of delay the setting of cement paste and produce a denser cement gel. This observation concurs with earlier findings by (Rathi and Kolase, 2013).

CONCLUSIONS

Based on the outcomes of the effects of sugar as a retarder on concrete made with selected brands of Portland cement in Nigeria, it can be concluded that:

1. The addition of sugar to the cement pastes made with Bua, Dangote and Sokoto cement brands retards the setting times of the cement paste both at the normal laboratory temperature of 27°C and 43°C.

2. The addition of sugar in concrete specimens made with the brands of cement increased the compressive strength when an optimum dosage is used.
3. The optimum dosage of sugar for Dangote and Sokoto cement brands was 0.06%. While for Bua cement brand 0.1% proved to be the optimum dosage.
4. Heat affects the setting time of the Bua, Dangote and Sokoto cement brands as such retarding admixture should be used in these cement brands when concreting in the hot weather regions.

The study therefore recommends the use of ordinary sugar as a retarding admixture in Bua, Dangote and Sokoto cement brands especially when concreting in hot dry weather regions in Nigeria such as Sokoto, Birnin Kebbi, Yola, Maiduguri, etc.

REFERENCES

Abalaka, A.E. (2011a). Effects of sugar on physical properties of ordinary Portland cement paste and concrete. *AUJ.T.*14 (3): 225- 228.

Abalaka, A.E. (2011b). Comparative Effects of cassava starch and simple sugar in cement mortar and concrete. *ATBU journal of Environmental Technology*: 4(1).

Ali, M. O. M., Elzamzami and Awad, M. E. (2000). The effects of Molasses and VZ4 Additions on the Properties of Cement and Concrete. *BRRJ*, 3(25). 25-26.

Alsadey, S. (2013). Effects of superplasticizing and Retarder Admixture on Properties of Concrete. *International Conference on Innovations in Engineering and Technology,* (ICIET 2013). Bangkok, Thailand. 1-2.

American Society for Testing and Material (2005): Standard Specification for Portland cement. ASTM C150-05. West, Conshohocken, PA19428-2959, United States, 1-3.

British Standard, (1986). Testing Concrete; Method for mixing and sampling fresh concrete in the laboratory. BS 1881-125, BSI, Linfordwood, Milton Keynes MK14 6LE, U.K.

British Standard European Norm 196-3 1995. Methods of testing cement: Determination of setting time and soundness. European standard, European committee for standardization, Brussels, Belgium.

British Standard European Norm, (2000). Testing Hardened Concrete; shape, dimension, and other requirements for specimens and moulds. BS EN 12390-1, BSI, Linfordwood, Milton Keynes MK14 6LE, U.S

British Standard European Norm, 1008, (2002). Mixing Water for Concrete. Specification for Sampling, Testing and Assessing the Suitability of Water, Including Water Recovered from Processes in the Concrete Industry, as Mixing Water in Concrete.

Dias, W.P.S., Dewapriya, M. A.N., Edirisooriya, E.A.C.K., and Jayathunga, C. G. (2010). Effects of Large Retarder Overdose on Concrete Strength Development. *The Institution of Engineers,* Sri Lanka, 13- 16.

Dransfield, J. (2012). Cement Admixture Association. *EFCA.* 38a Tilehouse Green Lane, Knowle, West Midland B939EY, UK. 1-4. Retrieved from http://www.admixtures.org.uk

Duggal, S. K. (2008). *Building Material*. Ansari road Daryaganji, New Delhi-110002: New Age International Ltd, 144-245.

Greesan, R., Prathap P. & Vijayakumar R. (2014). Manufacturing of Concrete with Retarders. *International Journal of Scientific & Engineering Research,* 5(4), 1637- 1639. Retrieved on 07/08/2015 from http://www.ijser.org

Gupta, B.L and Gupta A. (2004). *Concrete Technology*, A. K. Jain, Standard Publishers Distributor. 1705-B, Nai Sarak, Delhi- 110006, 121-290.

Khan, B.and Baradan, B. (2002). The effect of sugar on setting time of various types of cement. *Quarterly Science Vision.* 8(1). Izmir, Turkey, 71-78.

Khan, B. and Ullah, M. (2004). Effect of a retarding admixture on setting time of cement pastes in hot weather. *JKAU: English Science*. 15(1): 63- 79.

Khan B. (2006). Effects of high early temperatures on the setting time and strength of cement paste and mortar blended with barite powder. *International workshop CBM-CI*, Karachi, Pakistan, 456-461.

Kumar, D. (2015). Sugarcane Molasses in Concrete as a Water Reducing-Retarding Admixture. *International Journal of Civil Engineering*. ISSN: 2348-8352, 123-124.

Maroliya, M.K. (2012). Influence of Chemical Admixtures on Density and Slump loss of Concrete. *International Journal of Modern Engineering Research,* 2(6), 4077-4079.

Myrdal, R. (2007). Retarding Admixtures for Concrete. *Sintef Report.*No.7465 Trondheim, Norway, 5- 16. Retrieved on 07/08/2015 from http://www.sintef.no/coin

Nensok, M. H. (2010). The Effect of Environment and Curing Medium on the Properties of Blended Concrete. *Unpublished M. Sc Thesis Research Work*, Department of Building, Faculty of Environmental Science, University of Jos, Nigeria. 86-100.

Neville A. M. (2006). *Properties of Concrete*. Fourth edition. Pitman Publishing Corporation, Dorling Kindersley, New Delhi, India. 97-98.

Okereke, P. A. (2003). *Construction Material: Testing and Quality Control in Tropical Climate*, 72 Mbaise Road, Owerri: Crown publisher Limited, 6-10.

Otunyo, A. W., Onwusiri, S. C. and Nwaiw N. (2015). Effect of Sugar cane Juice on Slump values, Setting times and Strength of Concrete. *Nigerian Journal of Technology*, 34(2), 254-256.

Ramachandran, V. S. (1999). *Concrete Admixture Handbook; Properties, Science and Technology.* Noyes Publications, Park Ridge. New jersy, USA. 121- 193.

Rana, S. (2014). Effect of sugar on setting time and compressive strength of ordinary Portland cement paste. *World conference on Applied Science, Engineering and Technology.* Kathmandu, Nepal, 1-3. ISBN 13: 978-81-930222-0- 7.

Rathi, V. R. and Kolase, P. K. (2013). Effect of Cold Joint on Concrete. *International Journal of Innovative Research in Science, Engineering and Technology,* 2(9), 461- 462. Retrieved on 07/08/2015 from http://www.ijirset.com

Shetty, M.S. (2009). *Concrete Technology: Theory and Practice*, S. Chad and Company Ltd, Ram Nagar, New Delhi 110055, India, 124-554

Suryawanshi, Y. R., Pankaj N. B., Shinde, R.R, Pawar S.B. and Namrata M. (2014). Experimental study on effect of sugar on strength of cement, *International Journal of Research in Engineering and Technology*. *2(4): 2499- 252*. Retrieved on 08/02/2015 from http//:www.impactsjournals.us

EMPLOYABILITY OF BUILT ENVIRONMENT GRADUATES IN NIGERIA: DETERMINANT FACTORS

Salisu Gidado Dalibi[1]
[1]*Business school of Hohai University Nanjing, Jiangsu Province of China.*
[1]*Department of Quantity Surveying, Abubakar Tafawa Balewa University (ATBU) Bauchi. Nigeria.*

The Built Environment (BE) is a physical product of inputs from various professional fields and disciplines. Graduates from such fields were expected to have possessed the requisite skills leading to employment. Employability skills are very vital in today's labor market especially within the BE. These skills include basic skills, core skills, fundamental skills, soft skills and transferable skills etc., which enables them work within the BE under their experienced colleagues. However, such skills were in shortage, often inadequate and do not guarantee employment etc. Unemployment especially among graduates is worrisome to the Nigerian government and may be caused by two aspects: oversupply of graduates in the job market, and the inability of graduates to meet the skills needed by the industry. The research aim of this Paper is to identify and assess the impact of some factors that determine the employability of graduates in BE related fields and disciplines in Nigeria. Reviewed literatures were used to identify the factors which forms the main body of the questionnaire, structured using Likert scale and manually distributed to various experienced professionals. The result shows that graduates with employability skills who distinguish themselves during job interview/test were perceived as employable by the various organizations/firms/ companies operating in the BE; during construction boom will have better chances of getting employed in BE related professions.

Keywords: built environment, discipline, employability, factors, graduate, Nigeria.

INTRODUCTION

Built Environment (BE) refers to the man-made surroundings that provide the setting for human activity, ranging in scale from buildings to parks. It has been defined as "the humanitarian-made space in which people live, work, and recreate on a day-to-day basis" (Roof and Oleru, 2008). BE is also used to describe the interdisciplinary field that addresses the design, construction, management, and use of these man-made surroundings as an interrelated whole as well as their relationship to human activities over

[1] salgidos@yahoo.com

Dalibi, S. (2017) Employability of built environment graduates in Nigeria: determinant factors *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 628-641

time (rather than a particular element in isolation or at a single moment in time). BE is generally not regarded as a traditional profession or academic discipline in its own right, instead drawing upon areas such as economics, law, public policy, public health, management, geography, design, engineering, technology, and environmental sustainability. Within the field of public health, built environments are referred to as building or renovating areas in an effort to improve the community's well-being through construction of "aesthetically health improved and environmentally improved landscapes and living structures" (BE & H, 2012). As such, BE encompasses places and spaces artificially created or modified by humans such as buildings or structures, parks, and other transportation systems for human comfort and wellbeing.

The BE is a physical product of inputs from various professional disciplines such as Land surveying, Urban Planning, Architecture, Civil Engineering, Building Technology, Mechanical & Electrical Engineering, Quantity Surveying, Law, Environmental management science, Construction Management, Project Management and Estate Management etc. The Graduates from such aforementioned fields were expected to have possessed the requisite skills leading to employment within the BE to which the construction industry belongs. The ability of the BE to tackle problems and adjust to emerging trends depends on the quality of education, skills and other abilities of the graduates from these various fields that makes the BE. This can only happen if they are employed upon graduation which makes it necessary for them to possess the employability skills.

Employability skills are very vital in today's labor market especially within the BE. Graduates from BE related fields were expected to have possessed the requisite skills leading to employment. Such skills ranges from those perceived by the employer, the graduates' generic skills and those imposed within industry.

RESEARCH PROBLEM

Nigeria, with a population of about 180million people and more than two hundred tertiary institutions do graduate about 80,000 in the year 2009 and will soon rise to 500,000 (Tsiga, 2009). Most of these graduates will eventually seek employment in the labor market while others will be entrepreneurs. However, being a graduate does not guarantee employment in the Nigeria's labour market. This phenomenon may be caused by two aspects: oversupply of graduates in the job/labour market, and or graduates are unable to meet the skills needed by the industry. The first aspect is due to national economic factors and the second may be due to the skills are not fully polished while the graduates are still studying (Rahmat et al., 2012). Salau (2014), stated that "Though Government in collaboration with private investors have tried to encourage the practice of entrepreneurship but low progress has been made up to date".

Moreover, this challenge also poses questions such as: has there been enough demand for all these graduates by the labour market? Does this

mean that the human resources development efforts of the government and individuals have been a waste since those trained cannot put their skills into productive use? How far has the Nigerian educational system been able to adequately prepare students for the world of work? Of what importance are skills acquired by graduates when they are not demanded in the labor market? (Samuel et al., 2012).

These clearly indicates that the problem is generic in Nigeria and the BE related disciplines and its graduates are not exempted from such but may also have more challenges and requirements within and outside the industry because of the practical nature in delivering the physical product called "Project" which has constraints such as time, budget, with aesthetics requirements and the need for maximum satisfaction of from the stakeholders.

Moreover, a lot of research works carried out generalized the challenges of employability of Nigeria's graduates and only few focused on specific disciplines; none was carried out to focus on the Built Environment (BE) disciplines in Nigeria. This

Research aim

The aim of this Paper is to identify and assess the impact of factors that determine the employability of graduates in BE related fields and disciplines in Nigeria with a view of ranking these factors based on their impacts and to extend the literature in this subject area.

Research hypotheses

The following hypotheses were formulated for this research:

Null hypothesis (H_O); Employability of BE graduates ***is not*** hindered significantly by some selected factors in the Nigeria's Built Environment.

Alternative hypothesis (H_A); Employability of BE graduates ***is*** hindered significantly by selected some factors in the Nigeria's Built Environment.

Research scope and limitations

This research work is limited to the perception of various practicing professionals working in the Nigeria's Built Environment. Such professionals include the Architects, Quantity Surveyors, Civil Engineers, Building Engineers, Mechanical and Electrical Engineers, Project Managers, Construction Managers, Land surveyors, Town planners and Estate Surveyors.

LITERATURE REVIEW

Graduates, employability and the labour market

In today's workforce, characterized by change and increasing competition for jobs, it is important for educational programs, to be aware of the qualities that are valued by employers in the industry. It is the role of universities to design and implement programs that are appropriate to the missions and goals to supply the workforce relevant to the needs of stakeholders or employers. Universities have the responsibility to provide graduates with

knowledge in the professional field with intellectual skills and ability to apply theory to practical situations. Other generic skills such as the ability to communicate, possession of attitudes and values of responsible citizen are other areas that are expected to be developed during the course of study (MOEM, 2002 and Ramli et al., 2010). All these are geared towards a better chance in terms of employability in the labour market.

Skill is an ability to perform a specific task (DEST, 2006); whereas, employability is about having the capability to gain initial employment, maintain employment and obtain new employment if required (Hillage and Pollard, 1998); It is often used as a measurement by employers on graduates' marketability (BE & H, 2012). Employability skills denote characters that may make an individual attractive to potential employers (Bridgstock, 2009). Employability skills and competencies are directly linked to the needs of the labour market and the mandatory inclusion of employability skills in higher education has been proposed in some countries (Precision Consultancy, 2009).

The employability skill of a graduate portrays graduate's attributes, knowledge, capabilities and abilities often unobservable. However, new graduates must demonstrate their mastery of employability skills to survive in the labour market (Yuzainee et al., 2012). Employability skills emphasises the need for graduates to create their own profile to prepare for today's highly competitive market place for graduate jobs. The employability skills refer to the required skills to acquire, keep and doing well in a job (Robinson, 2000).

Industry analysts reported that for success in the workplace, employees need to possess a specific employability skills entry level requirement. These essential (employability) skills were often viewed as a company's most important raw material (Perry, 2003). and graduates with employability skills will have an advantage in getting jobs in the industry (Husain et al., 2010).

Employability: the determinant factors

Employability skill is often defined as the preparation for graduates to successfully get jobs and to develop in their careers (Fugate et al., 2004), and enable individuals to prove their value to an organization as the key to job survival (Askov and Gordon, 1999). Hapidah and Sahandri (2011), proposed four employability skills that every graduates should have, which are academic, connectivity skills, personality management, and exploration skills.

These skills (employability skills) differ and or vary but they are mostly linked together. Such skills include: basic skills, core skills, fundamental skills, soft skills and transferable skills etc. Any graduate applicant in the labour market must be able to display such skills (above any minimum standard or required level) to be strongly considered for a job and to be successful in the labour market.

A study by Samuel et al., (2012), identified five categories of skills such as: Verbal and written, communication, Analytical and investigative abilities,

Entrepreneurship and managerial skills, Teamwork, Computer skill and Drive and flexibility as major skills requirements of graduates in the Nigeria's labour market.

However, to gauge or measure an employable skills of a graduate is very subjective and depends on the perception of the job interviewers or evaluators or most importantly the employers' perception. This perception is very important because it takes into consideration a lot of issues and aspects of the graduates' background information and what they can offer if employed; which is detailed from the graduates' curriculum vitae/resume and also educational certificates obtained from institutions of learning.

Tertiary institutions (colleges, Polytechnics and universities) provide facilities that encourage specialized courses of study and research for the advancement and development of knowledge, and its practical application to government or country, industry, commerce and the community at large. A specialized course of study will provide the required education and the minimum skill required in a discipline that will enable its application upon graduation. A certificate is normally obtained after duration for the study. This certificate is the first and the most important document for graduates seeking employment in the labour market.

However, Perceptions of the employers about the graduates are significant mechanism to provide a baseline for improvement on the education received during university days. University must first understand the employers' needs so that the graduates will presents with the required qualities (Madu and Kuei, 1993). Parents, prospective students, employers, schools and educational institutions, the government and others want to be assured that qualifications bearing similar titles represent similar levels of achievement and that there is international comparability of standards to facilitate student and graduate mobility. Therefore, employers' perceptions are not only about graduates' presentation, but played a role as an alternative guideline for the university regarding the relevant academic content and syllabus. The information provided by employers can act as a reference for the university to understand the future needs or trend of a specific profession, so that the university will be able to make appropriate changes in their academic programs (Ramli et al., 2010).

Education should reflect and cater to the society's needs. While preparing an academic program, surveys carried out on employers can provide the university some information regarding the quality of teaching and learning process that they have undergone during their education. From the employers' perceptions, they viewed that "applying theory into practice" is the most important skill that a graduate should have. The ability to apply what they have learned during university study will lead them to have a higher level of performance. This ability to prioritize problem is related to the ability to communicate, recognize, identify and analyses the problem (Coplin, 2003). Hence, the Incorporation of Industrial Training (I.T.), Students' Industrial Working Experience Scheme (SIWES), Teaching Practice (T.P.) by the tertiary institutions. At the end of which the Nigerian

government do pay the students an allowance through the Industrial Training Fund (I.T.F).

These will enhance their skills and abilities on how to apply, where to apply and when to apply that knowledge to gain a more effective result. The students' ability to integrate and demonstrate generic skills have been demonstrated to linked to the development of their confidence in the application of new and different contexts of environment, that included their workplace (Wiata, 2001 and Harvey et al., 2010).

The high number of unemployed graduates have forced the employers to device screening mechanisms or strategies to reduce the number to be interviewed. Such strategies are employed by both the public and private sectors by strictly emphasizing on the criteria when advertising a job before any application and applicant is considered as the case may be; it includes:

i. Degree class e.g. second class upper division and above (Dabalen et al., 2000 and Samuel et al., (2012);

ii. Certain years of experience e.g. Minimum of 3/4/5/10 years of experience (Boateng and Sarpong, 2002);

iii. In some cases, Age brackets or limits for beginners.

These set of requirements or criteria do normally weed out any graduate that do not possess all or one of the requirements or criteria.

The ranking of Academic institutions, research achievements, their history and the performance of their alumni in various sectors plays a very vital role in employment of their graduates in the labour market. This reputation determines the level of respect and value to the institutions' certificates and by extension the employability of its graduates.

Most, if not all the sectors do have professional bodies that regulate and promote the professional practices with these sectors. The BE in Nigeria is also same. For example, the Nigerian Institute of Quantity Surveyors is for Quantity Surveyors, Nigerian Institute of Architects is for Architects and the Nigerian Institute of Builders is for Building engineers and building technologists etc. these professional bodies regulate the practices and its membership comprised of seasoned professionals within the practice. They set the standards and also award official registered membership to those that satisfy some criteria. These professional bodies liaise with tertiary institutions and their professional colleagues in the Academics regarding the industry requirements and also through the use of seminars, conferences and workshops etc., to promote the various professions. As such, any graduate who is a registered member will normally have an added advantage in terms of employability.

A vibrant economy for a developing country like Nigeria will be characterized by high construction volume and spending in infrastructural development projects. This will lead to engagement and employment of BE professionals and graduates. Whereas, during economic recessions, most

projects will be suspended, abandoned or stopped which will lead to the laying off of staff and employment cuts and job losses.

The changes in the economy have a serious effect in the construction industry and, therefore employability (Torres-Mach et al., 2013). Construction volume and spending in Nigeria's BE are driven by economic factors including income growth, industry activity, population growth, interest rates and inflation. All together, they impact the policies of the Government, the private sector in infrastructural development projects and by extension employment of BE graduates.

In some cases, graduates who may have obtained a recommendation letter from a well-known practitioner or a high ranking person in the government or a well-connected person or whom are family relations or business friends with the owner(s) of an organization were normally considered over the other applicants. This Favoritism or Nepotism as the case may be increases employability of these category of graduates in Nigeria and many parts of the world at large.

Summarily, the determinant factors identified in this work regarding the employability of BE graduates in Nigeria are listed in the table below:

Table 2.2-1: Summary of determinant factors for BE graduates' employability

S/n	Be employability factors
1	Employability Skills (Verbal, written, communication, Analytical, investigative abilities, Entrepreneurship, managerial skills, Teamwork, Computer / IT skill, Drive and flexibility)
2	Perceptions of the Employers
3	Degree class (e.g 1st Class, 2nd Class Upper, 3rd Class etc)
4	Years of experience (e.g 3/5/10 years' experience)
5	Reputation of Academic institutions
6	Professional bodies Membership and Qualification (NIQS, NIA, NIOB, NSE etc.)
7	Construction volume and spending
8	Favouritism / Nepotism

Source: Authors' 2017, from Literature reviewed

RESEARCH METHODS

Secondary sources of data such as journals, conference / seminar / workshop papers, text books, newspapers, magazines and internet sources etc. were used to review literatures on the employability, skills, BE fields and employers of BE graduates in Nigeria; which helps in identifying and narrowing SOME factors impacting the employability of BE graduates. These identified factors form the main body of the Questionnaire. The research questionnaire which was structure using a 5-point Likert scale format (Strongly Agree =5, Agree=4, Neutral/Undecided=3, Disagree=2, strongly Disagree=1) to obtain the various perceptions of the professionals

working in the Nigeria's Built Environment. The questionnaires were manually and randomly distributed to the respondents. Each professional discipline was administered equal number of questionnaires; 50 each in this case. These professionals include Architects, Quantity Surveyors, Civil Engineers, Building Engineers, Mechanical and Electrical Engineers, Project Managers, Construction Managers, Land surveyors, Town planners and Estate Surveyors. Frequency and percentage count tables, Mean item score and T-test statistics were used for data analyses.

DATA PRESENTATION, ANALYSES AND RESULTS

Results from the administered questionnaires

The Primary data for this research work was obtained through manually distributed questionnaires to professionals working in the Nigeria's Built Environment and the responses obtained were shown below.

The research respondents

The table below shows the respondents by their professional disciplines, the total number of questionnaires distributed to each and the rate of response from each of the professional disciplines targeted in this work.

Table 4.1.1: The Questionnaires (Qns) Responses by the various Professionals

S/n	Professional disciplines	Nr. Of qns distributed	Nr. Of qns returned	Percentage (%) of total qns returned per discipline
1	Architects	50	29	5.27
2	Quantity Surveyors	50	37	6.73
3	Civil Engineers	50	26	4.73
4	Building Engineers	50	24	4.36
5	Mechanical Engineers	50	20	3.64
6	Electrical Engineers	50	19	3.45
7	Project Managers	50	39	7.09
8	Construction Managers	50	30	5.45
9	Land surveyors	50	18	3.27
10	Town planners	50	22	4.00
11	Estate Surveyors	50	31	5.64
	Total	550	295	53.64

Source: Authors' Field work

From the table 4.1.1 above, it can be observed that All the professionals were administered equal number of questionnaires (50nr. each). 550 numbers of questionnaires were distributed randomly to the professionals within the Nigeria's built environment. 295 numbers of questionnaires were returned while 255 were not returned. This puts the response rate at 53.64% which was fair. The Project managers have the highest response rate followed by

the Quantity surveyors, then the Construction managers, and the Estate surveyors, while Land surveyors have the least.

The research respondents

The perceptions of the various professionals regarding each of the factors that determines the Employability of BE graduates in Nigeria was based on the structured 5-point Likert scale provided (Strongly Agree =5, Agree=4, Neutral/Undecided=3, Disagree=2, Strongly Disagree=1) as shown in the table 4.1.2 below.

The mean item score also known as the weighted average score is computed for each factor using the formula below

$$\text{Mean Item Score (MIS)} = \frac{5(SA) + 4(A) + 3(N) + 2(DA) + 1(SDA)}{N}$$

Where *SA, A, N, DA and SDA* are the numerical values for Strongly Agree, Agree, Neutral/Undecided, Dis-Agree and Strongly Dis-Agree respectively; *N* is the total number of response obtained and in this case is 295.The values of the mean item score computed allowed for passing a remark on each of the factors that determines the Employability of BE graduates. The range is a follows:

i. Strongly Agree = 4.5 - 5,
ii. Agree = 3.5 – 4.4,
iii. Neutral/Undecided = 2.5 – 3.4,
iv. Disagree = 1.5 – 2.4,
v. Strongly Disagree = 0.5 – 1.4

Table 4.1.2: An Assessment of the Determinant Factors for Employability of BE Graduates

S/N	Employability of BE Graduates: Determinant Factors	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	Mean Item Score	Remark	Rank
		5	4	3	2	1			
1	Employability Skills	194	98	3	0	0	4.65	Strongly Agreed	1st
2	Perceptions of the employers	161	63	59	5	7	4.24	Agreed	3rd
3	Degree class	121	75	71	18	10	3.95	Agreed	4th
4	years of experience	82	41	79	42	51	3.21	Neutral	7th
5	Reputation of Academic institutions	101	82	64	27	21	3.73	Agreed	5th
6	Professional bodies Membership and Qualification	85	121	38	33	18	3.75	Agreed	6th
7	Construction volume and spending	179	81	13	22	0	4.41	Agreed	2nd
8	Favoritism / Nepotism	45	31	90	41	88	2.67	Neutral	8th

Source: Authors' statistical computations

From the table 4.1.2 above, it can be observed that the respondents strongly agreed with only one factor, agreed with five factors and remain neutral/undecided with two of the factors assessed. The Employability Skills is the major factor for BE graduates employment and ranked 1st; Construction volume and spending is the second major factor followed by Perceptions of the Employers as 3rd major factor. The class of degree by a graduate is the fourth ranked factor as agreed by the respondents; Reputation of Academic institutions is 5th while Professional bodies membership and Qualification is 6th. Years of experience of graduate applicants for a job is the 7th ranked factor while Favoritism / Nepotism is the 8th ranked factor with the least score and were deemed neutral by the respondents based on the average scoring.

The following deductions were also made:

i. Employability Skills such as verbal, written, communication, analytical, investigative abilities, entrepreneurship, managerial skills, teamwork, computer / I.T. skill, drive and flexibility etc., altogether are deemed the most important when employing a graduate in the various built environment professional disciplines; without which the graduates have nothing to offer or contribute to the growth of the recruiting organizations. Specialized skills are acquired from the tertiary institutions through graduation. Within the BE, such skills determine the level of output and performance from the employees; Hence deemed the most important in terms of employability.

ii. The second important factor is the construction volume and spending which determines the number of proposed and on-going projects in a country. A huge construction volume and spending will engage a lot of the professionals in the construction industry to be busy executing the projects and also recruit and employ graduates to augment the work force where necessary; where as a low construction volume and spending will lead to dis-engagement and laying-off staff. These means that new BE graduates will not be employed.

iii. Graduates with the needed qualifications were normally interviewed, or sit for an aptitude test or special test as deemed fit by the organization. This stage is very vital for most organizations because of the practicability of BE and also it allows them to have a better Perception and ascertain the level of skills acquired by the graduates, their approach to real world problems/challenges and other traits or attitudes that may benefit or harm the organizations. At the end of which, those perceived with the ability that will benefit the organizations will be employed.

iv. Degree class (e.g. 1st Class, 2nd Class Upper / Lower, 3rd Class etc.) is very important as it indicates the academic performance of a graduate. However, this factor ranked 4th but it is often a criterion used in advertisement of jobs in the labour market because it reduces the number of applicants and provides a uniform ground for job

applications. This factor is very important in the curriculum vitae/resume of applicants and it may also indicate academic achievement which is vital to some of the employers'.

v. Tertiary institutions (colleges, Polytechnics and universities) have different ranking based on some performance parameters, academically and practically. As such, graduates from highly ranked tertiary institutions were perceived to have received a better training and acquired the requisite knowledge needed in the BE related disciplines. This provides an employability edge in recruitment.

vi. Professional bodies membership and Qualification is vital in today's BE related disciplines because it ascertain the level of professionalism by various individuals in their respective fields. This may be very important and a big criterion for employing expatriates and or high technical/skilled jobs. However, this is not the case for graduates especially those that are fresh from the tertiary institutions, because there is need for few years of practice to be able to qualify for the examination for the Professional membership. This factor is extremely important to BE related disciplines but it is less likely among fresh graduates.

vii. Experience is vital in any profession and the higher the experience the better the ability of the employee. This is very important for expatriates and high technical/skilled jobs. However, this is not the case for graduates especially those fresh from the tertiary institutions, because most of them only possess the experience during their Industrial Training (I.T.), Students' Industrial Working Experience Scheme (SIWES), or some part time jobs as the case may be. Though vital, but it is deemed neutral by the respondents.

viii. Some graduates are related through family or businesses etc. with the owner(s) of organizations while others do obtain a recommendation/reference letters from well-known practitioners or a high-ranking government officials or a well-connected people in the society in order to be favored for a job. This does not harm the chances of other graduates if the job is not advertised. Nonetheless, it is unethical for advertised jobs especially in the public sector. However, in the private sector, recommending graduate(s) to any organization based on a fore knowledge / information regarding their ability, capacity and suitability for a vacancy or a job posting is always allowed and practiced because it is deemed cost effective with regards to recruitment exercises. Such Favoritism or Nepotism as the case may be increases employability of these category of graduates in Nigeria and many parts of the world at large.

Testing of hypotheses

The hypotheses formulated for this research work was tested using one sample T-statistics; the formula is shown below.

$$t = \frac{\overline{x} - \mu_0}{s/\sqrt{n}}$$

where $\overline{x}$ is the sample mean, S is the sample standard deviation of the sample and n is the sample size. The degrees of freedom used in this test are $n - 1$.

The values of the mean item scores in table 4.1.2 above were used as the data for the statistical computations with the result shown in the table below.

Table 4.2.1: T-Test statistical computation result

Employability of BE Graduates	Mean	Standard Deviation	Standard Error	N	D F	Alpha (level of Significance)	Pvalue	Tcal	$Ttab_{0.05,\ 6}$
Determinant Factors	3.826	0.4855	0.1717	8	7	5%	0.0001	7.7260	-1.8946

With 7 degrees of freedom (DF) and 5% level of significance, the T-test calculated (Tcal = 7.7260) is greater than T-test tabulated ($T\text{-}tab_{0.05,\ 7}$ = -1.8946), as such, the Alternative hypothesis was accepted; which states that "*Employability of BE graduates* ***is*** *hindered significantly by some factors in the Nigeria's Built Environment.".* The hypotheses testing is further attested and supported by the assessment of the factors in the table 4.1.2 above which shows the agreement (strongly agree and agree) of six of the eight identified factors by the respondents.

CONCLUSIONS AND RECOMMENDATIONS

This study identified eight factors that significantly determine the employability of BE graduates in the Nigeria's Built Environment, out of which: Employability Skills is the major factor followed by Construction volume and spending within the industry; then the Perceptions of the Employers; altogether they are the three main factors. These clearly indicates that graduates with employability skills (such as verbal, written, communication, analytical, investigative abilities, entrepreneurship, managerial skills, teamwork, computer / I.T. skill, drive and flexibility etc.) who distinguish themselves during job interview/test were perceived as employable by the various organizations/firms/ companies operating in the BE; during construction boom (A huge construction volume and spending) will have better chances of getting employed in BE related professions.

Other factors such as Class of degree (e.g. 1st Class, 2nd Class Upper / Lower, 3rd Class etc.), Membership of Professional bodies (e.g. NIQS, NIA, NIOB), Reputation of the tertiary institutions, Years of experience of graduate applicants for a job and Favouritism / Nepotism also very important factors in terms of the graduate employability. They provide edge and also an added advantage for job considerations. The impact of these determinant Factors of employability is significant which is further attested by the T-test statistical test of the research hypotheses accepting the Alternative hypothesis; which states that "Employability of BE graduates is

hindered significantly by some selected factors in the Nigeria's Built Environment.".

There is need for further studies to identify, assess and examine the impact of other employability factors on BE graduates. Another study should be conducted to ascertain how each of these factors affect each all the Disciplines in the BE. There is the need to study the impact or relationship of education curriculum and the practical aspects of the BE professional disciplines.

REFERENCES

Akinyemi Samuel, Ofem, Igot Bassey, Ikuenomore Samuel O. (2012). Graduate Turnout and Graduate Employment in Nigeria. "International Journal of Humanities and Social Science"2 (4), 12-36

Askov, E. N. & Gordon, E. E. (1999). The brave new world of workforce education. New Directions for Adult and Continuing Education, 1999, 83, p. 59-68.

Ayiesah Ramli, Roslizawati Nawawi, Maslyn Poh Pau Chuna (2010). Employees' Perception of Employability Skills Needed in Todays Workforce among Physiotherapy Graduates. International Conference on Learner Diversity 2010. Procedia Social and Behavioral Sciences 7(C) (2010) 455–463

Boeteng, K. and Ofori-Sarpong, E. (2002). An Analytical Study of the Labour Market for Tertiary Graduates in Ghana. World Bank / National Council for Teriary Education/ National Accreditation Board Project, Ghana.

Bridgstock, R. (2009). The graduate attributes we've overlooked: enhancing graduate employability through career management skills. "Higher Education Research & Development", 28(1), 31-44.

Brigadier General Maharazu Tsiga (2009). Number of graduating students worries NYSC DG. available at: http://www.vanguardngr.com/2009/07/number-of-graduating-students-worries-nysc-dg

Coplin B. (2003). 10 things employers want you to learn in college: The know-how you need to succeed. California: Ten Speed Press 2003.

Cristina Torres-Mach,í Eugenio Pellicer, Vcítor Yepes and Miguel Picornell (2013). Impact of the economic crisis in construction: a perspective from graduate students. 2nd Cyprus International Conference on Educational Research, (CY-ICER 2013). "Procedia - Social and Behavioral Sciences" 89 (2013) 640 – 645

Dabalen, A. Oni, B. and Adekola, O. A. (2000): Labour Market Prospects for University Graduates in Nigeria. The Nigeria University System Innovation Project Study.

DEST. (2006). Employability skills from framework to practice, an introductory guide for trainers and assessors. A report by the Australian Chamber of Commerce and Industry and the Business Council of Australia for the Department of Education, Science and Training, Canberra.

Fugate, M, Kinicki, A. J. and Ashforth, B. E. (2004). "Employability: A psychosocial construct, its dimension, and applications". "Journal of Vocational Behaviour" 2004, 65(2), 14-38.

Hapidah Mohamad and Mohd Sahandri Gani Hamzah. (2011). Employability Profiles of Graduates: The Malaysia Scenario from an Employer Perspective. The 5th QS-Apple Conference.

Harvey L, Moon S, Geall V. (2010). Graduates' Work: Organisational Change and Students' Attributes. Centre for Research into Quality. available at: http://www.ce.acu.uk/crq/publications/gw/gwcon.htm. 1997.

Hillage, J., & Pollard, E. (1998). Employability: Developing a framework for policy analysis, Research Report No. RR85, Department for Education and Employment (DEE), London.

Husain, M. Y., Mokhtar, S. B., Ahmad, A. A., & Mustapha, R. (2010). Importance of Employability Skills from Employers' Perspective. Procedia - Social and Behavioural Sciences, 7:430-438

Madu, C. N., Kuei CH. (1993). Dimensions of Quality Teaching in Higher institutions. "otal Quality Management" 4(3),325-338.

Masura Rahmat, Kamsuriah Ahmad Sufian Idris & Noor Faridatul Ainun Zainal (2012). Relationship between employability and graduates' skill. UKM Teaching and Learning Congress 2011. "Procedia - Social and Behavioral Sciences" 59 (2012) 591 – 597

Ministry of Education Malaysia. Maklumat Pendidikan Swasta (2002). Jabatan Pendidikan Swasta, Kementerian Pendidikan Malaysia. 2002.

Odunayo Salau (2014). Attitude of Youths and Young Graduates towards Entrepreneurial Skill Acquisition in Abeokuta, Ogun State: Issues and Prospects. "International Journal of Economics & Management Sciences" 3(3)1000192

Perry, C (2003). All employers want the "Balanced graduate." Sydney, Australia: University of New South Wales, Careers and Employment. 2003.

Precision Consultancy. (2007). Graduate Employability Skills. Melbourne: Business, Industry and Higher Education Collaboration Council.

Robinson J.P. (2000). What Are employability skills? Community workforce development specialist. "Alabama Cooperative Extension System" 1(3).

Roof, K; Oleru N. (2008). "Public Health: Seattle and King County's Push for the Built Environment. "Journal Environ Health" 71: 24–27.

The Built Environment and Health (2012). "11 Profiles of Neighbourhood Transformation". Retrieved 12 April 2012.

Te Wiata I. (2001). A Big Ask: To what Extent can Universities Develop Useful Generic Skills? In F.Bevan, C. Kanes, & D. Roebuck (Eds).(2001). Knowledge Demands for the New Economy. Brisbane: Australian Academic Press 2001: 290-297.

Yuzainee Md Yusoff, Mohd. Zaidi Omar, Azami Zaharimb, Azah Mohamedb, Norhamidi Muhamadb (2012). Formulation in Evaluating the Technical Skills of Engineering Graduates. UKM Teaching and Learning Congress 2011. "Procedia - Social and Behavioural Sciences" 60: 493 – 499

EVALUATING DELAYS IN EXECUTION OF PUBLIC SECTOR CONSTRUCTION PROJECTS: A STUDY OF ROADS AND HIGHWAYS IN GHANA

Natasha Narh[1], Corrine Shaw[2], and Abimbola Windapo[3]
[1]Ashesi University College, Ghana
[2,3]University of Cape Town, South Africa

Public construction projects such as highway construction are mainly funded with donor support in developing countries like Ghana. Timely completion of such projects is essential, however, delays in construction projects in Ghana has resulted in additional cost, time overrun, litigation and contractor abandonment of projects. The objectives of this study were to identify the causes of delays in the execution of public construction projects, analyze how the execution processes of these projects are affected by delay factors and find strategies that can avert the delays. A quantitative research design was adopted. Data was collected using self-administered structured survey questionnaires and analyzed with SPSS using the Spearman Correlation Analysis, Relative Importance Index (RII) and Chi Square Test. A sample size of 290 construction professionals was obtained from staff of the Ministry of Roads and Highways in Ghana. It emerged that the leading causes of construction delays included: lack of financial capacity improper planning by contractors during bidding. It was also revealed that delay factors led to reduced quality and standardization of projects, elongation of project duration and reduction in value of money received as payment. The study found delay averting strategies to include: educating the contractors, effective mobilization of resources, and effective supervision of construction activities. The recommendations proposed to address the delays included adequate and timely project resourcing, selection of competent contractors with adequate project understanding of construction projects. The need for further research on the impact of politicians on public construction projects and processes for contractor selection was also recommended.

Keywords: cashflow, delays, finance, project execution, public construction projects, quality

INTRODUCTION

Large-scale public construction projects such as highway construction are mostly funded with donor support in developing countries (Long, Ogunlana, Quang, & Lam, 2004) like Ghana and timely completion is essential due to

[1] tashnarh@gmail.com
[2] Abimbola.Windapo@uct.ac.za
[3] Corrinne.Shaw@uct.ac.za

Narh, N., Shaw, C. and Windapo, A. (2017) Evaluating delays in execution of public sector construction projects: a study of roads and highways in Ghana *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 642-654

the associated benefits. Construction project delays add to the burden of the industry and threatens its survival. These delays affect timely completion of construction activities and bring about various complexities, risks, time overruns and have cost implications (Majid, 2016). Besides these consequences, Sambasivan and Soon (2007) assert that delays result in disputes amongst partners of the project, litigation and in some cases contractor abandonment of the project; clients end up suffering hardship or stress, rise in expenditure or falling revenue which eventually results in lack of production, high cost of materials and increase in labour cost, and contractors also experience financial loss in the form of non-productive labour, material delivery schedules, overhead expenses, unused equipment and machinery. Causes of these inefficiencies is a cause for concern because the construction industry in Ghana contributes 8.9% of total GDP, employment creation for both skilled and semi-skilled labour, and catalyses development of sectors like the manufacturing, ICT and the oil and gas industries (Fugar and Agyakwah-Baah, 2010) among others.

Delay in execution of construction projects in Ghana is a major developmental constraint and have raised discussions among stakeholders with emphasis on effects of delay on project completion, cost and time overruns (Frimpong, Oluwoye, Crawford, 2003; Addo, 2015). Kwamena and Charity (2007) also affirm that delays in project execution in Ghana adversely affect the time, quality and continuity of construction projects. Though research studies have explored the problems of delay in the construction industry, little attention has been given to road construction projects and in the context of Ghana. This leaves a gap in knowledge of the causes and effects of delay on road construction projects in Ghana, and the need for further investigations that would comprehensively contribute towards addressing the factors of delays in road construction projects in the country (Addo, 2015). This study investigates the causes, the effects and strategies for averting delays in road construction projects execution in Ghana using the road construction projects of Department of Urban Roads as a case study.

This study aimed at identifying delay factors in public construction projects in Ghana. To achieve this aim, the study sought to: identify the causes of delays in the execution of public construction projects; analyze how the execution processes of construction projects are affected by delay factors; and identify strategies that can avert delays in construction projects of the Department of Urban Roads. Therefore, the paper first presents a critical review of literature in the area of construction project delays, outlined the methodology used in the research, presented the results of the data analysis, discussed the findings and finally, outlined conclusions and recommendations that addresses the problems of delays on construction projects.

LITERATURE REVIEW

Overview of the construction industry

The construction industry spurs socio-economic growth of countries by primarily providing the relevant infrastructure that contributes to the growth of other industries (Ofori, 2012). Such infrastructure include the road network, social services infrastructure, markets, offices for delivery of government machinery, railways, and factories for production and distribution of goods and services (Ofori, 2012). Nonetheless, inefficiencies in the processes of contract management, low implementation of project management practices, cost and time overrun, among other excesses, characterize this sector.

Types of construction project delays

Construction delay refers to a later commencement or execution in the activity schedule and material deliveries when compared to project delivery times based on agreed contract. Delays have a negative impact on project performance causing time and financial difficulties, and disputes among project stakeholders; manifesting in time extensions that result in overtime works thereby adding extra expenses to the project cost (Long et al,. 2004). Adding to the negative impacts, clients are forced to absorb extra expenses to ensure timely completion of the project. The four types of construction project delays are namely:

Excusable or non-excusable delays

Trauner et al. (2009) describe excusable delays as those that result from unplanned and unforeseeable events beyond the contractors or the subcontractors' control such as fire outbreaks, floods, acts of God, client variation, mistakes and errors in specifications, variation in site conditions or underground services, abnormal weather conditions, material delivery delays, acute illness, death or absence of one of the contractors without notice, while delays due to the negligence of contractors are non-excusable.

Compensable and non-compensable delays

Excusable delays are either compensable or non-compensable. Compensable delays are either caused by the client, the client's representative or the project manager, changes in the work scope, site conditions and site accessibility; and the contractor will be entitled to claims of time, cost, or both (Trauner et al., 2009). Non-compensable delays are those deemed excusable but do not attract compensation claims by the contractor (Trauner et al., 2009). However, excusable non-compensable delays are often beyond the control of either the client or contractor and may be caused by bad weather conditions, force majeure, conflicts, national crises, floods, fires, or labour strikes.

Concurrent delays

Concurrent delays can be explained as a simultaneous occurrence of at least two independent causes of delay (Mubarak, 2005). These delays often include excusable and non-excusable delays, and the client, or any of the

project participants might cause such concurrent delays. However, no compensation for damages are advanced during these delays (Levy, 2006).

Critical and noncritical delays

Critical delays include an extension of project completion period whereas noncritical delays are those that have no effect on the project completion schedule (Trauner et al., 2009). The critical path activity is any activity in the construction project that when delayed, the project is consequently delayed.

Causes of delays in construction projects

The study seeks to evaluate the causes of construction projects delays in the context of Ghana. Through literature review, a number of factors that account for construction project delays were identified and are presented in Table 1.

Table 1. Causes of delay in construction projects

Causes of Delay	Factors	Sources of the cause	Literature cited
Non-clarity of project scope	Ambiguity in specifications; misinterpretation and different interpretations by contracting parties; change order and slow decision making by clients; rework due to changes in design and error in execution	Client related	Faridi and ElSavegh, 2006; Motaleb and Kishk, 2010; Baloyi and Bekker, 2011; Owolabi et al., 2014
Financial related factors	Financial constraints of contractors; Low cash flow; delay in payment to contractor/supplier; inflation/price fluctuation; inadequate funds from project sponsors/clients	Contractor, client and market related	Alaghbari, 2005; Faridi and ElSayegh, 2006; Kikwasi, 2012; Charles et al., 2015
Poor project management/ supervision	Poor contract management and supervision	Consultant & contractor related	Kikwasi, 2012
Lack of effective communication	Absence of active communication; obtaining permission from local authorities; restricted access to project site; delays in information flow	Client and contractor related	Kikwasi, 2012; and Owolabi et al., 2014
Lack of qualified and skilled personnel	Undersupply of workforce; lack of qualified professionals and unskilled labour	Market related	Al-Kharashi and Skitmore (2009), Azlan et al. (2011),
Improper planning	Unrealistic contract time schedules, improper planning of contractors at the bidding stage; delay in material procurement by contractor lack of project planning; poor means of contracting	Contractor related	Frimpong et al., 2003; Fugar et al., 2010.
Poor stakeholder relations	Vendors delay in supply and delivery of building materials; contractor order and procure without considering obstruction of timely delivery	Contractor related	Kikwasi, 2012
Unforeseen circumstances	Labour disputes and strikes; unexpected site conditions; changes in rules and regulations; natural disasters; organizational changes; transportation delays; poor economic conditions; conflict with neighbors	Market risks related	Frimpong et al., 2003; Alghbari et al., 2007; Haseeb et al., 2007

Table 1 indicates that eight causes of delays namely non-clarity of project scope, finance, poor project management/supervision, lack of effective

communication, lack of qualified and skilled personnel, improper planning, poor stakeholder relations and unforeseen circumstance, are identified in literature. The sources of these causes of delay are also predominantly client and contractor related.

Effects of delays on construction projects

Studies have shown that some resultant effects of delay in the execution of construction projects include: increased cost and time overrun elongation (Majid, 2006), low quality and standardization of projects, loss of money for extra spending, litigation among stakeholders, project rejection, lack of continuity and complete abandonment of projects (Haseeb et al., 2011). These generally compromises timeliness of project completion, quality of work and relations among stakeholders.

Strategies for averting delays on construction projects

Averting delay in construction is critical to mitigating the numerous causes and effects that have bedevilled road construction project quality and delivery in Ghana. Some factors used in averting delays and its associated effects in construction project execution are as follows: detailed project documentation, project system closure, project review for in-depth knowledge of time and cost, ensuring full completion and satisfactory stakeholder relation and communication. According to Ade et al., (2013), these factors culminates into three aversion strategies proactive, re-active and organizational strategy and these are tentative for mitigating causes and effect of delay of public construction projects.

METHODOLOGY

This study employs a cross-sectional survey research design adopting a deductive approach. A structured questionnaire was used to collect data and analysis was done using SPSS computer software. Data on registered construction professionals in Accra and Kumasi was obtained from the Department of Roads and Highways. The study population was categorized into: Civil Workers, Road Contractors and Government establishments such as Ministry of Finance and Economic Planning, Regional Coordinating Councils, Ministry of Roads and Highways, Department of Feeder Roads, Department of Urban Roads (DUR) and Ghana Highways Authority (see Table 2).

Respondents were selected using a multi-stage sampling technique which comprises simple stratified random sampling, convenience and purposive sampling, snowball sampling and chain referral. This enabled the researcher sample respondents with 10 years of work experience while ensuring equitable representation of the different professionals and stakeholders in the industry (Knight and Ruddock, 2008). Corporate members of government establishments, and randomly selected Civil Works Consultants and Road Contractors who have experience in the implementation phase of construction projects in Ghana's public sector were surveyed.

A sample size of 290 used in the study was established using the Kish (1965) statistical formula for determining sample size as stated in Equation 1:

$$N = \frac{n_1}{(1+n^1/N)} \quad \text{..... Equation 1}$$

Where: n = Sample Size

$$n_1 = \frac{S^2}{V^2}$$

N = Population Size

S = Maximum standard deviation

V = Standard error of sampling distribution (0.05)

P = Proportion of the population elements that belong to the defined class.
$S^2 = P(1-P) = 0.5(1-0.5) = 0.25$

Table 2: Population size for each of the selected Establishment

Establishments	No. of Professionals on Register	No. of Questionnaires Allotted
Civil Works Consultants	1050	78
Road Contractors (Class A1B1 to A4B4)	1090	104
Regional Coordinating Councils and Economic planning	300	27
Ministry of Roads and Highways and Ministry of Finance	80	6
Ghana Highway Authority, Department of Urban Roads and Department of Feeder Roads	900	69
Total	3420	284

The questionnaires were piloted on five groups of respondents at Nsawam district and respondents' feedback was used to check the reliability and validity of the questionnaire instruments. Self-administered structured questionnaires with both closed and open-ended questions were distributed. Closed ended questionnaires included five-point Likert Scale items (5 =Very High, 4 = High, 3 = Neutral, 2 = Low, 1 = Very Low) where respondents ranked causes of project delay in public road projects in Ghana. Another five-point Likert scale (5=Strongly Disagree, 4=Disagree, 3=Undecided, 2=Agree and 1=Strongly Agree) was used to measure the effects of delays on construction projects; and open-ended items addressed strategies in averting the effects of delays on construction projects.

Completed questionnaires were gathered, coded, entered, analyzed with the aid of SPSS computer software. The analytical tools employed include Relative Importance Index (RII) with specific model shown in Equation 2:

$$RII = \sum_{5} Wi\ Xi$$

$$\frac{\sum_{i=1}^{5} X_i}{5} \quad \text{.....Equation 2}$$

Where:
I = response category index = 1, 2, 3, 4, and 5 representing Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), and Strongly Agree (SA) respectively.
W_i= the weight assigned to the ith response = 1, 2, 3, 4, 5 respectively.
X_i = frequency of the ith response given as a percentage of the total responses for each cause.

The Spearman's correlation coefficient was also used for calculating the ranking, and the equation used is shown in Equation 3:

$$r_s = 1 - \frac{6 \sum d^2}{N(N2 - 1)} \quad \text{.....Equation 3}$$

Where:
r_s = Spearman's rank correlation coefficient.
d = the difference in ranking
N = the number of variables (26).

The chi square test was also used to test for significance.

Results were presented in tables, charts and narrations for interpretation and discussion.

DATA ANALYSIS AND DISCUSSIONS

Demographic Characteristics of the respondents

The majority of respondents in this study were males (90%) with the remaining being females (10%). It could be said that though both gender groups were represented, opinions were likely to be influenced by male responses, and this is expected because of the nature of the target population. The study also found that, a majority of respondents, 46%, were aged between 43 and 54 years, followed by 37% with age between 55-66 years, while 11% were aged 31-42 years and 6% fall within 18-30 years group. This suggests that the study participants, have adequate level of work experience and expertise, and can provide valid responses that is relevant to the root cause of delays and associated effects on road construction in Ghana.

Furthermore, the study revealed that, a significant proportion (62%) of respondents have education attainment of up to Bachelor's degree. There were also 20% of respondents with Post-graduate degrees while 18% possessed HND in key technical education qualifications. Education

background combined with experience in age was important in addressing the cause and effect of delay in Ghana's road construction projects, both in the public and private sectors.

Results on sectoral distribution of respondents show that, 53% of the respondents were from the public sector (mainly the Regional Coordinating Councils, Ministry of Roads and Highways, Ministry of Finance and Economic planning, Ghana Highway Authority, Department of Urban Roads, and Department of Feeder Roads). The private sector respondents formed 47% (contractors, architects, and other private sector engineers). This indicates that both the private and public sector were well represented in the study and opinions and experiences shared were inclusive and comprehensive.

Among the categories of respondents that participated in the study, 50% were contractors of Department of Urban Roads mandated to construct and monitor road construction projects for the Government of Ghana. Engineers and Consultants of road construction in Ghana constitute 19% and 17% respectively and Architects constitute 14% of total respondents. Since delay factors emanate from these players, their representation ensured detailed and relevant response on delay factors in road construction in Ghana.

Causes of delays in the execution of construction projects

Relative Importance Index (RII) of each factor identified as contributing to construction project delays in Ghana were determined, with 1 indicating low importance and 5 indicating high importance.

Table 2: Relative Importance Index of Factors

	Responses[4]							
Factors that cause delay in road construction projects	SD	D	U	A	SA	Total	RII	Rank
Low cash flow to complete the project	0.0	0.0	0.0	64.1	35.9	100.0	0.87	1
Financial constraints of contractors	1.4	7.2	6.9	40.0	44.5	100.0	0.85	2
Ambiguity in specifications and conflicting interpretation by parties	0.0	0.0	41.4	27.6	31.0	100.0	0.78	3
Lack of skilled technical personnel	5.9	0.0	31.4	48.3	14.5	100.0	0.77	4
Delay in material procurement by contractor	15.5	12.1	0.0	15.5	56.9	100.0	0.76	5
Delay in running bill payments to the contractor	0.0	0.0	41.4	46.6	12.1	100.0	0.75	6
Lack of motivation for contractors to early finish	15.5	0.0	0.0	69.0	15.5	100.0	0.74	7
Non-availability of design on time	0.0	9.3	17.6	73.1	0.0	100.0	0.73	8
Unrealistic time schedule of contracts	0.0	11.4	31.4	47.2	10.0	100.0	0.71	9
Inadequate experience of contractor	12.1	31.0	0.0	0.0	56.9	100.0	0.7	10
Poor labor productivity	15.5	0.0	24.1	44.8	15.5	100.0	0.69	11
Improper planning of contractor at bidding	0.0	0.0	0.0	64.1	35.9	100.0	0.67	12
Lack of project planning	0.0	33.1	2.8	64.1	0.0	100.0	0.66	13
Poor site management	32.1	4.1	1.0	41.0	21.7	100.0	0.64	14
Rework due to change of design or variation	36.9	41.4	7.2	10.3	4.1	100.0	0.63	15
Delays in the supply of raw materials	54.5	7.9	0.0	37.6	0.0	100.0	0.59	16
Poor contract management	27.6	31.0	0.0	41.4	0.0	100.0	0.58	17
Poor means of contracting	0.0	58.6	0.0	41.4	0.0	100.0	0.56	18
Rework due to error in execution	11.7	46.9	3.1	36.2	2.1	100.0	0.53	19
Lack of communication among project actors	31.7	33.1	1.0	32.1	2.1	100.0	0.47	20
Slow decisions from Client	24.5	47.6	8.3	11.7	7.9	100.0	0.46	21
Obtaining permission from local authorities	10.7	.7	41.7	16.9	30.0	100.0	0.44	22
Delay in material delivery by vendors	54.8	19.3	3.1	9.3	13.4	100.0	0.41	23
Restricted access at site	63.8	19.3	0.0	7.2	9.7	100.0	0.4	24
Extreme weather conditions	67.2	7.9	2.1	11.4	11.4	100.0	0.38	25
Changes in government regulations and laws	2.1	36.2	43.4	2.1	16.2	100.0	0.36	26

[4]Strongly Agree (SD); Disagree (D); Undecided (U); Agree (A); & Strongly Agree (SA)

It was found that, "Low cash flow to complete the project" had the highest RII value of 0.87 in the study and "Changes in government regulations and

laws" had the lowest RII value of 0.36. Furthermore, out of the twenty-six (26) factors of delay analysed, nineteen (19) of them have RII values above 0.5 and are considered the most critical road construction project delay contributors. These delay factors include the following from a ranking perspective: Low cash flow to complete the project; Delay in material procurement by contractor; Financial constraints of contractors; Ambiguity in specifications and conflicting interpretation by parties; Lack of skilled technical personnel; Delay in running bill payments to the contractor; Lack of motivation for contractors to early finish; No availability of drawing/design on time; Inadequate experience of contractor; Unrealistic time schedule imposed in contract; Poor labor productivity; Improper planning of contractor during bidding stage; Lack of project planning; Poor site management; Rework due to change of design or variation order; Delays in the supply of raw materials; Poor contract management; Poor means of contracting, and Rework due to error in execution.

Though they are contributors to delays, the lower rated seven (7) factors are found to have lesser effect on construction project delays as compared to the nineteen (19) other factors whose RII values are above 0.5.

EFFECTS OF DELAYS ON THE EXECUTION PROCESSES OF CONSTRUCTION PROJECTS

The effect of delay in Department of Urban Road construction projects in Ghana (Accra and Kumasi) was determined using a Likert Scale. The study revealed that, of the 290 respondents, 230 respondents (79.3%) agreed that delay leads to rework financing problems; 213 (73.4%) strongly agree that delay leads to a reduction in value of money for completion of projects and 228 respondents (78.6%) strongly agree that delay results in reducing the quality and standardization of projects, and the contractor ends up doing mediocre work. Furthermore, 228 (78.6%) of respondents strongly agreed that delays affect construction projects by elongating project duration, and for that matter increasing cost. Overall, it was revealed that, 86.6%, (a significant number of the respondents) strongly agree that project delay significantly affects actual project execution especially the duration and content/scope of the project are usually changed.

The data collected was interrogated further using Spearman Rho correlation analysis. The results of this interrogation show that the perspectives of the respondents regarding the effects of delays on road construction projects (i.e. rework financing problems; reduction in value for money; reduced quality and standardization; elongation of project duration as well as loss and expense claims) when distributed according to establishment are significantly different.

Table 3 Correlation of Effects of Delays on Construction Project

Spearman's rho		Rework financing problems	Reduction in Value for money	Reduced quality and standardization	Elongation of Project Duration	Loss and expense claims
Effects: Rework financing problems	Correlation Coefficient	1.000	.898**	.693**	.677**	.735**
	Sig. (2-tailed)	.	.000	.000	.000	.000
	N	290	290	290	290	290
Effects: Reduction in Value for money	Correlation Coefficient	.898**	1.000	.859**	.864**	.695**
	Sig. (2-tailed)	.000	.	.000	.000	.000
	N	290	290	290	290	290
Effects: Reduced quality and standardization	Correlation Coefficient	.693**	.859**	1.000	.994**	.819**
	Sig. (2-tailed)	.000	.000	.	.000	.000
	N	290	290	290	290	290
Effects: Elongation of Project Duration	Correlation Coefficient	.677**	.864**	.994**	1.000	.812**
	Sig. (2-tailed)	.000	.000	.000	.	.000
	N	290	290	290	290	290
Effects: Loss and expense claims	Correlation Coefficient	.735**	.695**	.819**	.812**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.
	N	290	290	290	290	290

**. Correlation is significant at the 0.01 level (2-tailed)

Strategies for averting delays on construction projects

Table 3 shows the following applicable strategies perceived by the respondents to be capable of averting delays during the execution phase of construction projects, with mean values of 4.0: adequate understanding of contractors on project task, effective mobilization and release of resources, early engagement of project managers as well as adequate and effective supervision of construction activities. However, respondents were undecided on the strategy - ensuring adequate training for project staff on specific requirements of construction projects, with a mean value of 3.28.

Table 4: Strategies to Advert Delays in Executing Construction Projects

Strategies for Averting Delays during the Execution Phase of Construction Projects	Frequency	Mean	Ranking
Adequate understanding of contractors on project task	290	4.4586	1st
Effective mobilization and release of resources	290	4.3724	2nd
Early engagement of project managers	290	4.3310	3rd
Adequate and effective supervision	290	4.10	4th
Ensure adequate training of project staff	290	3.28	5th
Valid Number (list wise)	290	20.542	-

The results presented in Table 3, were further interrogated using Chi-square to test for significance. Table 4 presents the result of this enquiry. It can be seen from Table 4 that two of the strategies - ensuring adequate training of project staff and adequate and effective supervision had an observed frequency greater than the minimum expected cell frequency of 58.0. Whereas the other set of strategies, thus early engagement of project managers, effective mobilization, and release of resources as well as contractors' adequate understanding of project content and requirements had a minimum expected cell frequency of 72.5. These frequencies are at a significance of 0.000, an indication that the strategies identified to avert delays during the execution of construction projects in Ghana are significant.

Table 5: Chi-Square Test of Strategies

Test Variables	Ensure adequate training of project staff on the specific projects	Adequate and effective supervision	Early engagement of project managers	Effective mobilization and release of resources	Adequate understanding of contractors of project task
Chi-Square	60.241[a]	275.621[a]	191.628[b]	214.800[b]	276.869[b]
Df	4	4	3	3	3
Asymp. Sig.	.000	.000	.000	.000	.000

0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 58.0.

0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 72.5.

Discussion of findings

The objectives of this study were to identify the causes of delays in the execution of public construction projects, analyse how the execution processes of these projects are affected by delay factors and find strategies that can avert delays in construction projects. It emerged that the following factors: improper planning on the part of contractors during bidding, low cash flow to complete projects and the lack of financial capacity on the part of the contractors were rated high by the respondents in terms of the causes of delay execution of construction projects by the Department of Urban Roads. These delay factors are contractor related and are aligned to earlier findings by Alaghbari (2005), Kikwasi (2012) and Frimpong et al., (2003).

Also, it was found out that a significant number of the respondents agreed that delays in construction execution lead to rework financing problems; reduction in the value of money received as payments for projects completed; reduction in the quality and standardization of projects; cause of elongation of project duration. Overall, majority (86.6%) of respondents strongly agreed that delay have a significant effect on project completion. These findings agree with the findings of earlier research in Saudi Arabia by Al-Kharashi et al., (2009). Also, the following strategies: educating the contractors to adequately understand project task, effective mobilization and release of resources, early engagement of project managers as well as adequate and effective supervision of construction activities were identified by respondents as applicable, feasible and significant strategies that could avert delays in construction project execution. This is supported by findings in earlier research by Ade et al. (2013).

CONCLUSION AND RECOMMENDATIONS

This study examines the causes of delays in the execution of public construction projects, and how the execution processes of these projects are affected by delay factors. It was found that mainly, contractor related factors: improper planning on the part of contractors during bidding, low cash flow to complete projects and the lack of financial capacity on the part of the contractors were rated high by the respondents in terms of the causes of delay in the execution of highway construction projects and that this results in rework financing problems; reduction in the value of money

received as payments for projects completed; reduction in the quality and standardization of projects; and project non-completion. The study established that strategies such as contractors understanding of project task, effective mobilization and release of resources, early engagement of project managers as well as adequate and effective supervision of construction activities are applicable and feasible strategies that could avert delays in construction project execution. Based on these findings, the study concludes that opportunity cost of delays in executing construction projects is the elongation of project duration, reduced standardization, and reduced quality.

Based on these conclusions, the study recommends that: resourcing strategies of construction projects in Ghana should be reviewed to enhance timely project execution; Contractors selected must have professional competency and understanding of project demands at early stages of contract advert, bidding and awarding; Bureaucracies in handling public construction projects in Ghana must be reviewed to eliminate or reduce its effect on service delivery and resource allocation; public construction projects must be effectively monitored and supervised to ensure professionalism in the construction sector and efficient project delivery. The study also recommends that further research be conducted to assess the procedures and selection processes of public contractors taking into account political, ethnic and regional factors in Ghana.

REFERENCES

Addo J. N. T. (2015) Delay and Its Effect on the Delivery of Construction Projects in Ghana, African Journal of Applied Research. (AJAR) Journal, 1 (1), 236-247.

Ade A.A.A, Aftab H. M., Ismail A., Ahmad T. A. (2013). Controlling Cost Overrun Factors in Construction Projects in Malaysia. Research Journal of Applied Sciences, Engineering and Technology 5 (8): 2621-2629.

Alaghbari, W.A. (2005). Factors affecting construction speed of industrialized building systems in Malaysia, Master's thesis, University Putra Malaysia, Serdang, Malaysia.

Al-Kharashi, A., Skitmore, M. (2009). Causes of delays in Saudi Arabian public sector construction projects. Construction Management and Economics, 27(1), 3-23.

Azlan, A. S., Wen, K. H. (2011). Building Defects: Possible Solution for Poor Construction Workmanship. Journal of Building Performance 2(1), 59-69.

Baloyi, L., Bekker, M. (2011). Causes of construction cost and time overruns. The 2010 FIFA World Cup stadia in South Africa", Acta Structilia Journal, 18 (1), 51-67.

Brown R. B. (2006), Doing Your Dissertation in Business and Management: The Reality of Research and Writing. Sage.

Faridi, A., El-Sayegh, S. (2006). Significant factors causing delay in the UAE construction Industry, Construction Management and Economics; 24(11): 1167–1176.

Frimpong, Y., Oluwoye, J., & Crawford, L. (2003). Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study. International Journal of Project Management, 21(5), pp.321-326.

Fugar, F. D. K. and Agyakwah-Baah, A. B. (2010). Delays in building construction projects in Ghana', Australasian Journal of Construction Economics and Building, 10 (1/2), pp 103-116.

Knight, A., Ruddock, L. (2008) "Advanced Research Methods in the Built Environment" Chichester, Wiley-Blackwell.

Kikwasi, G.J. (2012). Causes and Effects of Delays and Disruptions in Construction Projects in Tanzania. Australasian Journal of Construction Economics and Building, conference series, 1 (2), pp 52-59.

Kish, L (1965), Survey Sampling John Wiley and Sons Inc, New York.

Levy, S. M. (2006) "Project Management in Construction", McGrawHill, USA.

Long, N. D., Ogunlana, S., Quang, T., & Lam, K. C. (2004). Large construction projects in developing countries: a case study from Vietnam. International Journal of project management, 22(7), 553-561.

Majid, I. A. (2006). Causes and effects of delays in Aceh Construction Industry. Universiti Teknologi Malaysia.

Motaleb, O and Kishk, M (2010). An investigation into causes and effects of construction delays in UAE. In: Egbu, C. (Ed) Procs 26th Annual ARCOM Conference, Leeds, UK, 26(1), 1149-1157.

Mubarak, S. (2005) "Construction Project Scheduling and Control", John Wiley & Sons, USA.

Ofori, G. (2012). Developing the Construction Industry in Ghana: the case for a central agency, National University of Singapore.

Owolabi, J.D., Amusan, L.M., Oloke, C.O., Olusanya, O., Tunji-Olayeni, P.F., Dele, O., Peter, N.J. and Omuh, I.O., 2014. Causes and effect of delay on project construction delivery time. International Journal of Education and Research, 2(4), pp.197-208.

Sambasivan, M., Soon, Y. W. (2007). Causes and Effects of delays in Malaysian construction industry. International Journal of Project Management, 25(5), 517-526.

Trauner, J.T., Manginelli, W.A., Lowe, J.S., Nagata, M.F. and Furniss, B.J. (2009). Construction Delays: understanding them clearly and Delay Analysis in Construction analyzing them correctly. London: Elsevier Inc.

EVALUATING THE SUCCESS FACTORS FOR GREEN BUILDING PROJECTS IN THE NIGERIA'S BUILT ENVIRONMENT: THE PROJECT PROFESSIONALS' PERSPECTIVE

Salisu Gidado Dalibi[1], J. C. Feng[2], Abubakar Sadiq[3], Bello Sani Bello[4] and Hassan Ali Kumo[5]

[1,2,3,4,] Business School of Hohai University Nanjing, Jiangsu Province of China.

[1]Department of Quantity Surveying, Abubakar Tafawa Balewa University, Bauchi. Nigeria,

Project success or failure is strongly related to the perceptions of each individual project stakeholder and their willingness and ability to act either for or against the project. Therefore, failure could be perceptions of expectations not met, or promises not delivered, or the belief that the support (resources) could be applied elsewhere. These perceptions are not necessarily based on logic, but often on the quality of the relationships between the project and its stakeholder's. Developing countries like Nigeria need green building projects to address sustainability issues. However, such green building projects' briefs, goals, designs and constructions are characterised by the problem of lack of shared perception and agreement on the objectives of the projects by the stakeholders involved especially the developers / clients and the end-users. The need and the cost for incorporating Green features varies among the various stake holders and by extension the various project professionals working and representing the stake holders' interests in the project. Going by these characteristics, each of them perceives the success according to a hierarchy of dimensions, which comply with his / her own agenda. The aim of this study is to assess the success factors for green building projects in the Nigeria's construction industry based on the project professionals' perceptions. Research primary data was obtained through the use of research questionnaires which were randomly distributed and were analyzed statistically using frequency counts tables, mean item score and inferential statistics. The result shows the major success factors to be convergent interests and views of success among stakeholders; end result achieved as envisioned by meeting GB project goals, performance, functionality specification, GB Technical Know How, Innovation and efforts among the built environment professionals in design and construction. In the overall analysis, the success factors significantly affect Green building developments in the Nigeria's Built Environment.

[1] salgidos@yahoo.com
[2] feng.jingchun@163.com
[3] sadiq635@yahoo.co.uk
[4] belsann@yahoo.com
[5] halikumo@gmail.com

Dalibi, S.G., Feng, J.C., Sadiq, A., Bello, B. S. and Kumo, H. A. (2017) Evaluating the success factors for green building projects in the Nigeria's built environment: the project professionals' perspective *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 655-673

Keywords: green building, perception, professional, stakeholder, success factor

INTRODUCTION

The world's population continued growth has led to the implementation of resource-efficient measures in all areas of human activities especially in the built environment (BE) which has a significant impact on all resources while also devastating the environment, affecting the air quality and transportation patterns of communities; both the present and the future generations (Bauer, et al., 2007; Eurostat, 2011 and Dalibi, 2012). This is due to the need for a dynamic equilibrium without any form of threat especially to the environment (Zubairu, 2012). The combination of these challenges gave birth to a new concept in building design, construction, renovation, operation and maintenance of buildings in an environmental friendly manner known as Green Buildings (Dalibi, 2014).

Green building (GB) is the foundation of sustainable construction and refers to a structure that is resource-efficient in terms of economy, utility, durability, and comfort (USGBC, 2012 and epa.gov); GBs are those sensitive to the "Environment, Resource and energy consumption, Impact on people, Financial impact and the world at large (Kats, 2003); GBs are environmentally friendly which encompasses energy use, water use, and storm-water and wastewater re-use (Satterfield, 2009); GBs combine energy and water efficiency systems, Day Lighting strategies, Indoor Environmental Quality (IEQ) systems and efficient Building Envelope system to provide comfort and positive impact to the occupants and the environment (Dalibi, 2012). Sustainability in construction is all about following suitable practices in terms of choice of materials, their sources, construction methodologies, as well as design philosophy so as to be able to improve performance, decrease the environmental burden of the project, minimize waste and be ecologically friendlier (Abolore, 2013). It enhances the environment against the negative side effect of construction activities (Dahiru et al., 2013); a clear answer to health, economic and environmental challenges (Karolides, 2002); maximize the resource savings, protect the environment, reduce pollution, provide people with healthy, comfortable and highly efficient space, and exist harmoniously with nature" (MOC, 2006; Li and Currie, 2011; Liu, 2012).

The term "green building", or "more sustainable building", does not have an exact definition, but, nevertheless, these terms have been used frequently (Berardi, 2013).

Thus, the GB elements and features considered in this work based on (Karolides, 2002; Kats, 2003; MOC, 2006; Satterfield, 2009; Li and Currie, 2011; Liu, 2012; Dalibi, 2012; USGBC, 2012; epa.gov; Abolore, 2013) include the following:

1) Sustainable sites and materials
2) Energy Efficiency systems,
3) Water Efficiency systems,
4) Day Lighting systems,
5) Indoor Environmental Quality (IEQ) systems,
6) The Building Envelope systems.

These clearly indicate that GB is a major response to ensure environmental sustainability globally within the construction industry. However, countries like USA, UK, China, Australia, Germany, Japan, Korea and other developed nations have embraced the concept fully; while other countries are prioritizing which feature to incorporate in to their building projects; whereas other countries are ignoring or slowly embracing the concept due to some factors or reasons. These may be directly associated with some factors linked with the success or failure of the GB as a concept.

A development project of any kind has its Success / Failure factors which is an objective perspective or perception and varies among the stakeholders. Though, each project has its main goals, objectives and targets which is normally agreed and shared by all the stakeholders. But, each stakeholder has a separate list of priorities, preference and targets for the project which determines the level of satisfaction with the project. Hence, the need to determine the success factors of GB for the concept to thrive in developing countries like Nigeria.

THE RESEARCH PROBLEM

Nigeria as a developing country is faced with the shortages of residential housing developments both quantitative and qualitative; which is also accompanied by huge power, water, natural and processed material consumptions etc. which were due to the population growth, increased households and the increased levels of urbanization. These increased urbanization is extremely felt in major cities like Abuja (the Federal Capital territory- FCT), Lagos, Kano, Kaduna, Port Harcourt, Ibadan, Jos and Calabar etc.

Despite all these glaring challenges and the need for drastic measures, GB developments and sustainable practices are embraced very slowly and practiced at slow pace in the Nigeria's construction industry. This is worrisome and is due to some factors affecting such pace.

GB projects design and construction is somehow new in the Nigerian construction industry (about two decades old) and Just like any conventional building development, its success / failure hinges on its stakeholders' perceptions. These problem of lack of shared perception and agreement on the objectives and success/failure of the green building projects by stakeholders from:

- Incompatibility of interests among various stakeholders (Fenn et al., 1997),
- Absence of measured building performance data from currently operating sustainably designed buildings (BD&C, 2003; ENSAR, 2003; Andreau et al., 2004),
- Cost of green buildings in comparison with conventional buildings (Lisa and Morris, 2004),
- The believe that incorporating green elements into building designs increase first cost and the impact of other factors which includes Building type, Location, Climate, Site conditions and the Project team (Morris, 2007),
- Different Views regarding environmental sustainability and the built environment,
- Different Set of Criteria for success/failure for the project etc (Kumo, 2012).

Going by these characteristics, each stakeholder perceives the success according to a hierarchy of dimensions, which comply with his / her own agenda.

RESEARCH AIM

The aim of this paper is to identify and evaluate the success factors of green building developments based on the project professionals' perceptions with a view of exposing the impacts of such factors on the GB developments in Nigeria's BE.

RESEARCH HYPOTHESES

The following hypotheses were formulated for this research:

- *Null hypothesis (H_O);* Green building developments success *are not* hindered significantly by some selected factors in the Nigeria's Built Environment.
- *Alternative hypothesis (H_A);* Green building developments success *are* hindered significantly by some selected factors in the Nigeria's Built Environment.

RESEARCH SCOPE AND LIMITATIONS

This research work is limited to the perception of various practicing professionals working in the Nigeria's Built Environment. Such professionals include the Architects, Quantity Surveyors, Civil Engineers, Building Engineers, Mechanical and Electrical Engineers, Project Managers, Construction Managers, Land surveyors, Town planners and Estate Surveyors etc. As professionals, they viewed the success of GB as a whole; which includes their perspective, the Clients' perspectives, the end-

users' perspective and other stakeholders' perspectives etc. during the design, planning, construction stages.

REVIEW OF LITERATURE

Project success factors, perceptions and identification

Assessing project success has always been a subject of much debate because of the large number of criteria by which the various participants of a project would like to assess a project. In developing countries (like Nigeria), there is substantial gap between the standards required and standard achieved in construction and trying to improve project based performance is always a challenge (Nguyen et al., 2004).

Odusami (2003), defined success criteria as a set of principles or standards by which judgement is made while factors are a set of circumstances, facts or influences which contribute to the result. Success criteria correspond to the dimensions (or measures) on which the success of the project is judged whereas success factors are key variables that explain the success of the project (Diallo and Thullier, 2004).

Bala (2000), opined that there indeed exists a distinction between a successful project and successful project management. Clients are more disposed to achieving a successful project rather than successful project management. The designers and the contractors, on the other hand, both expect certain profit and fee goals. However, all three parties desire to have the project on time.

Pinto and Slevin (1988) as cited by Kumo (2004), concluded that project success is a complex and often illusionary construct, but nonetheless it is of crucial importance to effective project implementation and it is suggested to have two major components: issues dealing with the project itself and issues dealing with the client. In addition, they stressed the necessity of developing an adequate target in terms of knowing when to determine project success.

The basic issue is that the set of criteria and the standard to be used may or may not be agreed by all the participants and stakeholders at the beginning of each project; even preference in any common outlined success criteria may differ among the various stakeholders especially with the divergent views on environmental sustainability, green construction and its impact on the built environment.

Project success should be viewed from the different perspectives of the individual owner, donor/financier, developer, contractor, end-user, the general public, and so on. These perspective differences will explain the reason why the same project could be considered a success by one and unsuccessful by another. For those involved with a project, project success is normally thought of as the achievement of some predetermined project goals, which commonly include multiple parameters such as time, cost, performance quality and safety (Kumo, 2012). However, it must not be forgotten that the end-users and the general public do not necessarily have similar predetermined goals regarding the project at all. Hence, the

expectation on the outcome of the project and the perception of project success or failure will vary and always almost different for everyone involved and or affected by the project.

According to Baccarini (1999), as cited in Diallo and Thuillier (2005), project management success does not mean project success; although in the case of construction projects they are closely linked (Munns and Bjermi, 1996). Onwusonye (2005), opined that critical Success Factors provide measure for the completion and quality of the project. If a factor or a characteristic is critical to the success of a project, its absence dooms the project.

In construction projects, De Wit (1988) identified seven success factors. These success factors are planning effort (construction), planning effort (design), project manager-goal commitment, project team motivation, project manager technical capabilities, scope and work definition and control systems. Jha and Devaya (2009) outlined twenty-two project success factors and ranked them based on their importance whereas Odusami (2003), outlined ten factors based on Owner's criteria, Designer's criteria, Contractor's criteria; each for measuring success from their view point as shown in Table 2.

Table 2: Project success factors

Rank	Project SFs	Remarks
1	Quality compliance	Considered 'Extremely' important
2	Safety and health compliance	
3	Cost compliance	
4	Client satisfaction	
5	Profitability	Considered 'highly' important
6	User satisfaction	
7	Personal growth	
8	Efficiency of project execution	
9	Schedule compliance	
10	Organizational and managerial expectation	Considered 'important'
11	Perceived performance and functionality	
12	Meeting technical performance and functionality specification	
13	Reduction of dispute	
14	Contractor satisfaction	
15	Project management team satisfaction	Not important
16	Technical innovation	
17	Environmental sustainability	
18	Technical performance	
19	Functionality	
20	Preparing for the future	
21	Meeting design, functional, technical, managerial and organizational goals	
22	Project termination	

Source: Jha and Devaya (2009), as cited by Kumo (2012).

Table 3 shows the relating to project success factors based on owners' designer's and contractor's criteria. It is evident from this result that the difference in perspective will explain the reason why the same project could

be considered a success by one and unsuccessful by another. For those involved with a project, project success is normally thought of as the achievement of some predetermined project goals, which commonly include multiple parameters such as time, cost, performance quality, Aesthetics, and safety. However, it must not be forgotten that the users and the general public do not necessarily have similar predetermined goals regarding the project at all.

Table 3: Project success factors based on Owner's, Designer's and Contractor's Criteria

	A. Owner's criteria	B. Designer's criteria	C. Contractor's criteria
1	On schedule	Satisfied client	Met schedule
2	Within budget	Quality architectural product	Profitability
3	Functions for intended use	Met design fee and profit goal	Under budget
4	End result as envisioned	Professional staff fulfilment	Quality specification met or exceeded
5	Quality (Workmanship, products)	Met project budget and schedule	No claims for liability
6	Aesthetically pleasing	Marketable product/process	Safety
7	Return on investment	Minimal construction problem	Client's satisfaction
8	Building must be marketable	Building function as intended	Good customer buy out
9	Minimal aggravation in producing a building	Socially acceptable	Good direct communication
10		Client pays	Minimal or no surprises during the project

Source: Odusami (2003) as cited by Kumo (2012)

GB Developments success and hindrances: determinant factors

Construction of GB entails tailoring a building and the site to the local climate, site conditions, cultural and community in order to reduce resource consumption, augment resource supply, and enhance the quality and diversity of life. This is achieved through analysing important and interrelated issues, such as, the site and climate, building orientation and form, lighting and thermal control system, and materials, while optimizing all these in an integrated design (Dahiru, et al., 2013). In other words, it is a total quality management approach to buildings so as to ensure the achievement of synergistic design through interdisciplinary teamwork (Ibid). Thus, GB as rightly observed by Karolides (2002), it is neither, an assemblage of 14 environmental' components nor a piecemeal modification of an already designed standard building. It is neither a building style in which the building (Green Building) is expected to assume certain form or to have a "characteristic look". Rather, it is a building philosophy in which

natural and resource efficient features are incorporated in a building. Further, deliberate effort is made towards enhancing the surrounding environment. One major distinguishing feature of GB is that all the professionals that would be involved in the planning, design and construction of such buildings must be brought early (at the design stage), for professional input in the design of GB. This is in order to achieve synergy (Dahiru, et al., 2013).

Every project or development comes with its unique benefits, challenges and factors that affects (hindered) its success; GB developments in Nigeria are not an exception. Byrd and Leardini (2011); stated that "To be sustainable, buildings should usefully last for many generations. This requires some knowledge of the future climate and the resources available to maintain the operations, in particular the energy consumption, of buildings". The sustainable construction practice is a new trend (two-three decades old) in construction with insufficient data about the costs and absence of measured building performance data from currently operating sustainable designed buildings (BD&C, 2003; ENSAR, 2003; Andreau et al., 2004). Industry professionals, in both the design and construction disciplines, are generally slow to change, tend to be risk-adverse; moreover, environmental or economic benefit of some green building approaches has not been scientifically quantified (Wang, 2013).

Lisa and Morris (2004); opined that the first question often asked about sustainable design is: what does "green" cost? Typically meaning does it cost more? This raises the question: More than what? More than comparable buildings? More than the available funds? Or more than the building would have cost without the sustainable design features? The answers to these questions have been thus far elusive, due to the lack of hard data (Hankinson and Breytenbach, (2012). Morris (2007); argued that "The most common reasons cited in studies for not incorporating green elements into building designs is the increase in first cost". While a Davis Langdon Report in 2007 stated that "there is no one size that fits all answer to the question of the cost of green".

Dalibi et al., (2016), asserted that many housing estates were developed over the years, by both the Public and the Private sectors or a partnership of both in the Abuja FCT, Nigeria. However, Such Housing estate developments do not reflect the desired housing needs of the end-users, thereby increasing dissatisfaction among the end-users. The attitude to GBs by developers'/ clients' attitudes, lack of comprehensive data about the financial obligations with regards to incorporating green features into renovation or proposed projects is very worrisome. Incorporating green building features / elements are basically at the developer's disposal and may have a significant impact on the total development cost which in turn affects end-users / occupants in terms of Rental value, Sales value, Envisaged savings due to green elements, Future asset value of the green building etc.

Fenn et al., (1997), pointed out that incompatibility of interests amongst stakeholders caused conflicts and disputes in construction projects.

Notwithstanding, Berke (2002), advocated the holistic inclusion of different interests from stakeholders and involving the public in planning. Incorporating the various interests of stakeholders should be extremely important for the preparation of green specifications, construction and maintenance.

GB projects design and construction is new in Nigeria and is characterized by the problem of lack of shared perception and agreement on the objectives and success/failure of the green building projects by stakeholders (Dalibi and Kumo, 2016); also Different Set of Criteria for success/failure for the project (Kumo, 2012) etc. Going by these characteristics, each stakeholder perceives the success according to a hierarchy of dimensions, which comply with their personal agenda.

The initial emphasis of sustainability was on Technical issues such as materials, building components, construction methodologies and energy related design concept (usgbc.org; epa.gov). However, the appreciation of the significance of non-technical issues (soft issues) has grown, giving recognition to Economic and Social sustainability concerns as well as Cultural heritage of the built environment as being equally important (Abolore, 2013). Sustainable world progress is dependent upon continued Economic, Social, Cultural, and Technological progress (Shelbourn et al., 2006). According to Nuruddeen and Gidado (2015), these four main factors that were previously described, which include; Economic, Social, Cultural and Technological factor, each of which is found to have a significant effect towards adopting Green Building Technology. Thus, the adoption of GB technology is also dependent upon these independent variables.

Qian Shi (2008), opined that more and more people are gradually attaching importance to sustainable construction. Compared with some developed countries, the percentage is not very high at present. Therefore, the awareness of green building by the general public will form the market-driven power for such developments especially in the urban area, which can be demonstrated by the urban housing market. Other difficulties include: Lack of basic data of using GB assessment system, Lack of professionals, Lack of interest from real estate developers and Difficulty of having a unified GB assessment standard etc.

Building materials have been playing an important role in the construction industry; they are those materials put together in erecting or constructing structures, no field of engineering is conceivable without their use (Akanni, 2006). The cost of building materials poses a significant threat to both the construction industry and people aspiring to own houses (Njoku, 2007; Mekson, 2008; Mohammed, 2008; Anosike, 2009; Udosen and Akanni, 2010;). The setback witnessed in housing efforts in Nigeria was hinged on the high cost of the building materials which can be traced to high rates of imported materials used for construction that's attracted much cost compared to the local building materials (National Housing Policy, 1991; Iwuagwu and Eme-anele, 2012; Kayode and Olusegun, 2013). Ibn-Homaid (2002) and the 1993 report of UNCHS (United Nations Center for Human

Settlement), found that building materials remain the most significant input in project development and play a very important role in the delivery of construction projects. With GBs, most of the material components are not locally produced / manufactured in Nigeria e.g. solar panels, Switchable glazing, water conserving appliances and grey water systems etc.

The green buildings; success factors

The Success factors of GB developments identified from the reviewed literature above were listed in the table below.

Table 3: Success Factors to GB developments

Sf no.	Success factor in gb developments
SF1	GB Technical Know How, Innovation and efforts among the Built Environment Professionals in design and construction
SF2	Adequate GB cost data and other performance related Data
SF3	Incorporating / adopting GB features with End-users' Preferences and requirements
SF4	Overcoming/ bridging Political, Economic, Social, Technological, Environmental and Cultural (PESTEC) barriers.
SF5	Convergent interests and views of success factors and success criteria of GB developments among stakeholders
SF6	GBs awareness
SF7	A unified GB assessment tools, systems and or standard
SF8	Locally sourced or fabricated GB materials and other components
SF9	End result achieved as envisioned by Meeting GB project goals, technical performance and functionality specification
SF10	Client / Developers' satisfaction
SF11	End-Users' Satisfaction with the GB project
SF12	GB project team satisfaction
SF13	Marketability of the GB development project

Source: Authors' 2017, from the Reviewed Literature.

RESEARCH METHODS

Secondary sources of data such as journals, conference / seminar / workshop papers, text books, newspapers, magazines and internet sources etc. were used to review literatures on the GB field, GB challenges and Projects Success Factors. This helps in identifying and narrowing the various factors that are related to GB developments. These identified success factors form the main body of the Questionnaire which were manually distributed to the various professionals working in Nigeria's Built Environment; selected randomly. A *5-point Likert scale* Questionnaire format (Strongly Agree =5, Agree=4, Neutral/Undecided=3, Disagree=2, strongly Disagree=1) was used to obtained the various perceptions of the professionals working in the Nigeria's Built Environment. Such professionals include the Architects, Quantity Surveyors, Civil Engineers, Building Engineers, Mechanical and

Electrical Engineers, Project Managers, Construction Managers, Land surveyors, Town planners and Estate Surveyors etc. Frequency and percentage count tables, Mean item score, and T-test statistics were used for data analyses.

DATA PRESENTATION, ANALYSES AND RESULTS

RESULTS FROM THE ADMINISTERED QUESTIONNAIRES

The Primary data for this research work was obtained through manually distributed questionnaires to professionals working in the Nigeria's Built Environment and the responses obtained were shown in the following paragraphs

Table 4 shows that distribution of the respondents into the different professions in the building and construction industry.

Table 4: The Questionnaires (Qnrs) Responses by Professional Disciplines

S/n	Professional disciplines	Nr. Of qnrs distributed	Nr. Of qns returned	Percentage (%) of total qns returned per discipline
1	Architects	40	22	5.00
2	Quantity Surveyors	40	28	6.36
3	Civil Engineers	40	23	5.23
4	Building Engineers	40	21	4.77
5	Mechanical Engineers	40	15	3.41
6	Electrical Engineers	40	17	3.86
7	Project Managers	40	30	6.82
8	Construction Managers	40	22	5.00
9	Land surveyors	40	14	3.18
10	Town planners	40	17	3.86
11	Estate Surveyors	40	25	5.68
	Total	440	234	53.18

Source: Authors' Field work

From the Table 4 the following observations were made:

i. 440 numbers of questionnaires were distributed randomly to various professionals in the Nigeria's built environment. 234 numbers of questionnaires were returned while 206 were not returned. This puts the response rate at 53.18% which is fair.

ii. All the professionals were administered equal number of questionnaires (40nr. Each. The Project managers have the highest response rate followed by Quantity surveyors and then Estate surveyors, while Land surveyors have the least.

Table 5 shows the evaluation of the success factors by the respondents regarding the GB developments projects in Nigeria.

Table 5: An evaluation of the GB Success Factors (SF) by the Professionals

SF nr	Success factor in GB developments	Strongly Agreed 5	Agreed 4	Neutral 3	Disagreed 2	Strongly Disagreed 1	Mean Item Score	Remark	Rank
SF1	GB Technical Know How, Innovation and efforts among the Built Environment Professionals in design and construction	166	65	3	0	0	4.70	Strongly Agreed	3rd
SF2	Adequate GB cost data and other performance related Data	101	55	38	39	1	3.92	Agreed	9th
SF3	Incorporating / adopting GB features with End-users' Preferences and requirements	98	48	28	34	26	3.68	Agreed	12th
SF4	Overcoming/ bridging Political, Economic, Social, Technological, Environmental and Cultural (PESTEC) barriers.	98	44	69	23	0	3.93	Agreed	8th
SF5	Convergent interests and views of success factors and success criteria of GB developments among stakeholders	188	45	1	0	0	4.80	Strongly Agreed	1st
SF6	GBs awareness	79	81	36	28	10	3.82	Agreed	10th
SF7	A unified GB assessment tools, systems and or standard	66	48	28	36	56	3.14	Neutral	13th
SF8	Locally sourced or fabricated GB materials and other components	108	11	92	5	18	3.79	Agreed	11th
SF9	End result achieved as envisioned by Meeting GB project goals, technical performance and functionality specification	182	51	1	0	0	4.77	Strongly Agreed	2nd
SF10	Client / Developers' satisfaction	169	49	4	8	4	4.59	Strongly Agreed	5th
SF11	End-Users' Satisfaction with the GB project	170	45	11	5	3	4.60	Strongly Agreed	4th
SF12	GB project team satisfaction	133	89	12	0	0	4.52	Strongly Agreed	6th
SF13	Marketability of the GB development project	136	66	3	14	15	4.26	Agreed	7th

Source: Authors' 2017: statistical computations

From the result in Table 5 the following observations and deductions were made regarding GB success factors in Nigeria's BE:

i. The respondents *Strongly Agreed* with six of the identified success factors, *Agreed* with six factors also while remaining *Neutral/undecided* with only one success factor. This clearly indicates the relevance and the impact of these factors on GB developments in Nigeria as perceived by the respondents.

ii. Convergent interests and views of success factors and success criteria of GB developments among stakeholders – 1st; End result achieved as envisioned by Meeting GB project goals, technical performance and functionality specification -2nd; GB Technical Know How, Innovation and efforts among the Built Environment Professionals in design and construction – 3rd; End-Users' Satisfaction with the GB project – 4th; Client / Developers' satisfaction – 5th; were the top 5 ranked factors.

iii. These top five ranked success factors clearly indicate that there is need for a uniform interests and views of success factors and criteria of GB developments among stakeholders to avoid conflicts and to promote project enthusiasm in the project. Meeting GB project goals, technical performance and functionality specification as the envisioned end result has a lot to do with the GB Technical Know How, Innovation and efforts among the Built Environment Professionals in design and construction. The function and technical requirements of the GB features *(especially the building envelope)* requires a lot of experience and knowledge of GB among the professionals. This will enable the delivery of a GB facility that suits the requirements of the final end-user. The requirements and the satisfaction of the end-users of GB is very important because it affects the proclaimed functional capability and marketability of the GB project without which the investment will be negatively affected. However, if the GB project satisfy the technical, functional requirements with high marketability and good returns on the investments, it will result in maximum satisfaction among the Clients / Developers.

iv. Other success factors such as: Marketability of the GB development project – 7th; Overcoming/ bridging Political, Economic, Social, Technological, Environmental and Cultural (PESTEC) barriers. -8th; Adequate GB cost data and other performance related Data -9th; GBs awareness – 10th; Locally sourced or fabricated GB materials and other components -11th and Incorporating / adopting GB features with End-users' Preferences and requirements -12th; are also very important because any GB is an integrated system that draws from the local climate, environment and sustainable materials and most importantly it is hinged on the realization of its positive impact on the environment. All together, they impact the rate at which the GB project will be embraced in a country like Nigeria.

v. The only success factor which the respondents remain Neutral/undecided was "Unified GB assessment tools, systems and or standard" which ranked the least -13th Ranked. This may be due to the use of complete or partial aspects of GB assessment systems/tools from various countries within the Nigeria's construction industry. Such GB assessment systems/tools include but not limited to LEED, BREAM, ATHENA, CASBEE, BEAM PLUS, MINERGIE ECO etc. This may also due to the presence of multi-national construction companies operating in Nigeria for many decades such as Julisu Berger (Germany), B. Stabilini (Italy), Orascom and Arab Contractors (Egypt), CCECC, CHEC and CGC (China).

Testing of hypotheses

The hypotheses formulated for this research work was tested using T-statistics. The values of the mean item scores in Table 6 were used as the data for the statistical computations with the result shown in the table below.

Table 6: T-Test statistical computation result

GB Success Factors	Mean	Stand. Dev	Stand. Error	N	D F	Alpha (level of Sig.)	Pvalue	Tcal	$Ttab_{0.05, 12}$
Professionals' Perceptions	4.192	0.5801	0.1609	13	12	5%	0.0000	10.5175	-1.7823

With 12 degrees of freedom (DF) and 5% level of significance, the T-test calculated (Tcal = 10.5175) is greater than T-test tabulated ($Ttab_{0.05, 9}$ = -1.7823) the as such, the Alternative hypothesis was accepted; which states that "Green building developments success ***are*** hindered significantly by some factors in the Nigeria's Built Environment".

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

This study identified thirteen success factor to GB developments in the Nigeria's Built Environment and they were evaluated and ranked based on the perception of the project professionals working in the Nigeria's BE. The respondents strongly agreed with six of the identified success factors, also agreed with another six factors and remain Neutral /undecided on only one factor.

The three major success factors were Convergent interests and views of success factors and success criteria of GB developments among stakeholders – 1st; End result achieved as envisioned by Meeting GB project goals, technical performance and functionality specification -2nd; GB Technical Know How, Innovation and efforts among the Built Environment Professionals in design and construction – 3rd. these clearly indicates the relevance of stakeholders' view and interest in any project development

especially GB to meet it desired goals, performance and functionality which is only realistic if there is GB Technical Know How, Innovation and efforts among the Built Environment Professionals in design and construction. Other success factors reflect the End-users' role in making the GB project concept, design and construction to be a successful development endeavor.

The impact of these success factors on GB developments is significant which is further attested by the T-test statistical test of the research hypotheses by accepting the Alternative hypothesis; which states that "Green building developments success ***are*** hindered significantly by some factors in the Nigeria's Built Environment".

Limitations and recommendations

This study is limited to the perceptions of a limited number of project professionals within the built environment (234no.) in Nigeria who may be representative of both the Client and or developers, the contractors and the construction regulatory departments of the government as the major stakeholders and may also be among the end-users of the GB residential developments; and hence, the limitation of this study to their perceptions.

There is need for broader research works that will triangulate or combine both the quantitative and qualitative research methods and also to encompass the perceptions/perspectives of other stakeholders such as the GB Clients or Developers, the end-users, GB vendors etc., in this area to provide more in depth understanding of hindrances to GB developments and the required strategies to promote the GB concept in Nigeria's built environment.

REFERENCES

Abolore, A. A. (2013). Comparative study of environmental sustainability in Building Construction in Nigeria and Malaysia. "*Journal of Emerging trends in Economics and Management Sciences"* 3 (6):951-961.

Akanni, P. O. (2006). Small scale building material production in the context of the informal economy. "*The Professional Builders*", pp. 13-18.

Anosike, P. (2009). *Nigerian groans under high cost of building material*. The Daily Sun, pp. 38-39.

Berardi, U., (2013). *Clarifying the new interpretations of the concept of sustainable building*. Sustainable Cities and Society 8, 72–78WU, Z. 2010. Current Status and Future Trend of Green Building in China. 2010 Shanghai EXPO.

Baccarini, D. (1999). The Logical Framework Method for defining Project Success. "*Project Management Journal"* Vol.30(4)

Bala, K. (2000). *The professionals' perspective of successful project management parameters*. PhD thesis, Department of Building, Ahmadu Bello University, Zaria.

Berke, P.R., (2002). Does sustainable development offer a new direction for planning? Challenges for the twenty-first century? *"Journal of Planning Literature"* 17, 21–36.

Building Design and Construction (BD&C), editors. (2003). White Paper on Sustainability: A Report on the Green Building Movement. Building Design and Construction (Supplement).

B.U. Iwuagwu, N. Eme-anele (2012). Earth construction technology and design: A positive solution to mass housing in Africa, *"International journal of scientific Innovations and Sustainable Development*"2(2012) 89-92.

Byrd, H and Leardini, P (2011). Green buildings: issues for New Zealand. "*Procedia Engineering"*, 21, 481-488.

Carmona Andreu, Isabel and Tadj Oreszczyn. (2004). Architects Need Feedback on Environmental Performance. "*Building Research and Information"* Jul-Aug 2004, Vol. 32 (4).

D Dahiru, K Bala and AD Abdul-Aziz (2013). *Professionals' Perception on the Prospect of Green Building Practice in Nigeria*. SBE 13: Creating a Resilient and Regenerative Built Environment. 15-16 October 2013, Cape Town, South Africa.

De Wit, A. (1988): Measurement of Project Success. "*International Journal of Project Management"* 6:21-32

Diallo A, Thuillier D. (2004). The dimensions of success for International Development projects: the perceptions of African project coordinators. *"International Journal of Project Management*" 22: 19-31.

Diallo A, Thuillier D. (2005). The success of international development projects, trust and communication: An African perspective. "*International Journal of Project Management*. 23: 237-252.

EUROSTAT (2011): *"Consumption of energy" -Statistics Explained*. Available at http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Consumption_of _energy *Accessed in Jan. 2012.*

ENSAR Group (2003). *Sustainable Federal Facilities Task 2.1 Business Case*. November 2002 workshop notes. Boulder, Co.

Environmental Protection Agency (EPA) n.d., *GREEN BUILDING*, available at http://www.epa.gov/greenbuilding/pubsabout.htm.

Fenn, P., Lowe, D., Speck, C. (1997*).* Conflict and Dispute in Construction. *Construction "Management and Economic"* 15 (6), 513–528.

Greg Kats (2003). "*The cost and financial benefits of green building"* – A report to California's Sustainable Building Task force.

Hankinson, M., & Breytenbach, A. (2012). *Barriers that impact on the implementation of sustainable design*. http://cumulushelsinki2012.org/cumulushelsinki2012.org/wp-content/uploads/2012/05/ Barriers-that-impact-on-the-implementation-of-sustainable-design.pdf. Accessed Nov 2013.

Ibn-Homaid, N. T. (2002). A Comparative Evaluation of Construction and Manufacturing Materials Management. "*International Journal of Project Management*" 20:263-270.

Jha, K.N; and Devaya, M.N (2009). *The hierarchy and relationship of project performance Criteria in Indian construction projects.* Proceedings of International conference to Commemorate 25 years of construction management and economics Journal. University of Reading, UK. Vol. 3.

K. Munns, B.F. Bjeirmi (1996). The Role of Project Management in Achieving Project Success. "*International Journal of Project Management*""14 (2),81-87

Karolides, A. (2002). *Project Planning & Cost Estimating*, In "Green Building Approaches" RS Means Co Ltd; USA Pp 1-22.

Kumo, Hassan Ali (2012). *Perception of stakeholders on success criteria for world bank water supply projects in kaduna state – Nigeria.* MSc thesis submitted to Department of Building Faculty of Environmental Design Ahmadu Bello University, Zaria, Kaduna State –Nigeria.

LI, Y. & CURRIE, J. (2011). *Green Buildings in China:Conception, Codes and Certification*. Available at: http://www.institutebe.com/InstituteBE/media/Library/Resources/Green%20Buildings/Issue_Brief_Green_Buildings_in_ China.pdf.

Lisa Fay Mathiessen and Peter Morris (2004). *Costing green: "A comprehensive database and budgeting methodology"*. Davis Langdon Reports. Available at: https://www.usgbc.org/sites/default/files/CostingGreen_AComprehensiveCostDatabaseand BudgetingMethodology.pdf

Michael Bauer, Peter Mosle, Michael Schwarz (2007). "*Green Building: Guide book for Sustainable Architecture"* Springer: The Netherlands

Mohammed, H. Y. (2008). *Nigeria: Builders Groan on Rising cost of Building Materials*. Daily Trust, p. 29. December 25, 2008.

MOC (2006). *Evaluation standard for green building* (GB/T 50378-2006) [绿色建筑评价标准]. 1 ed.: MoC.

National Housing Policy (1991). *A National Housing Policy (NHP) of the Federal Republic of Nigeria.* Federal Government Press, Lagos, 1991.

Nguyen, L. D., Ogunlana, S. O; and Lan, D. T. X (2004). A study on Project /po08yui9uy7ghy8t6effswbghvcdzghdfcdxvcfhgyu98t64434escvcfdfrd fcghgvghbbgftyfgyttttSuccess Factors in Large Co06nstruction Projects in Vietnam. "*Engineering Construction and Architectural Management"* 11(6), 404-413.

Njoku, J. (2007, April 9). Grappling with Escalating Cost of Construction Materials. The Vanguard, pp. 36-37

Nuruddeen Usman and Usman Mohammed Gidado (2015). An Assessment of the Factors Affecting Green Building Technology (GBT) Adoption. WASET 18th IC Jeddah Saudi Arabia Jan 26-27, 2015, 13 (01) Part XIII

Odusami, K. T (2003). Criteria for Measuring Project Performance by Construction Professionals in the Nigerian construction industry. *Journal of Financial Management and construction*. 8(1), 39-47.

Oloruntoba Kayode and Ayodele E. Olusegun (2013). Local Building Materials: A Tool Towards Effective Low-Income Housing in Nigeria. *Middle-East Journal of Scientific Research* 18 (4), 492-497,

Onwusonye S.I. J. (2005). The significance of Informal sector in Project Procurement Methods in Enhancing Project finance from the money and Capital Markets. *The Quantity Surveyor,* NIQS 54 (31-39).

Pinto, J.K. and Slevin D. P. (1988). Critical Success Factors in Effective Project Implementation. "*Project management handbook"*.

Peter Morris (2007). What does Green Really Cost? PREA QUATERLY.

Qian Shi (2008). Strategies of Implementing a Green Building Assessment System in Mainland China. Journal of Sustainable Development 1 (2) Available at www.ccsenet.org /journal.html.

Salisu Gidado Dalibi, Hadiza Balarabe and Jamilu Bala MaiAuduga (2016). *Green Buildings: A Concept aligning the interests of Stakeholders (Developers / Clients and End-users) in Estate Development Projects in Abuja - F.C.T (Federal Capital Territory), Nigeria.* SBE16 Hamburg: Strategies – Stakeholders – Success factors. International Conference on Sustainable Built Environment in Hamburg, Germany. 7-11th March 2016.

Salisu Gidado Dalibi (2012): Cost Impact Assessment of Green Buildings in China (A Case Study of Few Selected Green Building Projects in Shanghai, China). Msc. Thesis submitted to Hohai University Nanjing – Jiangsu Province of China.

Salisu Gidado Dalibi (2014): *Green Buildings: The Clients' & The End Users' Common Ground in Environmental Sustainability*. Nigerian Institute of Quantity Surveyors (NIQS) National Training Workshop; in Uyo, Akwa Ibom State of Nigeria. 9th – 11th October 2014.

Salisu Gidado Dalibi and Hassan Ali Kumo (2016). *Success Criteria for Green Building Projects in the Nigeria's Construction industry: "The Stakeholders' perception*". SBE16 Hamburg: Strategies – Stakeholders – Success factors. International Conference on Sustainable Built Environment in Hamburg, Germany. 7-11th March 2016.

Shelbourn A., Bouchlaghem, D. M., Anumba, C. J., Carillo, P. M., Khalfan, M. M.K., Glass, J., (2006**).** Managing knowledge in the context of sustainable *construction* **"***Journal of Information Technology in Construction*" 11(2006), available at http://itcon.org/2006/4/ pg. 57

Udosen, J. U., & Akanni, P. O. (2010). A Factorial Analysis of Building Material Wastage Associated with Construction Projects. *Journal of Civil and Environmental Systems Engineering*, 11(2), 81-90.

United Nations Centre for Human Settlement. (1993*). Building materials for housing: Appropriate intermediate, cost effective building materials, technology and transfer mechanism for housing delivery.* Retrieved from http://ww2.unhabitat.org/programmes/housingpolicy/ documents/ HS.C.14.7.html.

Yujun Liu (2012). *Green Building Development in China: A Policy-Oriented Research with a Case Study of Shanghai.* Master's degree Thesis in Environmental Studies and Sustainability Science submitted to Lund University International Master's Program in Environmental Studies and Sustainability Science.

Zane Satterfield, P. E. (2009). *Tech Brief on Green Building* Published by: *The National Environmental Services Centre* (Winter 2009), Vol. 8, Issue 4 Tech Briefs.

Zhiyong Wang (2013). *New cost structure approach in green buildings: Cost-benefit analysis for widespread acceptance and long-term practice.* submitted to the System Design and Management Program in partial fulfillment of the requirements for the degree of Master of Science in Engineering and Management at the Massachusetts Institute of Technology January 2013.

Zubairu, S. (2012). *The Importance of Evaluation and Sustainability in the Built Environment* In: Laryea, S., Agyeponng, S., Leiringer, R. and Hughes, W. (Eds) Procs 4th West Africa Built Environment Research (WABER) Conference, 24 – 26 July Abuja, Nigeria, 9 – 13.

EVALUATION OF COCOA POD ASH ON THE CHARACTERISTIC STRENGTH OF SANDCRETE BLOCK PRODUCED IN OSHOGBO, NIGERIA

Olawale, S.O.A.[1] and Ogunbiyi, M. A.[2]

[1&2]*Department of Civil Engineering, Faculty of Engineering and Environmental Sciences, Osun State University, Osogbo, Nigeria*

This present work investigates the use of Cocoa Pod Husk Ash (CPHA) as an additive in sandcrete block production. The aim of this study is the evaluation of the effect of CPHA addition to the locally produced sandcrete blocks on its compressive strength characteristic. The compressive strength of the blocks produced using this additive was investigated. The critical problem is the non-uniformity of the production process practiced across the broad spectrum by manufacturers and the desire to improve profit in the face of dwindling resources and inflationary pressure of price of raw materials which leads to the production of sandcrete blocks of low quality. This study investigates the effect of using cocoa pod ash in a range of proportion of this additive (1%, 2%, 3%, 4% and 5% by weight of cement) and measuring the effect on the compressive strengths of various blocks produced. This study establishes the compressive strength at various curing ages of blocks with CPHA as additive; these were compared to the control samples from three sources within the locality. Result shows the improvement in the compressive strength of blocks produced, increased by more than 400%. This is encouraging and further work on developing the practice business model is being undertaken to completely convince the local manufacturers of the importance of using this additive to produce better sandcrete blocks, than presently available in the market.

Keywords: BS (British Standard) , CO_2 (Carbon Dioxide) , CPHA (cocoa pod husk ash) , L,H,T (Length, Height, Thickness)

INTRODUCTION

The production of local sandcrete blocks is never a regulated industry and there has been serious abuse of practice as reported by Adeoye and Oriaje (2015). This has been one of the suspected causes of incessant building collapse being experienced in the country. Although there is no statistical data to indicate the spatial distribution of building collapse across the

[1] olawales@hotmail.com

[2] mosesogunbiyi@gmail.com

Olawale, S. O. A. and Ogunbiyi, M.A. (2017) Evaluation of cocoa pod ash on the characteristic strength of sandcrete block produced in Oshogbo, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 674-681

country; however, it does not take a genius to suspect the poor quality of locally produced sandcrete blocks. A mere visit to the production sites of these locally produced sandcrete blocks will reveal the inherent problem of profit maximization at the expense of quality and safety whereby, almost mud material is used in place of river washed sand. Also, the number of blocks output per bag of cement is always optimized leading to poor and weak blocks being produced. Most of these blocks collapsed under the stacking weight alone talk less of being used to construct load-bearing walls in a building. It is impossible to stop the practice in a country where corruption permeates the system from top to bottom. The only solution left is to find a means of improving the strength of the products without altering the materials and cost of production. The question arose on finding a solution to improving the strength of these blocks at minimum or no cost with a significant improvement in the strength of the blocks.

LITERATURE REVIEW

The search for solution to the above stated problem lead to this study employing the use of Cocoa Pod Husk Ash (CPHA) as a strengthening medium because of its pozzolanic characteristics to improve the strength of sandcrete blocks. Pozzolans as defined by Oluremi (1990) are siliceous materials, which by themselves possess no cementitious properties but in processed and finely divided form, react in the presence of water with lime, to form compounds of low solubility having cementitious properties. The abundance of CHPA is an attraction for its choice in this study. The ash is produced at little or no cost to the local producers of these blocks. Generally, the high cost of cement used as binder, in the production of mortar, sandcrete blocks and concrete has led to a search for alternatives, in addition to cost, high energy demand and emission of CO2, which is responsible for global warming, the depletion of lime stone deposits is a disadvantage associated with cement production. According to Oluremi (1990), about 7% CO2 is released into the atmosphere during cement production, which has a negative influence on ecology and future of human health arising from global warming. In developed countries, according to Michael (1994), the most common and readily available material that can be used to partially replace cement in sandcrete blocks production without economic implications are agro based wastes, notable ones are Acha husk ash (AHA), Bambara Groundnut Shell Ash (BGSA), Bone Powder Ash (BPA), Groundnut Shell Ash (GSA), Rice Husk Ash (RHA) and Wood Ash (WA). Additional agro waste materials include ashes from the burning of dried banana leaves, bagasse, bamboo leaves, some timber species, sawdust and Periwinkle Shell Ash (PSA.

Apart from obvious advantages of low cost of production resulting from the reduced quantity of cement, promotion of waste to wealth agenda leading to a reduced pollution from these wastes and subsequent reduction in the CO2 emission from the reduction of cement input in the production of these blocks. According to a study conducted by Adeoye and Oriaje (2015), the

common mixing ratios employed by sandcrete block manufacturers around Osogbo and environ is;

- 1:5 – This implies 1 bag of cement and 5 wheel barrows of sand.
- 1:6 – This implies 1 bag of cement and 6 wheel barrows of sand.
- 1:8 – This implies 1 bag of cement and 8 wheel barrows of sand.

According to NIS 587:2007[4] as shown in Table 1.1, various sizes of blocks determine their usage not considering the compressive strength of the blocks produced.

Table 1.1: Types of Sandcrete blocks and their uses

Type	Work size (mm) L x H x T	Web thickness (mm)	Usage
Solid Blocks	450 x 225 x 100	-	Non load-bearing walls
Hollow	450 x 225 x 113	25	Non-load-bearing walls
Hollow	450 x 225 x 150	37.50	Non-Load-bearing walls
Hollow	450 x 225 x 225	50	Load-bearing walls

Hollow sandcrete blocks containing a mixture of sand, cement and water are used extensively in many countries of the world especially in Africa according to Oyekan and Kamiyo (2011) . In many parts of Nigeria, sandcrete block is the major cost component of the most common buildings. The high and increasing cost of constituent materials of sandcrete blocks has contributed to the non-realization of adequate housing for both urban and rural dwellers. The production of cement contributes significantly to the emission of carbon dioxide, a naturally occurring greenhouse gas. The sandcrete block industry is constantly looking for supplementary cementitious material with the objective of reducing the solid waste disposal problem generated due to agro waste production. For instance, quarry dust (QD) is the by-product obtained during the crushing and washing of stones from the crushing units. Wood ash is a by –product of wood in boilers at paper mills and other burning facilities. Khaza and Vasugi (2014) reported that substantial energy and cost savings can result when industrial by-products are used as partial replacements for the energy-intensive Portland cement, thus generating an increase in demand for the materials which can be alternated for cement and sand in sandcrete.

Agro waste materials such as, rice husk ash, palm kernel ash and groundnut shell ash have been successfully used as additives in sandcrete block production for decades .The successful usage as an additive, contributes to the resolution of the landfill problem and reduction in the cost of building materials, provides a satisfactory solution to the environmental issues and problems associated with waste management, saves energy, and helps to protect the environment from pollution. Agricultural wastes, such as rice husk ash, wheat straw ash, and sugarcane bagasse ash, hazel nutshell ash which constitute pozzolanic materials can be used as additives in sandcrete blocks production according to Khaza and Vasugi (2014). Bakar, Putrajaya, and Abdulaziz, (2010) assert that supplementary cementitious materials

prove to be effective to meet most of the requirements of durable concrete and that blended cements are now used in many parts of the world.

CPHA has been used in various forms to achieve better crop yield in non-fertile farm lands. Ayeni (2010) established the versatility of CPHA as poor soil nutrient booster. CPHA has been effectively used to improve the valuable nutrients of clayey soil leading high yield of maize in some localities in Nigeria. In another development, Amoanyi et al (2012) reported of an improved wet and dry compressive strength of Afari and Mfensi clay in Atwima Nwabiagya District in Ashanti Region of Ghana. The addition of 10% and 15% of lime and CPHA resulted to significant increase in the wet and dry compressive strengths of this clay. In another development, it has been established that CPHA is a good strength booster in earth bricks. This is could be a solution to the problem of shortage of housing in Africa. As reported by Mann et al (2015) CPHA was effectively used as a stabilizer in the production of stabilized earth brick leading to its improved engineering characteristics. However, Anthony et al (2014) concluded to the contrary that CPHA additive is detrimental to the engineering and geotechnical properties of lateritic soil for road construction work. They concluded that CPHA has no pozzolanic properties. This paradoxical experience has made imperative to investigate further how best to use CPHA in other materials such as sandcrete blocks.

RESEARCH METHODOLOGY

This work attempts to recreate the production paths followed by the local sandcrete block producers to have a common denominator for the comparison and more importantly to prevent any deviation from their practice so as to be able to see the improvement of the CPHA additive on their locally produced blocks. Cue was taken from three local manufacturers of sandcrete blocks who are the major suppliers of blocks around the university area where there has been a significant increase in building construction to cater for the growing demand of accommodation. Their production methodologies were assessed in order to produce the blocks used in the present study. Also, samples were collected from these three producers used as control samples. The study could not ascertain the ages of these samples but it was assumed that the production mechanics would not deviate spuriously from the norm. The source of the river washed sand used by the local manufacturers was identified and other materials employed by this study, were collected from the same source. Sieve analysis of sands from the three producers and that used in the present work were carried out and compared as shown in figure 1, the results show that the samples satisfy the overall grading limit as specified by BS 882: (1992). The same batching system of the use of wheel barrows for the sand measurement was used for this study. The batch ratio of 1 bag of cement to 6 wheel barrows of sand was scaled down in order to produce the blocks on a small scale and the CPHA additive was made from raw cocoa pod.

The additive of 1%, 2%, 3%, 4% and 5% by weight of cement replacement was used in the present work. The blocks were produced by hand compaction which mimics the local producers' method. The blocks were tested at 7, 14 and 28 day curing periods; then basic compressive strength test using the standard compression machine was carried out. The failure load of each test specimen was recorded and the load bearing surface area was used to compute the compressive strength of the tested blocks. The samples from the three control producers were tested similarly. The sketch of the effective surface area is shown in figure 2 below.

The Compressive Strength Computation:

$$s = F_{app} / A_c$$

where F_{app} is the failure load

A_c is the cross sectional area

RESULTS AND DISCUSSION

Figure 1 shows the comparison of sieve analysis of the fine aggregates obtained from the three factories and the one used in this study. It can be observed that the sieve curve of the current study material is very representative of the materials obtained from the other sites. This curves envelopes the other three curves and it follows the same trend like the other sites.

The results as presented in figure 3 and 4 clearly demonstrate the huge improvement in compressive strength with CPHA over the local blocks without the additive. The sieve analysis as shown in the figure 1 below establishes the fact that the same material as those of local producers is used in this study. This is important in order to replicate their production condition. The cement is from the same source and brand (Dangote cement). The only material different is the source of water that was collected from the local stream flowing through the campus. The replication of near the same conditions put this study on the common denominator as the local producers.

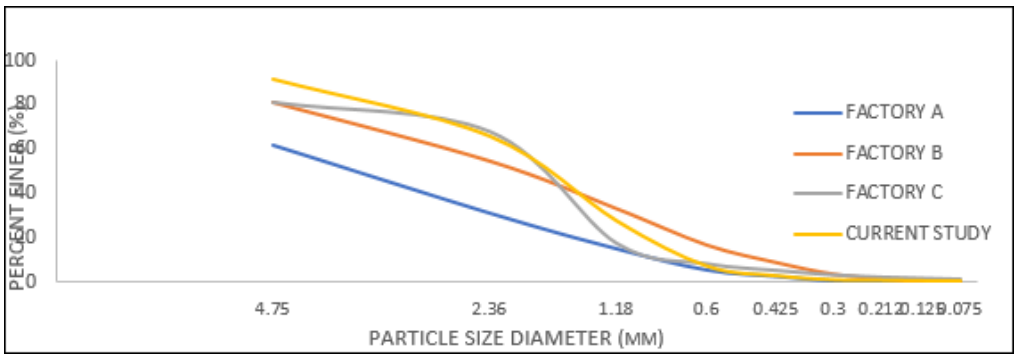


Figure 1: Comparison of Sieve Analysis results of the sand material.

The cross section surface area used to compute the compressive strength is shown in figure 2. The graph of the average compressive strength with

curing ages of 7, 14 and 28 days for various CHPA contents are shown in figure 3. It is interesting to note that for 2% and 3% CHPA additive, the strength dips at 7 day curing age. This indicates that optimum strength is guaranteed from 28 days and above. The most beneficial regime of additive content is around 3% as shown in both figures 3 & 4. This regime consistently shows steady increase in the strength over the curing ages considered in this study. The percentage increase in strength at this additive regime is more than 400%. The average compressive strength of the control samples is about 0.4 MPa. This is consistent with the findings of Adeoye and Oriaje [1].

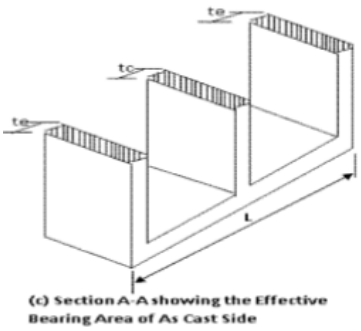


Figure 2: Section showing the Effective Bearing Area of a Hollow Block

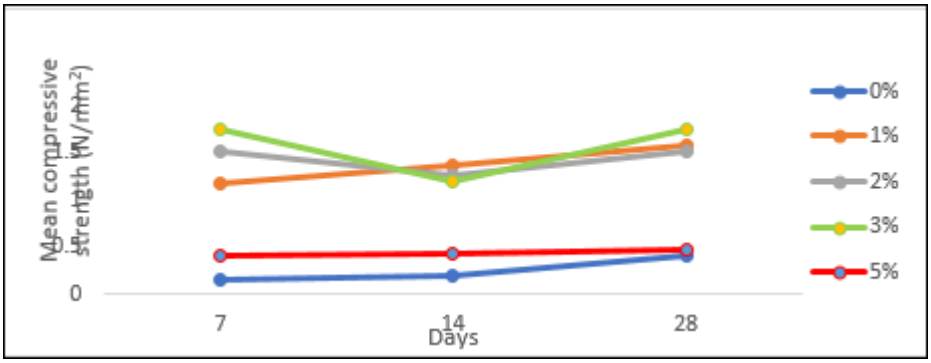


Figure 3: Line graph of Mean compressive strength versus curing days for all percentage additions.

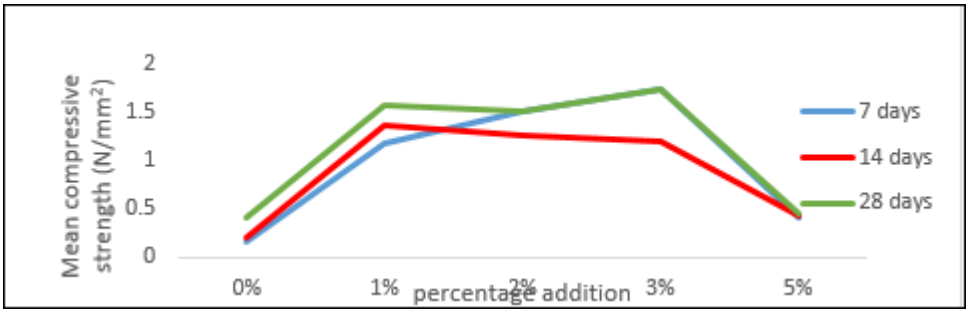


Figure 4: Line graph of Mean compressive strength versus percentage addition at 7, 14 and 28 days respectively.

CONCLUSION

It is interesting to note the huge improvement in compressive strength of locally produced sandcrete blocks by adding CPHA to the local process. It can be observed that the optimum percentage of CPHA is 3% that resulted to about 500% increase in compressive strength. It is also observed that any proportion of CPHA addition up to 5% is of great benefit. This wide range of volume addition of CPHA is a safety net because there is propensity for the abuse of this material by the local producer of sandcrete blocks. This will reduce the risk of over usage of the additive. The underlining problem of weak and inconsistent products being used in the building industry in the study localities of Osogbo cannot be overemphasized. Hopefully, the use of CPHA will reduce the problem of weak sandcrete block production in the locality of study. The rate of building collapse around these localities is high. Hopefully, the use of this additive at very low extra cost and even reduction of cement consumption will reduce the rate of building collapse under construction due to use of weak locally produced blocks.

REFERENCES

Adeoye, Bisola and Oriaje, T. A. (2015) Assessment of Concrete practice by Nigerian masons: a Case Study of Osogbo catchment.

Oluremi, A. A. (1990) Input of Local Materials in Buildings as a means of Reducing Cost of Construction. Journal of the Nigerian Institute of Quantity Surveyors; pp. 12-14. 1990.

Michael, K.O. (1994), Rice Husk as stabilizing agents in Clay Bricks, Higher National Diploma Project, Department of Civil Engineering, Federal Polytechnic Bida, Nigeria.

NIS 2000. NIS 87: (2000). Nigerian Industrial Standard: Standard for Sandcrete Blocks. Standard Organization of Nigeria. Lagos. Nigeria

Oyekan, G. L and Kamiyo, O. M. (2011). A Study on the Engineering Properties of Sandcrete Blocks Produced with Rice Husk Ash Blended Cement. JETR 3(3), 88-98.

Khaza and Vasugi (2014) Partial Replacement of Wood Ash and Quarry Dust with Cement and Sand to Study the Strength Parameters of Concrete. International Journal of Civil Engineering and Technology (IJCIET), ISSN 0976 – 6308 (Print), ISSN 0976 – 6316(Online), Volume 5, Issue 8, August (2014), pp. 32-43 © IAEME

Bakar, B. H. A., Putrajaya, R. C., & Abdulaziz, H. (2010). Malaysian Saw dust ash –Improving the Durability and Corrosion Resistance of Concrete: Pre-review. Concrete Research Letters, 1 (1): 6-13, March 2010.

British Standards Institution. (1992). BS 882: Specification for aggregate from Natural Sources for Concrete: British Standards Institution, London, England.

Ayeni L. S. (2010) Effect of Combined Cocoa Pod Ash and NPK Fertilizer on Soil Properties, Nutrients Uptake and Yield of Maize (Zea Mays). The Journal of American Science, vol. 6, no 3, March1, 2010, ISSN 1545-1003.

Robert Amoanyi, P.S. Kwawukume and Francis Y. Momade (2012). Improving the Strength Properties of Afari and Mfensi Clays in Chemical Stabilization. International Journal of Engineering Research in Africa, vol. 8, (2012), pp1 – 15.

Manu Isaac Yaw, Asiedu Emmanuel, Yalley Peter P. K. and Denutsui K. Senyo (2015). Feasibility of using Cocoa Pod Husk Ash (CPHA) as a Stabilizer in the production of compressed Earth Bricks. International Journal of Engineering Research and General Science, vol. 3, issue 6, November – December 2015 ISSN 2091-2730

Anthony Woode, David Kwame Amoah, David Nartey, Daniel Misefah, Felix Anyetei Nai, Robert Abame Nsoh and Nmamah Isaac Addoe (2014). An Experiment to Determine the Prospect of Using Cocoa Pod Husk Ash as Stabilizer for Weak Lateritic Soil. Civil and Environmental Research, vol. 6, no. 10, 2014, ISSN 2224-5790(Paper), ISSN 2225-0514(Online).

EXPATRIATE AND INDIGENOUS CONSULTANTS' INVOLVEMENT IN CONSTRUCTION PROJECT DELIVERY IN NIGERIA

Godwin Iroroakpo Idoro[1] and Ebenezer Olutide Bamidele[2]
[1]*University of Lagos, Akoka, Yaba, Lagos, Nigeria*
[2]*Federal Polytechnic, Ilaro, Ogun State, Nigeria*

Studies have established that expatriates are generally given more patronage than their indigenous counterparts in project delivery in Nigeria. This assertion is based on the patronage of construction firms only. This study investigates the engagement of indigenous and expatriate consultants in project delivery in Nigeria. The objectives are to assess the levels of engagement of indigenous and expatriate consultants in project delivery and their relationship with project value and outcome. The objectives were achieved through a survey of 99 recently completed projects and 792 consultants consisting of eight prominent consultants in each project. Data were collected using structured questionnaires and analysed using percentage, ratio, t-test and Pearson correlation test. The results reveal that indigenous consultants are more engaged than expatriate consultants however; the engagement of indigenous consultants does not contribute to project time, cost and quality while that of expatriate consultants helps to minimise delay. The study also established that the relationship between project value and the engagement of indigenous consultants is negative while that of expatriate consultants is positive. It is concluded that indigenous consultants are more engaged in terms of number than their expatriate counterparts however; expatriate consultants handle the high value projects in Nigeria. It is further concluded that the engagement of indigenous consultants does not contribute to project outcome while that of expatriate consultants helps to reduce delay. It is recommended that clients generally should promote the involvement of indigenous consultants in high value projects in order to develop local capacity in the delivery of projects.

Keywords: construction projects, expatriate consultants, indigenous consultants, project delivery, project outcome

[1] iroroidoro@yahoo.com
[2] bolutide11@yahoo.com

Idoro, G. I. and Bamidele, E. O. (2017) Expatriate and indigenous consultants' involvement in construction project delivery in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 682-697

INTRODUCTION

The construction industry is known to be a major player in every economy worldwide (Ogunlana, 2002; CBN, 2008; Idoro, 2010; Nigerian Bureau of Statistics, 2015). It is known to contribute significantly to Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF), supply of infrastructure, employment generation and general comfort and well-being of citizens. Three major parties namely: clients, consultants and contractors are considered as the major drivers of the industry. Clients are regarded as project sponsors who initiate projects and engage both consultants and contractors. Alinaitwe (2008) regards a client as the owner of a facility being commissioned and he is responsible for the commissioning and payment of the cost of design and construction of the facility. Consultants are professionals engaged by clients or their representatives to provide specific services or produce specific project documents for a fee. They may also be engaged by clients to carryout resident supervision and management services during construction but they are not expected to carry out the execution of any aspect of construction works. Contractors are regarded as parties who sign a contract with clients to execute any aspect of the construction of projects for an agreed sum. They consist of the main, sub, trade and even labour contractors. It is clear from the above explanation that the delivery process of a project is mainly the affair of consultants and contractors.

In Nigeria, Nigerians and foreigners can be engaged as indigenous and expatriate consultants and/or contractors respectively. Studies (Edmonds, 1979; Ogunpola, 1984; Olateju, 1991; Idoro, 2007; Idoro, 2010) classified contractors in Nigeria generally into either expatriate or indigenous. Idoro (2007) referred to construction firms that are fully owned and managed by Nigerians as indigenous contractors and their multinational and even national counterparts that are jointly owned by Nigerians and foreigners but solely managed by expatriates as expatriate contractors. Studies have discovered that clients generally give preference to expatriate contractors in the award of contracts (Edmonds, 1979; Ogunpola, 1984; Olateju, 1991; Idoro, 2007; Idoro, 2010). Edmonds (1979) discovered that expatriate contractors are large construction firms and are few in number but they are responsible for 90% of the total construction works in Nigeria. Ogunpola (1984) asserted that the numerical strength of expatriate contractors is about 7% of the total number of contractors in Nigeria but they account for a substantial proportion of construction works. Olateju (1991) affirmed that indigenous contractors got only about 7% of the total value of contracts awarded by the Federal Government and Oyo State Government from 1974-1984. Idoro (2004) opined that the construction industry in Nigeria is indeed dominated by expatriate contractors and that the concern of stakeholders is not that of attracting foreign participation rather that of promoting indigenous participation. The finding in another study conducted by Idoro (2010) that the frequency of award of contracts to expatriate contractors is significantly higher than that of indigenous contractors shows that the preference for expatriate contractors in award of contracts in

Nigeria has not changed. Idoro (2010) concluded that the practice by which clients give preference to expatriate contractors in the award of contracts which started in the colonial era still persists.

While there is a consensus in previous studies on preference for expatriate contractors over their indigenous counterparts in construction, the same cannot be said of consultants. Studies on the involvement of indigenous and expatriate consultants in project delivery in Nigeria are few. The prevailing preference for expatriate contractors in the award of contracts and the dearth of literature on what prevails on the patronage of indigenous and expatriate consultants prompt this study. The study attempts to fill this gap in literature by investigating the levels of engagement of indigenous and expatriate consultants in project delivery and their contribution to project outcome in Nigeria. The objectives are to assess the levels of engagement of indigenous and expatriate consultants in project delivery and determine their relationship with project value and outcome. The results of the study will assist stakeholders to ascertain the extent of involvement of the two categories of consultants in the construction industry. The results will further assist stakeholders to ascertain whether or not the ongoing efforts at regulating Nigerian content in the construction industry should include consultancy services.

LITERATURE REVIEW

Consultants are regarded as a very important party in project delivery. They constitute the major members of the project team. They are professionals engaged by clients or their representatives to provide specific services or produce specific project documents for a fee. They may also be involved in the supervision and management of a project during construction but do not carry out the execution of any aspect of construction works. Several professionals or experts from varying fields of specialisation are engaged as consultants in projects. The common consultants for a construction project are but not limited to surveyors, planners, civil engineers, soil scientists, architects, structural engineers, estate managers and valuers, electrical and mechanical engineers, builders, quantity surveyors, interior decorators, landscape specialists, accountants, lawyers and economists. These specialists render a wide range of services that are crucial to the success of a project. They are responsible for preparing the brief of the requirements and resources of project stakeholders, setting targets, deadlines and establishing standards for meeting the requirements, preparing project documents that describe the targets, deadlines and standards set and sometimes supervising and monitoring the activities of contractors that execute the project to ensure that the targets, deadlines and standards are achieved (Idoro, 2011). Havemann (2007) maintained that consultants are also accountable for the technical risks in a conventional project

The services of consultants are crucial to the delivery and overall performance of a project. Crawshaw (1996) identified poor design coordination between design team members who constitute consultants as

a major contributor to rework. Hattam and Lalani (1997) stated that by selecting an appropriate consultant team, the chance of delivering a project on time and within budget may increase. HSE (2002) reported that dissatisfaction is widely experienced by clients in the construction sector and this is attributable to incompetent service providers especially contractors and consultants. Mansfield (2009) maintained that the use of a team member of specialist design and cost consultants can significantly enhance the management of risks and ensure optimum performance in the key variables of time, cost and quality while Kasma (1987) was of the opinion that the accuracy and relevancy of consultants' design and recommendations can have profound impacts on subsequent work quality and claims. Consultants are also known to be the link between the design and construction of a project because their services are not often terminated after design but extended to the construction of the project. In many cases in particular complex and incomplete designs, the design cannot be correctly implemented without the consultants. These assertions support the claim by Idoro (2011) that a project cannot be delivered successfully without the services of consultants.

In Nigeria, consultants can either be Nigerians who are regarded as indigenous consultants or foreigners who are described as expatriate consultants. Studies on the extent of patronage of the two categories of consultants have been scarce. However, several studies have been done on the extent of patronage of indigenous and expatriate contractors. Okafor (2005) in a survey discovered that the ratio of the number of contracts executed by indigenous contractors to that of expatriate contractors in Nigeria in 2004 is 0.14 and concluded that the average number of projects awarded to indigenous contractors was far below that of expatriate contractors. Oni (2001) observed that indigenous contractors have not been duly recognised as capable by investors (clients) in both public and private sectors and that investors feel that expatriate contractors can perform better than them because they are white. Eze (2004) supported the assertion by attributing the preference for expatriate contractors to foreign mentality which is preference for white people and products over indigenous ones. Oyewale (2004) discovered that while expatriate contractors were registered in the top two categories of registration namely: C and D for contract values of N51-250 million and above N250 million respectively, majority of indigenous contractors were registered in bottom three categories of registration namely A, B and C for contract values of N1-5 million, N6-50 million and N51-250 million respectively. Idoro (2009) considered the categorisation and registration as a direct way of excluding indigenous contractors from participating in bidding for large contracts for which categories C and D contractors are required.

Although studies on engagement of consultants in project delivery still remains relatively scarce however; it is known that the basis for the patronage of expatriate contractors is that they parade foreign professionals who are regarded as expatriates (Eze, 2004). The same professionals whether Nigerians or foreigners who do not establish construction firms or

get employed in one, get established as consultants and subsequently get addressed as indigenous or expatriate consultants. The question arising from the existing categorisation of both consultants and contractors is that 'do Nigerian clients prefer expatriate consultants to indigenous consultants as they do for expatriate contractors? This question deserves an answer which this study attempts to provide.

METHODS

To achieve the objectives of the study, a field survey was conducted. The population consisted of construction projects recently completed in Nigeria. There was no reliable data of the population therefore, a pilot study was conducted and 148 projects consisting of building and civil engineering projects were identified and used as the study sample. From the sample, 99 projects with highest value were selected by purposive sampling to ensure that eight consultants namely: project manager, construction manager, management contractor, architect, quantity surveyor and structural, electrical and mechanical engineers who were the focus of investigation in this study were engaged as members of the project team for each project. The Site Managers of the projects were identified and used as the respondents of the study. To assess the level of engagement of the two categories of consultants being investigated, eight prominent consultants stated above engaged in each project were investigated. Respondents who were the Site Managers of the projects sampled were requested to indicate the category of consultant (indigenous or expatriate) engaged for each of the eight consultants engaged in the projects. The respondents were also requested to provide the initial and final contract sums and periods, values of variation and rework recorded in the projects. The data were used to derive the parameters of project outcome namely: cost and time overruns, cost of variation and cost of rework respectively.

Data were collected using structured questionnaires administered to the respondents and also collected by research assistants. The instrument was first validated by lecturers in the Department of Building, University of Lagos and some consultants who are postgraduate students in the Department before the field survey. The reliability of the instrument was determined by analysing the Crombach alpha coefficient values for the items or questions in the instrument. The Crombach alpha coefficient value of questions concerning the engagement of indigenous and expatriate consultants was 0.911 while the value of questions concerning project outcome was 0.723. These Crombach alpha coefficient values indicated that the instrument was reliable. To achieve the objectives of the study, three research hypotheses were postulated. The first hypothesis states that the difference in the levels of engagement of indigenous and expatriate consultants in project delivery in Nigeria is not significant. The hypothesis was tested to ascertain whether or not preference is accorded expatriate consultants in patronage. The second hypothesis states that the levels of engagement of indigenous and expatriate consultants are not significantly related to project outcome. The hypothesis was tested to ascertain the

contribution of the engagement of the two categories of consultants to project outcome. The third hypothesis states that the relationship between the value of projects and the engagement of indigenous and expatriate consultants is not significant. This hypothesis was tested to ascertain whether or not preference is accorded expatriate consultants over indigenous consultants in high value projects as obtainable in the case of contractors. The data were analysed using percentage, ratio, t-test and Pearson correlation test.

Characteristics of the respondents of the study

The characteristics of the respondents of the study were investigated as a background to the results. Five characteristics namely: respondents' gender, age, experience in construction, educational and professional qualification were investigated. The distribution of the respondents over the sub-variables of the characteristics is analysed using percentage. The results are presented in Table 1.

Table 1: Descriptive results of characteristics of respondents

Characteristic	N	%	Characteristic	N	%
Gender			**Educational qualification**		
Male	75	75.8	HND	18	18.2
Female	24	24.2	B. Sc.	27	27.2
Total	99	100	PGD	15	15.2
Age			M. Sc.	39	39.4
18-60 years	96	97.0	Total	99	100
Above 60 years	3	3.0	**Professional qualification**		
Total	99	100	NIQS	45	45.5
Experience			NIOB	24	24.2
1-5 years	9	9.1	NIA	24	24.2
6-10 years	33	33.3	NSE	6	6.1
Above 10 years	57	57.6	Total	99	100
Total	99	100			

N=Number of respondents

Table 1 shows that male respondents constitute the majority while female respondents constitute the minority. The result is a reflection of the nature of the construction industry which is dominated by men. Table 1 further reveals that the majority of the respondents belong to the working class age group. It further reveals that the respondents were distributed over staff with short, medium and long experience and that the respondents are all graduates who are professionally registered with the four most prominent professions namely: quantity surveyors, builders, architects and engineers in the Nigerian construction industry.

Relationship between educational/professional qualification and experience of indigenous and expatriate consultants

The relationship between the educational/professional qualification and experience of indigenous and expatriate consultants sampled were analysed. The results are presented in Table 2.

Table 2 shows that the p-value (0.001) for the test of relationship between educational qualification and experience of the two categories of consultants

is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. The implication is that the educational qualification of the consultants contributes to their experience. The test of relationship between professional qualification and experience of the consultants is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. The implication is that the professional qualification of the consultants contributes to their experience.

Table 2: Chi-square test of relationship between educational/professional qualification and experience of consultants

Parameters	**Experience (years)**								N	α^2 value	df	p-value
	1 -5		6 – 10		>10		Total					
	N	%	N	%	N	%	N	%				
Educ Qual												
HND	4	22.2	7	38.9	7	38.9	18	100	99	23.440	6	0.001
B.Sc.	4	14.8	16	59.3	7	25.9	27	100				
PGD	0	0.0	6	40.0	9	60.0	15	100				
M.Sc.	3	7.7	6	15.4	30	76.9	39	100				
Total	11	11.1	35	35.4	53	53.5	99	100				
Prof Qual												
NIQS	7	15.6	22	48.9	16	35.6	45	100	99	22.121	6	0.001
NIOB	3	12.5	9	37.5	12	50.0	24	100				
NIA	0	0.0	3	12.5	21	87.5	24	100				
NSE	0	0.0	0	0.0	6	100.0	6	100				
Total	9	9.1	33	33.3	54	54.5	99	100				

N=Number of respondents, df=Degree of freedom, Educ=Educational, Prof=Professional, Qual=Qualification, NIQS=Nigerian Institute of Quantity Surveyors, NIOB=Nigerian Institute of Building, NIA=Nigerian Institute of Architects, NSE=Nigerian Society of Engineers

Relationship between educational/professional qualification and gender of indigenous and expatriate consultants

The relationship between the educational/professional qualification and gender of the indigenous and expatriate consultants sampled were analysed. The results are presented in Table 3.

Table 3: Chi-square test of relationship between educational/professional qualification and gender of consultants

Parameters	**Gender**						N	α^2 value	df	p-value
	Male		Female		Total					
	N	%	N	%	N	%				
Educ Qual										
HND	9	50.0	9	50.0	18	100	99	17.629	3	0.001
B.Sc.	24	100.0	0	0.0	24	100				
PGD	12	80.0	3	80.0	15	100				
M.Sc.	24	57.1	18	42.9	42	100				
Total	69	69.7	30	30.3	99	100				
Prof Qual										
NIQS	33	78.6	9	21.4	42	100	99	30.007	3	0.001
NIOB	24	100.0	0	0.0	24	100				
NIA	9	33.3	18	66.7	27	100				
NSE	3	50.0	3	50.0	6	100				
Total	69	69.7	30	30.3	99	100				

N=Number of respondents, df=Degree of freedom, Educ=Educational, Prof=Professional, Qual=Qualification, NIQS=Nigerian Institute of Quantity Surveyors, NIOB=Nigerian

Institute of Building, NIA=Nigerian Institute of Architects, NSE=Nigerian Society of Engineers

Table 3 shows that the p-value (0.001) for the test of relationship between educational qualification and gender of the two categories of consultants is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. The implication is that the gender of the consultants contributes to their educational qualification. The p-value (0.001) for the test of relationship between professional qualification and gender of the consultants is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. The implication is that the gender of the consultants also contributes to their professional qualification.

Characteristics of projects sampled

The projects sampled were also investigated to identify their characteristics. Five characteristics namely: project and construction types, client type and project cost and duration were investigated. The distribution of the projects over the sub-variables of the characteristics is analysed using percentage. The results are presented in Table 4.

Table 4: Descriptive results of characteristics of projects sampled

Characteristic	N	%	Characteristic	N	%
Project type			**Project cost**		
Building	90	90.9	N1-500 million	63	63.6
Civil engineering	9	9.1	N501-1000 million	18	18.2
Total	99	100	Above N1 billion	18	18.2
Construction type			Total	99	100
New	75	75.8	**Project duration**		
Maintenance/renovation	24	24.2	1-6 months	18	18.2
Total	99	100	7-12 months	42	42.4
Client type			Above 1 year	39	39.4
Public	30	31.3	Total	99	100
Private	66	68.7			
Total	96	100			

N=Number of respondents, N==Naira (Nigerian currency) with US$1=N365

Table 4 reveals that the projects sampled were drawn from building and civil engineering projects however; building projects (90.9%) constitute the majority while civil engineering projects (9.1%) constitute the minority. Table 2 also shows that the majority of the projects are new (75.8%) while the minority are maintenance and renovation works (24.2%). The results also reveal that the majority of the projects are private (68.7%) while the minority are government projects (31.3%). Further result is that the study sample is distributed over small (63.6%), medium (18.2%) and high value (18.2%) and short (18.2%), moderate (42.4%) and long duration (39.4%) projects.

Relationship between project type and project cost, duration and client type

The relationship between the types of projects sampled and their cost, duration and client type were analysed. The results are presented in Table 5

Table 5: Chi-square test of relationship between project type and project cost, duration and client type

Parameters	Project type						N	α^2 value	df	p-value
	Building		Civil		Total					
	N	%	N	%	N	%				
Project Cost										
N1-500 million	60	95.2	3	4.8	63	100	99	7.242	2	0.124
N501-1000 million	15	100	3	0.0	18	100				
> 1 billion	15	83.3	3	16.7	18	100				
Total	90	90.9	9	9.1	99	100				
Project Duration										
1-6 months	18	100	0	0.0	18	100	99	3.862	2	0.145
7-12 months	39	92.9	3	7.1	42	100				
>12 months	33	84.6	6	15.4	39	100				
Total	90	90.9	9	9.1	99	100				
Project Client										
Public	30	100	0	0.0	30	100	96	4.514	1	0.034
Private	57	86.4	9	13.6	66	100				
Total	87	90.6	9	9.4	96	100				

N=Number of respondents, df=Degree of freedom

Table 5 shows that the p-values (0.124 and 0.145) for the test of relationship between the type and cost and duration of the projects sampled are greater than the critical p-value (0.05) therefore; the test fails to reject the hypothesis. The implication is that the project type does not relate significantly with project cost and duration that is project type does not determine the cost and duration of the projects sampled. However, the p-value (0.034) for the test of relationship between project client and type is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. The implication is that project client contributes to the type of project executed.

Level of engagement of indigenous and expatriate consultants in project delivery

One of the objectives of the study is to evaluate the levels of engagement of indigenous and expatriate consultants in project delivery in Nigeria. To achieve the objective, the percentage engagement of indigenous and expatriate consultants in the projects sampled was investigated. For this purpose, eight very prominent consultants were selected. Respondents were requested to indicate the type of consultant (indigenous or expatriate) engaged for each of the eight consultants in the projects sampled. The percentages of use of the two categories of consultants for each of the eight consultants were analysed. The results are presented in Table 6.

Table 6 shows that the use of indigenous consultants constituted the majority (project manager = 71.9%; construction manager = 63.6%; management contractor = 62.5%; architect = 72.7%; structural engineer = 75%; quantity surveyor = 84.4%; mechanical engineer = 81.8%; electrical engineer = 84.8%) in all the eight types of consultants investigated while expatriate consultants constituted the minority (project manager = 28.1%; construction manager = 36.4%; management contractor = 37.5%; architect = 27.3%; structural engineer = 25%; quantity surveyor = 15.6%; mechanical engineer = 18.2%; electrical engineer = 15.2%). The results indicate that the

construction industry in Nigeria engages both indigenous and expatriate consultants but the former is dominant.

Table 6: Descriptive result of the use of indigenous and expatriate consultants in project delivery

Consultant	N	%	Consultant	N	%
Project manager			**Structural engineer**		
Indigenous	69	71.9	Indigenous	72	75.0
Expatriate	29	28.1	Expatriate	24	25.0
Total	96	100	Total	96	100
Construction manager			**Quantity surveyor**		
Indigenous	42	63.6	Indigenous	81	84.4
Expatriate	24	36.4	Expatriate	18	15.6
Total	66	100	Total	99	100
Management contractor			**Mechanical engineer**		
Indigenous	45	62.5	Indigenous	81	81.8
Expatriate	27	37.5	Expatriate	18	18.2
Total	72	100	Total	99	100
Architect			**Electrical engineer**		
Indigenous	72	72.7	Indigenous	84	84.8
Expatriate	27	27.3	Expatriate	15	15.2
Total	99	100	Total	99	100

N=Number of respondents

The results in Table 6 have shown that indigenous consultants are more engaged than their expatriate counterparts in all the eight types investigated. Further investigation was carried out to determine the overall level of engagement of indigenous and expatriate consultants in project delivery. The percentages of use of the two categories of consultants were analysed. The results are presented in Table 7.

Table 7: Descriptive results of and t-test of difference between levels of engagement of indigenous and expatriate consultants in project delivery

Consultant	N	ER	t-value	Df	p-value	Difference
Indigenous	99	0.65	7.603	98	0.001	Significant
Expatriate	99	0.21				

N=Number of respondents, ER=Engagement ratio/level, Df=Degree of freedom

Table 7 reveals that the overall ratio of engagement of indigenous consultants (0.65) is higher than that of their expatriate counterparts (0.21). This result further confirms that indigenous consultants are more patronised than their expatriate counterparts in project delivery in Nigeria.

Further investigation was also carried out to determine whether the difference between the levels of engagement of the two categories of consultants discovered in Table 6 was significant. The investigation involves the test of the first hypothesis of the study. The hypothesis states that the difference in the levels of engagement of indigenous and expatriate consultants in project delivery in Nigeria is not significant. The hypothesis was tested using the t-test at $p \leq 0.05$. The rule for the rejection of the hypothesis is that when the p-value>0.05, the test fails to reject the hypothesis but when the p-value$\leq$ 0.05, the test rejects the hypothesis. The results are presented in Table 7.

The result in Table 7 shows that the p-value (0.001) is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. This result implies that the level of engagement or the patronage of indigenous consultants is significantly higher than that of expatriate consultants.

Relationship between levels of engagement of indigenous and expatriate consultants and project outcome

Another objective of the study is to determine the relationship between the engagement of indigenous and expatriate consultants and project outcome. Four parameters of project outcome namely: project cost overrun, time overrun, cost of variation and cost of rework which are prominent parameters for evaluating project performance were used. The levels of engagement of the two categories of consultants in Table 5 were used. To achieve the objective, the second hypothesis of the study was postulated. The hypothesis states that the levels of engagement of indigenous and expatriate consultants are not significantly related to project outcome. The hypothesis was tested using Pearson test at $p \leq 0.05$. The rule for the rejection of the hypothesis is that when the p-value>0.05, the test fails to reject the hypothesis but when the p-value≤0.05, the test rejects the hypothesis. The results are presented in Table 8.

Table 8 reveals that the p-values for the test of relationship between the level of engagement of indigenous consultants and project time-overrun (0.768), project cost-overrun (0.482), cost of variation (0.659) and cost of rework (0.203) are higher than the critical p-value (0.05) therefore; the test fails to reject the hypothesis. These results indicate that the relationship between the engagement of indigenous consultants in project delivery and project outcome is not significant. The implication of the results is that the engagement of indigenous consultants does not contribute to project outcome.

Table 8: Pearson test of relationship between level of use of indigenous and expatriate consultants and project outcome

Parameters correlated	N	S-value	p-value	Correlation
Engagement of indigenous consultant				
Project time-overrun	72	-0.035	0.768	Insignificant
Project cost-overrun	72	0.084	0.482	Insignificant
Cost of variation	45	-0.072	0.659	Insignificant
Cost of rework	27	-0.253	0.203	Insignificant
Engagement of expatriate consultant				
Project time-overrun	72	-0.268	0.023	Significant
Project cost-overrun	72	-0.099	0.406	Insignificant
Cost of variation	45	-0.048	0.756	Insignificant
Cost of rework	27	-0.161	0.424	Insignificant

N=Number of respondents, S-value=Pearson correlation coefficient

Further results are that the p-values for the test of relationship between the level of engagement of expatriate consultants and project cost-overrun (0.406), cost of variation (0.756) and cost of rework (0.424) are higher than the critical p-value (0.05) therefore; the test fails to reject the hypothesis. These results indicate that the relationship between the engagement of

expatriate consultants in project delivery and project cost-overrun, costs of variation and rework are not significant. The implication of the results is that the engagement of expatriate consultants does not contribute to cost-overrun or reduction in variation and rework in construction projects. However, the p-value for the test of relationship between the level of engagement of expatriate consultants and project time-overrun (0.023) is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. This result is an indication that the relationship between the engagement of expatriate consultants in project delivery and project time-overrun is significant. The implication of the result is that the engagement of expatriate consultants contributes to overrun in the delivery time of construction projects. The negative value of the Pearson correlation coefficient (-0.268) implies that the relationship is negative which implies that the higher the level of engagement of expatriate consultants in project delivery, the less the overrun in the delivery time of construction projects and vice-versa.

Relationship between project value and levels of engagement of indigenous and expatriate consultants in construction project delivery

Further investigation was carried out to determine whether or not the value of projects influence the engagement of the two categories of consultants in project delivery. The purpose of this investigation is to ascertain whether or not preference is accorded expatriate consultants over indigenous consultants in high value projects as obtainable in the case of contractors. The initial contract sums of the projects sampled was used as the parameter of project value while the levels of engagement of the two categories of consultants in Table 7 were used for the investigation. For this purpose, the third research hypothesis was postulated. The hypothesis states that the relationship between the value of projects and the engagement of indigenous and expatriate consultants is not significant. The hypothesis was tested using Pearson test at $p \leq 0.05$. The rule for the rejection of the hypothesis is that when the p-value>0.05, the test fails to reject the hypothesis but when the p-value≤0.05, the test rejects the hypothesis. The results are presented in Table 9.

Table 9: Results of Pearson test of correlation between project value and levels of engagement of indigenous and expatriate consultants in project delivery

Parameters correlated	N	Mean	S-value	p-value	Cor
Project value	24	2E+009			
Level of engagement of indigenous consultant:	24	0.7397	-0.569	0.004	Sig
Level of engagement of expatriate consultants	24	0.2309	0.569	0.004	Sig

N=Number of respondents, S-value=Pearson correlation coefficient, Cor=Correlation

The results in Table 9 reveal that the p-value for the test of relationship between the value of projects and the levels of engagement of indigenous and expatriate consultants (0.004) is less than the critical p-value (0.05) therefore; the test rejects the hypothesis. This result is an indication that the relationship between the value of projects and the engagement of indigenous and expatriate consultants in project delivery is significant. The

implication of the results is that the value of projects contributes to the engagement of both indigenous and expatriate consultants in the delivery of construction projects. However, the negative value of the Pearson correlation coefficient (-0.569) is an indication that the relationship between project value and the engagement of indigenous consultants is negative which implies that the higher the value of projects the less the level of engagement of indigenous consultants and vice-versa. The positive value of the Pearson correlation coefficient (0.569) is an indication that the relationship between project value and the engagement of expatriate consultants is positive which implies that the higher the value of projects the higher the level of engagement of expatriate consultants and vice-versa.

DISCUSSION OF FINDINGS

The results of the levels of engagement of the two categories of consultants in project delivery in Nigeria have shown clearly that indigenous consultants are more engaged than their expatriate consultants. The finding is reflected in the levels of engagement of the two categories of consultants which is 62.5-84.8% for indigenous consultants and 15.2-37.5% for expatriate consultants and also in the overall levels of engagement of the two categories of consultants which are 0.65 and 0.21 for indigenous and expatriate consultants respectively. Since the data collected are on the number of consultants, the finding simply implies that indigenous consultants significantly outnumber their expatriate counterparts in patronage. This result is in accordance with the availability of the two categories of consultants since indigenous consultants are more readily available than their expatriate counterparts. This finding suggests that the distribution of the numerical strength of indigenous and expatriate consultants is similar to that of indigenous and expatriate contractors which was discovered to be 93% and 7% respectively by Ogunpola (1984).

The result of the study that the level of engagement of expatriate consultants contributes to the reduction of project time-overrun is an indication that engaging the services of expatriate consultants helps to minimise delay in project delivery. Delay has remained a prominent feature of project delivery in Nigeria and several reasons are responsible. Hattam and Lalani (1997) asserted that the chance of delivering a project on time and within budget may increase when appropriate consultant team is selected. The results of this study suggest that the engagement of expatriate consultants tends to increase the chances of delivering a project on time in Nigeria.

The findings of the study that the relationship between project value and the engagement of indigenous consultants is negative and that the relationship between project value and the engagement of expatriate consultants is positive suggest that preference is given to indigenous consultants for projects of small values while preference is giving to expatriate consultants for projects of high values. The implication of the result is that high value projects are handled by expatriate consultants

while low value projects are reserved for indigenous consultants. The scenario is the same with contractors in which high value projects are handled by expatriate contractors who are less than 10% of the population of contractors in Nigeria but handle about 90% of the value of construction executed (Edmonds, 1979; Ogunpola, 1984; Olateju, 1991; Idoro, 2007; Idoro, 2010). The finding implies that the same preference given to expatriate contractors by Nigerian clients as discovered by Oni (2001), Eze (2004), Oyewale (2004), Okafor (2005) and Idoro (2009) is given to expatriate consultants.

CONCLUSIONS AND RECOMMENDATIONS

The study investigated the levels of engagement of indigenous and expatriate consultants in project delivery in Nigeria, their relationship with project value and outcome in the attempt to establish whether or not Nigerian clients prefer expatriate consultants to indigenous consultants as they do for expatriate contractors. The results have shown that the level of engagement of indigenous consultants is significantly higher than that of expatriate consultants however; the relationship between the value of projects and the level of engagement of indigenous consultants is negative while that of expatriate consultants is positive. From these findings, it is concluded that although, indigenous consultants are more engaged than their expatriate counterparts however; preference is giving to expatriate consultants for projects of high values over their indigenous counterparts. This conclusion implies that Nigerian clients give preference to expatriate consultants over their indigenous counterparts to handle major projects as they do for expatriate contractors.

The study has further discovered that the level of engagement of indigenous consultants did not contribute to any of the four parameters of project outcome investigated while the level of engagement of expatriate consultants contributed significantly to project time-overrun. From this finding, it is concluded that the services of indigenous consultants do not contribute to improvement in the outcome of a project while the services of expatriate consultants help to reduce delay in the delivery of projects. The conclusion implies that the former provides better services than the latter.

From this conclusion, it is recommended that indigenous consultants should make efforts at improving the services they render with a view to ensuring that they have meaningful impact on project outcome. This could be achieved by further training and development both academic and professional such as postgraduate training in higher institutions of learning and the Continuous Professional Development (CPD) of professional bodies. It is further recommended that stakeholders in the industry especially Federal and State governments and the organised private sector clients should promote the involvement of indigenous consultants in major projects with a view to promoting the development of local capacity in the delivery of construction projects. This step may require initiatives such as low interest loans and mobilisation fees to encourage capacity building among

indigenous consultants and even deliberate policy and legislation to promote the engagement of indigenous consultants. Towards this end, the Nigerian Content in the Construction Industry Bill which is already with the National Assembly should be made to cover consultancy services and passed into law.

Suggestion for Further Studies

The study has established that clients in the Nigerian construction industry give preference to expatriate consultants for projects of high values over their indigenous counterparts. The same preference has been established in previous studies in respect of expatriate construction contractors. However; the reasons for the preference for expatriate contractors and consultants have not been investigated. It is therefore recommended that further studies be carried out to determine the reasons for the preference for expatriate contractors and consultants in construction project delivery in Nigeria.

REFERENCES

Alinaitwe, H M (2008). An Assessment of Clients' Performance in having an Efficient Building Process in Uganda. *Journal of Civil Engineering and Management,* 14(2), 73-78 CBN (2008). *Official Report,* Central Bank of Nigeria

Crawshaw, D T (1976). *Co-ordinating Working Drawings. Building Research Establishment, Paper CP 60/76*, Watford, UK

Edmonds, G A (1979): Macro firms; Construction Firms for the Computer Age. *Journal of Construction Engineering and Management* 109 (1). 13-24.

Eze, N (2004) *African Industrial Organisational Psychology.* 1st edition. Pumark Nigeria Limited, Lagos

Hattam, D E and Lalani, N (1997). Selecting the Right Consultant Team. *Institute of Transportation Engineering Journal,* 67(9), 40-46

Havemann, G (2007). The Challenges of engaging South Africa's Unemployed in Construction Sector Delivery. *Proceedings of the CIB World Building Conference on Construction for Development,* Cape Town, South Africa, May 14-18, 2007

HSE (2002). Train Derailment at Porters Bar 10 May 2002. Progress Report by the HSE Investigation Board, HSE Interim Report, June, HST, London

Idoro, G I (2004). The Effect of Globalisation on Safety in the Construction Industry in Nigeria. *Proceedings of International Symposium on Globalisation and Construction,* Asian Institute of Technology, Thailand, November 17-18, pp 817-826

Idoro, G I (2007) A comparative Evaluation of Health and Safety Performance of Indigenous and Multinational Construction Firms in Nigeria. *Construction Research Journal, Journal of the Department of Building, University of Lagos, Lagos, Nigeria,* 1(1), 65-75

Idoro, G I (2009). Correlation between Managerial and Technical Capacities and Quality Performance of Indigenous and Expatriate Construction Contractors in Nigeria. *International Journal of Construction Project Management,* 1(2), 1-15

Idoro, G I (2010). Influence of Quality Performance on Clients' Patronage of Indigenous and Expatriate Construction Contractors in Nigeria. *Journal of Civil Engineering and Management,* 16(1), 65-73

Idoro, G I (2011). Influence of In-sourcing and Outsourcing of Consultants on Construction Project Performance in Nigeria. *Australasian Journal of Construction Economics and Building,* 11(4), 45-58

Kasma, D R (1987). Consultant Selection. *Journal of Management in Engineering,* ASCE, 3(4), 288-296

Mansfield, J R (2009). The Use of Formalised Risk Management Approaches by UK Design Consultants in Conservative Refurbishment Projects. *Engineering, Construction and Architectural Management*, 16(3), 273-287

National Bureau of Statistics (NBS) (2015). *Nigerian's Construction Sector Summary Report 2010-2012*, Nigerian Bureau of Statistics, Abuja, Nigeria

Ogunlana, S O (2002): Training for Construction Industry Development Best Practice in Ogunlana, S. O. (Ed.) *Training For Construction Industry Development.* CIB Publication No. 282, pp. 1-6

Ogunpola, A (1984): The Structure of Building Costs and Implication for Economic Development. *Proceedings of the Annual Conference of Nigerian Economic Society***.** Nigerian Economic Society, University of Ibadan, Ibadan, Nigeria. pp 28.

Okafor, A A (2005) A Study of Constraints to Capacity Building of Indigenous Contractors in the Nigerian Construction Industry. M. Sc. Project. Department of Building, University of Lagos, Lagos, Nigeria

Olateju, B (1991): Enhancing the Contract Management Capabilities of the Indigenous Contractor: *Effective Contract Management in the Construction Industry.* The Nigerian Institute of Building, Lagos, Nigeria. pp.132-142

Oni, O H (2001). Problems of Indigenous Contractors in Lagos State. B. Sc. Project, Department of Building, Obafemi Awolowo University, Ile-Ife, Nigeira

Oyewale, 0 (2004). An Assessment of the Nigerian Economy on the Performance of the Construction Sector. M. Sc. Project, Department of Building, University of Lagos, Nigeria

EXPLORING ICT EDUCATION IN SOUTH AFRICAN SCHOOLS OF THE BUILT ENVIRONMENT

Aghaegbuna Ozumba[1], **Adeyemi Akintola**[2], **Thandeka Dlamini**[3], **Audicuos Rashekula**[4] **and Palesa Mathe**[5]

School of Construction Economics and Management, University of Witwatersrand, I Jan Smuts Avenue, PO Box 20, Wits 2050, Johannesburg, South Africa

With growing demand to increase student enrolment and throughput in South African higher institutions, this paper explores the ICT footprint in Schools of the Built Environment curricula and reports the findings of two sequential studies. The research methods involved purposive selection of participants comprising students, academic staff and administrative staff of selected South African Schools of the Built Environment. Data were collected using questionnaires that incorporated open-ended questions, interviews and documents analysis. The data were analysed using descriptive statistics and content analysis of textual data. A comparison of results from the two studies shows considerable increase in the ICT footprint in the schools' curricula between the two studies. There were however strong suggestions of disparity in the participants' perceptions of the adequacy of ICT content in curricula across the different schools. The findings further show misalignment between the perceptions of students and lecturers; existence of information and knowledge related deficiencies, and capacity and resource related challenges. The findings are indicative of a need to improve teaching and learning delivery for ICT education within the BE schools through focused and immersive theoretical and practical content delivery. This would require increased interaction with industry professionals in order to facilitate a balanced approach to teaching and learning with ICT in the BE schools.

Keywords: academia, built environment, curriculum, ICT, ICT education, ICT content, ICT footprint.

INTRODUCTION

It is clear that the use of Information and Communication Technology (ICT) can greatly enhance teaching and learning activities (Mackgato, 2014). Its

1 Obinna.ozumba@wits.ac.za
2 adeyemi.akintola1@students.wits.ac.za
3 Thandeka.Dlamini@students.wits.ac.za
4 0713326D@students.wits.ac.za
5 0702233E@students.wits.ac.za.

Ozumba, A., Akintola, A., Dlamini, T., Rashekula, A and Mathe, P. (2017) Exploring ICT education in South African schools of the built environment *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 698-714

use in education can be a veritable aid to student-student, student-lecturer, lecturer-lecturer interaction/collaboration by enabling knowledge creation and sharing (Raju, Raju, Abbaiah and Gudavalli 2016; Aghaee and Keller, 2016). However, since the use of ICT does not produce guaranteed results, considerable research effort has gone into investigating how it may be effectively integrated into educational curricula (Saz, Engel and Coll, 2016). The research interest in this paper concerns the ICT footprint in the curricula of schools of the Built Environment (BE) in South Africa.

ICT has been defined in terms of the technologies which enable the capture, storage and manipulation of information (Christiansson, 2005). ICT is also broadly viewed in the paper as encompassing the fields of information, communication, automation, and related technologies. Similarly, the use of ICT in construction includes Information and Automation Systems (IAS), Computer Integrated Construction (CIC), ICT and Automation for construction (ICT-A), as described in Ozumba and Shakantu (2008). Therefore the ICT footprint of curricula in built environment schools is construed as encompassing these relevant bodies of knowledge and principles as they are incorporated into the learning environment.

ICT has had profound impact on modern society's way of conducting business has been profound (Sun and Howard, 2004; Murray et al., 2002). The creation and management of knowledge through information systems have become an essential requirement in society across various industries. The adoption and integration of ICT in the construction industry, has placed demands on skills requirements for construction graduates (Oyediran, 2005). This development has made ICT competencies, necessary outcomes for construction graduates of higher education institutions (Czerniewicz and Jaffer, 2007). Pertinent questions are nevertheless being asked about the impact of integrating ICTs in teaching and learning activities. In a study that investigated the impact of ICT integration on language learning in China for instance, the findings show its effectiveness in improving student test scores relative to schools where ICT was not used (Bai, Mo, Zhang, Boswell and Rozelle, 2016). Similarly, research carried out by Al Awani, Senteni and Singh (2016), on the impact of using digital video for learning shows a strong relationship between its use and overall quality of classroom experience. Importantly, the authors recommended professional development programmes that could enable the effective integration of such technologies into curricula.

With the growing demand to increase enrolment numbers and throughput in South Africa, ICT tools are looked upon to provide the necessary support, more so to alleviate the challenge of attrition (Stoltenkamp and Siebrits, 2015). Molebatsi and Phorah (2015) nevertheless acknowledged that there are still significant challenges to effective delivery of knowledge despite significant advancements in applicable technology. Furthermore, the literature also suggests that full integration of ICT has not been realized (Ozumba et al., 2010). With the development of ICT in construction, it would be detrimental to the future of current graduates and indeed the local construction industry, if the ICT footprint of their curricula is not

internationally standardized and constantly updated. While research shows appreciable work in this regard, it is necessary to keep abreast of relevant developments across the wider world. This is especially as ICT tools and procedures such as BIM are becoming the language of BE practice. Therefore this paper explores ICT education in BE schools further with particular emphasis on the South African context.

ICT EDUCATION IN THE BUILT ENVIRONMENT

The use of ICT in educational processes clearly has the potential to bring about significant changes, some of which include: changes to teachers' roles; collaboration and distant learning; independence of time and location in learning; the enablement of virtual universities; and level of adaptations and development in pedagogy and learning styles (Al Awani et al., 2016; Bai et al., 2016; Christiansson, 2005). Enriching the ICT content of curricula will inevitably enhance e-learning, and encourage more learner involvement in many ways (Smit, Wall and Betts, 2005). The development of ICT has also created new ICT-based skills requirements. Such ICT-based competences are essential for the relevance of participants in the built environment (Christiansson, 2005). Furthermore other studies assert the importance of ICT education in the training of BE students (Mourshed et al., 2003; Tedre, Bangu and Nyagava, 2009; Ssewanyana and Busler, 2007). The need for ICT in construction related processes demands ICT skilled construction professionals and by extension a need for ICT education in BE schools.

Despite the foregoing, gaps have been noted between the ICT education of graduates and ICT skills requirements in the industry and similarly, gaps in the curricula of South African BE schools has been suggested (Ozumba et al., 2010). Other key gaps in relevant ICT knowledge include: mobile IT in construction; collaboration technologies; knowledge and information management (KIM); virtual reality (VR); virtual prototyping; automation and robotics; integrated design and database solutions; life cycle simulation; and nanotechnology applications (Ozumba et al., 2010). Additional concepts identified as relevant include: virtual building; common data environment; building information modelling (BIM); interoperable data exchange; model-based estimating; 4D construction planning and visualisation, and; environmental performance analysis and control (Smit et al., 2005). The literature does suggest the existence of challenges to achieving curricula with adequate ICT content in the education of BE students. Some challenges to ICT education identified in literature include infrastructure; the need for capacity-building; deficiency in language and content; and financing the cost (Tinio, undated). For the construction industry in developing countries, the general level of ICT development has been identified as a major causative factor for the prevailing gap. There are also other challenges to ICT education in the BE, from the perspective of e-learning (Mourshed et al., 2003; Smit et al., 2005).

ICT Education in South African schools of the built environment

The need for ICT education and skills has been emphasised by education regulators in South Africa. However there seems to be less attention to differences in sectorial needs with regard to implementation (Jones, 2008). Policy issues still plague the proper implementation of ICT education generally (Isaacs, 2007). From a preliminary study of South African BE schools, the need for curriculum update, awareness of current developments, poor scope and teaching approach, and low level of detail were identified as impediments. In addition, the dearth of relevant information on this area of study within the South African context was highlighted (Ozumba et al., 2010) as is still the case currently.

In Ozumba et al. (2010) an ordered progression in knowledge and skill acquisition for ICT in the curricula of BE schools in South Africa was not evident. Based the study's findings and limitations, it was necessary to further examine issues such as provision of ICT facilities, industry involvement, teaching and learning delivery, and stakeholders' views. Hence for the current study, the following exploratory research question was posed:

What are the expectations and requirements for adequate ICT education in South African schools of the Built Environment?

The purpose of the current paper was therefore to explore the perceptions of stakeholders, in relation to the adequacy of generic and construction-related ICT content in the curricular of BE schools in South Africa. The stakeholders of interest are staff and students of relevant schools within South African institutions of higher learning.

METHOD

A multi-stage research design was employed in this study. Sampling for each study was also purposive as ethical access to comprehensive students and staff lists were difficult to obtain. Therefore, the participants include those who could respond to the questions of interest and were willing to participate. The two stages of further research were designed and performed independently. Details of the multi-stage research design, one conducted in 2010 and the other in 2011 are presented below in Table 1. The analysis of data and discussions are presented separately in sections for the sake of clarity.

For the 2010 study, the respondents were grouped according to the following disciplines: Architecture, Planning, Quantity Surveying, and Construction Management. However, the 2011 study in addition to those disciplines included, participants were grouped in to the following disciplines for the sake of uniformity:, Landscape Architecture, Construction Management, Property Studies, Real Estate, Interior design, and Geoinformatics. Presentation of results is divided into two sections, students and staff respectively.

While the response rate for the 2010 study was low, since the study was exploratory in nature, the results are considered to be indicative rather than generalizable over the population. In addition 16 of the responses were returned by respondents from Gauteng province, while only two were returned from outside the province. Therefore the responses essentially represent the situation in Gauteng province of South Africa. The greater Johannesburg area being the economic centre and international gateway of the nation is seen as being indicative of what could be the general situation in the country.

Table 1. Research methods

Aspect	2010 study	2011 study
Approach	Survey	Survey
Methods for data collection	Questionnaires incorporating open ended questions	Content analysis of curricula documentation to assist in questionnaire design. Questionnaires and interviews were the main data collection instruments which allowed for richness in the data.
Study participants	The sample was purposively drawn from core academic staff, support staff and programme administrative staff of 9/22 South African universities.	The sample was purposively drawn from core academic staff, support staff and programme administrative staff of South African universities. However, only 4 out of 1l Schools that offered BE environment course in the Gauteng Province were selected for interviews and questionnaire surveys.
Sample size	Questionnaires were distributed purposively to 83 potential participants out of which 18 were returned (21.69% response rate). Specifically, this included 4 Heads of Schools, 11 lecturers, 2 school administrators and 1 support staff.	Questionnaires were distributed purposively to 80 respondents all of which were returned
Variables investigated	ICT tools used; perceptions of adequacy of ICT content in curricula (generic and BE related software); perceptions on required improvements; and challenges encountered.	Teaching approaches; methods of assessment; degree of exposure to industry related ICT; perceptions of students regarding their knowledge of ICT, ICT content in curricula, teaching approaches used by their lecturers. The interviews captured the perceptions of relevant staff members on the ICT content in their curricula, teaching approaches used; methods of assessment and exposure to industry related ICT.
Methods used for analysing data	Content analysis of textual data and descriptive statistics on quantitative data. Results from the analyses are presented in tables, charts and narratives. Comparisons using correlation analysis, charts and tables were also employed.	Content analysis of documents/ textual data and descriptive statistical analysis on quantitative data (Berenson, Levine and Krehbiel, 2012; Remenyi, Onofrei and English, 2013). Results from the analyses are presented in tables, charts and narratives. Comparisons using correlation analysis, charts and tables were also employed.

It was important to align the 2011 study with the previous 2010 study, which had limitation of reach. By concentrating the primary data collection in Gauteng, it is possible to relate the two sets of data, and consolidate the findings. There are collectively eleven relevant schools of BE within the four institutions within Gauteng region. The sample population was made up of heads of schools, members of staff, school administrators and students.

For the 2011 study, questionnaires administered purposively to students were (80) in number, of which all were completed and returned. Completed questionnaires which were discarded due to errors were (4) in number. Majority of students who responded 33(43%) were studying Quantity Surveying and Construction Management, 33(43%) were Architecture and Landscape Architecture students, 8(10%) were from Urban, Town and Regional Planning, and 2(3%) were studying Real Estate and Property Studies. According to year of study, 31(41%) of respondents were in their first year, 14(18%) in second year, 11(15%) in third year and 20(26%) in honours/post graduate, according to local classification.

The interviews with staff members were held with (9) academic staff, 1 school administrator and 4 heads of schools based on their consent and availability. Considering the exploratory nature of the research and the high response rate from the student survey, the interview response was deemed adequate.

Ethical considerations in the collection and presentation of data

Ethical principles were followed in the research process requiring that informed consent is sought from participants. Confidentiality of responses and anonymity of participants were assured and maintained. Respondents' participation was voluntary in each case and they could withdraw at any time.

RESULTS

Results of the 2010 study

Table 2 presents depicts the software taught by the schools of BE, as derived from responses to open-ended questions. Respondents from each of the four schools investigated, indicated the use of some contemporary software packages in teaching and learning.

In summary, majority of respondents 16(88%), agreed to the adequacy of ICT content of curricula. However with regard to industry specific needs, only 9(50%) of respondents agree to the adequacy of ICT content of the curricula. An appreciable proportion of respondents 5(27%) were not sure. When added to the 4(23%) who did not agree, they also amount to 9(50%) of respondents. Furthermore majority of respondents 17(95%) perceive the ICT content in the curricula as needing improvement. The remaining 1(5%) did not see any need for improvement. As stated in the method section, respondents were asked to identify challenges to implementing adequate ICT content in the curricula. Table 3 shows challenges identified by respondents in their responses to open ended questions and their subsequent categorisation.

Table 2. Software packages used in the built environment schools

Schools	Packages
Architecture	AutoCAD, ArchiCAD, Autodesk Revit, 3D MAX, Indesign CSS, Photoshop CSS, Sketchup
Town/urban and regional planning	AutoCAD, Arc GIS, SAS, SPSS, Google earth, Google map
Construction management	CCS- construction computer software, MS project, Autodesk Navisworks, Primaveria
Quantity surveying	WinQS, QS Plus, CCS, MS project, Kwickfees, Autodesk Navisworks, MS Excel

Table 3: Analysis of respondent's indications of challenges to implementing ICT content in their curricular in 2010

Challenges indicated	Categorisation
Lack of knowledge / awareness Lack of experienced lecturers Lack of ICT-trained lecturers Poor teaching / instructing abilities	Competence and capacity related challenges, on the part of school/faculty
Need for practical experience for students Insufficient time to cover relevant ICT content	Challenges related to curriculum design, and the learning environment for students
Lack of facilities for students Cost of specialists Insufficient funding for implementing more ICT	Challenges related to the management of requirements for adequacy of the ICT content

Respondents' indications of challenges to ICT education are comparable to challenges identified in literature. Key areas include awareness and skills; curriculum issues; cost and other management related challenges. The following additional issues were highlighted in literature: lack of flexibility among lecturers in terms of exploring e-learning and ICT education; rate of obsolescence of software and lack of upgrades; lack of ICT education as part of degree requirements; use of non-standard software; and lack of partnership with industry as implied by Molebatsi and Phorah (2016) and also confirmed by Wong, Wong and Nadeem (2011) in a study of BIM education in a Hong Kong University.

From Table 2 it appears that there is considerable utilisation of relevant software in the schools investigated. However the results suggest appreciable differences in the perceptions of respondents for the three key variables analysed. The differences further support the suggested gaps, especially in information, working knowledge and experience for ICT in construction. The result presents a contradiction in the sense that 16(88%) of respondents indicated general adequacy of ICT content, while 17(95%) of the same respondents indicated the need for improvement of ICT content. Essentially ICT content in the curricula was deemed to be highly adequate generally but not in relation to industry-specific ICT skills needs.

Results of the 2011 study

The following results are presented in two sections consisting students' and staff responses respectively.

Students' Response

The questions asked examined students' computer literacy, access to computers, internet access, usage of relevant technologies, and familiarity with current ICT trends. All the respondents had access to computers while 64(85%) of them had access to computers both at home and in school. Majority 65(86%) also had internet access at home. In terms of ICT skills, 19(25%) of the respondents rated themselves as having excellent ICT skills. Half of them 38(50%) rated their ICT skills as good while a lower 15(20%) rated themselves as fairly skilled. Conversely, only 21(28%) of respondents used available ICT to execute assignments and class projects. A higher 35(46%) used the ICT framework to correspond with instructors and participate in tutorials. Despite the provisions, application of knowledge through assignments and projects was still largely done outside the ICT framework provided in each school. Majority of respondents used ICT (computers and internet) for other functions such as social networking and entertainment. While these represent appreciable use of ICT infrastructure and tools, the most usage was for other things besides knowledge and skills acquisition related to the built environment. This finding suggests a lack of proper orientation and monitoring of usage.

Further, in ascertaining students' appreciation of the relevance of ICT education in their training, questions were posited about: their assessment of the importance of ICT literacy and skills; importance of using ICT in teaching and learning; importance of industry experience as part of ICT education; and the ideal proportion of ICT to incorporate into courses or course modules as in Table 4 below.

Table 4: Comparison of responses on the importance of ICT

Importance of ICT skills/literacy	Importance of ICT in TandL	Importance of industry experience	Need for ICT core course
95%	84%	91%	92%

All variables recorded high values of importance according to the perceptions of respondents. However the value for importance of using ICT in teaching and learning was slightly lower than other variables, though majority of students acknowledged its importance. The need for a core course where ICT for each built environment discipline is taught was strongly indicated as a need. In addition to the data presented in Table 4, (42%) of students preferred to take one course where most of the ICT content would be located, with smaller components incorporated into other courses. The next highest proportion (30%) wanted the ICT content to be spread evenly throughout all courses offered. About (25%) of respondents wanted a singular core course for ICT in construction. The results also suggest that majority of students prefer an even spread of content across the courses offered, while also maintaining a core course.

Furthermore, less than half of respondents indicated the existence of provisions for ICT in their education. A proportion of (49%) used tutorials, (42%) used on-line learning tools, (18%) had contact sessions with ICT specialists who came in as guest lecturers, while (11%) indicated the use of field trips. The remaining (20%) did not experience any of the abovementioned provisions for ICT education. Note that groups of students indicating various approaches were not mutually exclusive. Hence the proportions do not add up to (100%) in this particular section. The next section presents analysis of familiarity with BE ICT tools and practices as well as their incorporation into curricula within the schools.

Using 15 relevant contemporary trends in ICT derived from literature, students indicated knowledge areas they were familiar with and those on which they were receiving instructions within their respective schools. The results are shown in Figure 1.

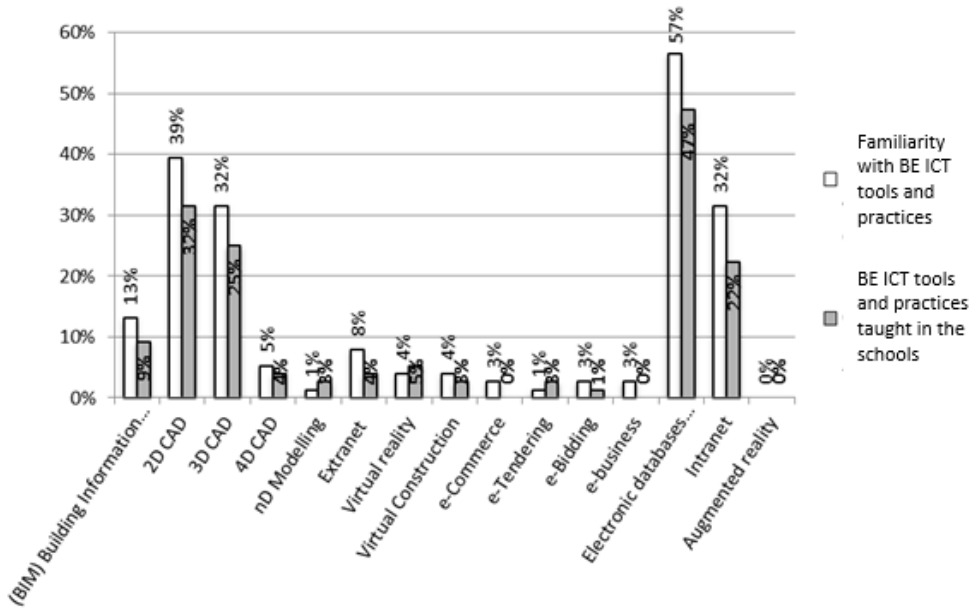


Figure 1. Comparing familiarity with BE ICT tools/practices and their incorporation into curricula

A linear correlation of values for familiarity with BE ICT tools and practices and their teaching returned a correlation coefficient of (0.9935). This suggests a strong association, whereby teaching of relevant knowledge areas and familiarity with them amongst students apparently follow the same pattern. However it would seem that familiarity with BE ICT tools and practices amongst students was not solely influenced by efforts to introduce such technologies in class. For example familiarity with e-business was indicated though there were no indications of teaching being delivered on that topic. Furthermore, only (4) out of the (15) BE tools/practices had above (20%) of students who indicated 'yes' for both variables. Indications for fairly recent developments such as BIM, nD-Modelling, and virtual design and construction were very low as was evident in Makura (2014).

Figure 2 depicts the software package types to which students were exposed. A total of (14) software package types were identified by students as those which they were introduced to in their various schools. These include design, management, costing, specification and statistical software packages.

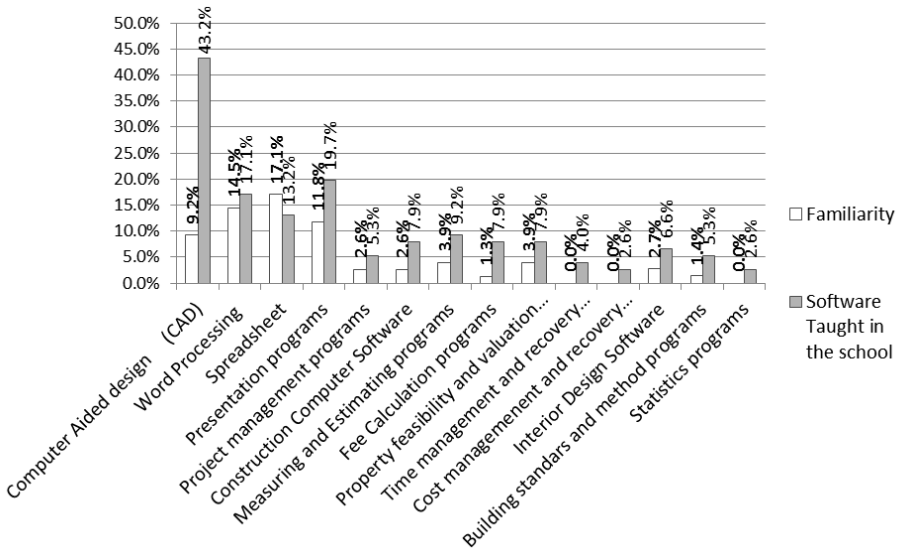


Figure 2: Comparison between familiarity with software tools types and their occurrence in teaching and learning

The result of a linear correlation of values for exposure to software and familiarity to the same software suggests some degree of association between the variables (a positive correlation coefficient of 0.5950. Further, an inspection of the chart in Figure 2 also shows a pattern that is contrary to results in Figure 1. Familiarity trailed behind student exposure to software in school through teaching. The result suggests appreciably low familiarity with such specific software packages, in relation to their inclusion in content and delivery among students. It also suggests that exposure to such software packages through teaching has a questionable influence on students' familiarity with the range of software types investigated. Presentation programmes, spread sheet, word processing and CAD software ranked the highest in terms of familiarity and exposure provided for students. The remaining (10) software package types recorded very low proportions of students who were either familiar with them, or exposed to such software in school. While the results suggest inadequacies in student engagement with relevant software, there could be additional inadequacies in the provision of instruction by academic staff.

In terms of packages being introduced to students in their schools, the highest proportion (44%) was for CAD and next are presentation programs, word processing and spread sheet packages. For the final overall assessment of the adequacy of ICT content in the curricular, (63%) of students agreed to the adequacy of current ICT content in curricula, while (12%) remained neutral, (18%) disagreed and (3%) strongly disagreed. The

result suggests some disparity in students' experiences, which could be occurring across the universities investigated and across individual schools within each university. When analysed according to responses from the four universities studied, the results support the suggestion of some disparity in students' perceptions of ICT content adequacy. Figure 3 shows a chart comparing students' responses on ICT content adequacy in curricula, according to individual universities.

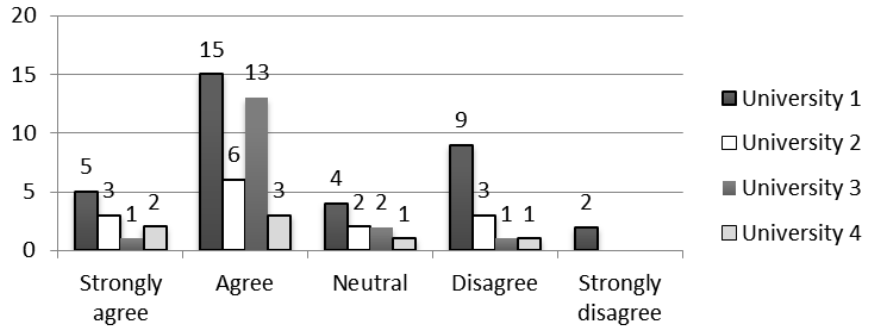


Figure 3: Comparison of respondents' indications on the adequacy of ICT education in the curricular in 2011

Positive indications on adequacy of ICT education are not consistent since there are also indications of disagreement from the same universities. Results here also support the notion of disparities in ICT content of curricula between schools that are within the same university, regardless of the fact that they are most probably part of the same faculty. In this case the richness of ICT content could be more dependent on operators within individual schools.

Responses from staff (interviews)

As stated earlier, participants from the staff were (14) in number; made up of (9) academic staff, (1) school administrator and (4) heads of school. The following headings cover the range of interview questions, which were posed to the staff members: ICT content in the curricular, facilities for ICT education, ICT training of teaching staff, approach to teaching and learning delivery, industry exposure for students, challenges to ICT education, research in ICT for construction; their perceptions on the importance, need for core ICT course, and adequacy of current ICT education. The analysis of their responses is presented below in narratives.

ICT content: From the interview responses, it was evident that there was ICT content in the curricular across all four schools. Teaching staff also confirmed the teaching of ICT components within the courses they presented. There was general agreement that ICT content was updated yearly, except for one head of school who disagreed. However, update procedures heavily depend on service providers. There was also an indication of plans for further development of ICT content in one instance. In addition, not all the schools considered global trends adequately when updating their ICT content. A lot depends on course managers, locally

relevant ICT bodies of knowledge and local demands of each profession. There were no clear policies guiding integration of ICT in the curriculum of schools. Most course managers relied on guidance from people within their faculties.

Teaching and learning approach: Apart from teaching ICT components with the delivery of some courses, communication between lecturers and students was also conducted through e-learning platforms in the form of announcements, assignments and electronic discussion boards. The use of practical demonstrations during classes was also indicated. Assessments were mostly done manually; nonetheless there seemed to be a challenge with presenting current content through available e-learning portals, and in assessing ICT knowledge within the courses that have such components. Nevertheless, some of the assignments given out to students were completed through e-learning systems. Furthermore students were minimally exposed to ICT in the industrial environment. Though some students did fulltime industry work in some cases, the focus was not on gaining ICT skills. The use of audio-visual materials and practical demonstrations were deemed inadequate by some participants. There was general agreement on the idea of using experiential training as a form of assessment. However, there were challenges with resources and logistics. Academic staff members suggested the following: Deep immersion through industry visits, combining part time coursework and part time industry work, assessment which integrates problem solving with ICT skills, and use of group computer sessions.

In terms of teaching ICT as a standalone course, (3) heads of school disagreed while (1) agreed. One head of school emphasised that BE schools are focused on construction education as opposed to ICT education. On this point, academics were divided. Majority of staff members did not support the provision of a core course that teaches ICT. Most suggested spreading ICT content amongst existing courses. There was however an indication by one respondent that ICT could be concentrated in a core course only if it is well defined.

Challenges to ICT education: Challenges mentioned by staff were: Unhealthy variation in the exposure of students to practical ICT training; access to resources for large groups; rigidity of questioning; difficulty in integration of specialised lecture material with current quiz format; and network down times. Lack of necessary equipment was also indicated. In such cases, lecturers used their own hardware and software. Conversely heads of schools confirmed appreciable provision of facilities. Regardless of the contradictions, demand on the ICT systems would most probably result from increase in student numbers, whereby an increase in computer workstations and other enabling infrastructure becomes imperative. Provision of mobile tablet computers to students was suggested as a way to ease the pressure on existing facilities. In summary, challenges highlighted in both studies are generally similar. Other challenges such as lack of knowledge and awareness, and lack of experienced lecturers and ICT-trained lecturers, were also derived from the responses.

ICT training for teaching staff: Six of the nine teaching staff interviewed had received specialist computer training. Majority had expertise in Microsoft Office suite of software. Four of the respondents had expertise in WinQS and other measurement and estimating software such as QSPlus and CCS. Two respondents had expertise in AutoCAD, Photoshop, and SketchUP. Two respondents had expertise in Microsoft Project, and one respondent had expertise in Ecotect Energy Simulator. Furthermore it was confirmed that ICT knowledge and skills were considered when recruiting academic staff in most instances. Regardless of the training received by current staff members, none of them was teaching software directly rather as components in the courses they presented. Plans to hire the services of specialists in construction ICT to improve course curriculum were indicated.

Research in Construction ICT: From the interview responses it would seem that academics specialising in design, are not particularly inclined to research in the area of ICT in construction. Inadequate information about current research trends in the area of ICT in construction was evident from the responses. Though respondents indicated interest in research, lack of capacity and relevant information was highlighted as challenges. The need for partnership with industry was also highlighted.

Perceptions on ICT education benefits: The academics identified savings in time; increase in level of communication between lecturers and students; and reduction in human error.

DISCUSSION

Findings from the 2010 study suggest inadequacy of ICT content in the curricula of BE schools investigated. In addition, the major challenges were information, capacity, curriculum issues and general management. Furthermore there did not seem to be a formal approach to ICT education of students from the survey responses. The findings support the possibility of appreciable information and capacity related challenges, as indicated by respondents. It is also suggested here that challenges of management, technology support and enabling environment, could be traced in part to knowledge, capacity and experience among staff members. Other factors such as infrastructure, access and cost are however not discounted.

The analysis of stakeholder perceptions from the 2011 study highlights considerable disparities in their perceptions in contrast to the finding of Makura (2014) regarding student and staff perceptions of ICT use in education. The apparent misalignment of perceptions suggests the existence of information, knowledge and communication gaps between stakeholders. Since the stakeholders are made up of service providers and service receivers, there is perhaps more responsibility on the part of service providers to bridge the gaps. The aforementioned gaps could relate to their expectations of each other. Findings also highlight the need for capacity building and a higher degree of awareness, on the part of management and staff, as service providers. The analysis of data from interviews also point

to the need for expansion in the ICT skills sets of academic staff. This is similar to the implication of the study carried out by Makura (2014).

Generally the greater need should be to address the issues through curriculum re-design that is targeted at improving the ICT footprint of the curriculum for each relevant school. Judging from the two studies; progressions of ICT components through the years of study, the delivery levels, and core courses throughout the years of study should be used to address most of the identified gaps. However, it is important to note that it is difficult to incorporate all ICT related content in a standalone course (Wong et al., 2011). Despite appreciable growth in the ICT footprint of the curricula of schools investigated between 2010 and 2011, ICT education in the BE schools still needs to be upgraded. It is also necessary, to improve and maintain international standards and local relevance.

Further, challenges of capacity will hamper the development of more effective curricula and the implementation of curriculum within each school. Increased dependence on service providers from ICT sector will place demands on funds and logistics. Conversely equipping staff members with the right level of skills would be more profitable to individual schools in the long term. A situation where current teachers lack deep working knowledge of the technologies they use, or instruct students in, will only result in less exposure for the students. It is also arguable that a lecturer might tailor the content and delivery of any module to suit their own limitations. In that case, it would be imperative that teaching staff gain enough expertise to effectively teach the ICT components in the courses they present.

Furthermore, there is also the need to improve teaching and learning delivery for ICT education within the BE schools. While the use of tutorials and on-line learning tools has been proven to be effective, the need for contact with industry practitioners in the area of construction ICT and focused immersive practical experience cannot be overemphasised. Even so the need to increase industry interaction in order to facilitate ICT education should be in balanced combination with input from academics. That would make for balanced knowledge and skill acquisition.

CONCLUSION

The studies reported in this paper were aimed at exploring stakeholders' perceptions/position on ICT education in South African BE schools. Results suggest disproportionate perceptions on the part of respondents. There seems to be an appreciable level of misalignment in the expectations of students and perceived requirements by staff members, who are the service providers. The results also strongly suggest information and knowledge related gaps as well as capacity and resource related challenges. The possibility of an element of arbitrariness in the ICT content design of the curriculum as highlighted in Ozumba et al. (2010) was not dismissed. Despite the foregoing deductions, there is evidence of appreciable progress in ICT education between the 2010 and 2011 studies. Furthermore, recent observations in the research agenda suggest that some schools are

expediently making effort to equip their labs and train the lecturers. However the major issues highlighted in the current paper still require further investigations. Limitations of reach and response rate were placed on the collection of primary data. However, the data analysed is deemed sufficient for this exploratory stage in the research agenda.

Considering findings and limitations expressed in the current paper, it is necessary to investigate the ICT education in local BE schools in terms of its alignment with the skills requirements of the local industry and international standards. The apparent misalignment between student, staff members and management perceptions should be investigated further. The association between awareness and knowledge, and teaching of ICT in BE schools should be examined in further detail. In addition, future studies should analyse the content, delivery and assessment in more detail. It would be more insightful to conduct the study according to various disciplines and schools. Results of the studies presented in this paper provide more insight to a definite area of gap in the South African BE sector. While all possible issues have not been explored at this stage, furthering the study will provide strong basis for continuous improvements in the ICT education of BE students within South Africa. Beyond the local BE schools, findings such as the misalignment of stakeholders' perceptions and expectations, hold implications for ICT education in other disciplines.

REFERENCES

Aghaee, N., and Keller, C. (2016). ICT-supported peer interaction among learners in bachelor's and master's thesis courses. *Computers and Education, 94*, 276-297. doi:10.1016/j.compedu.2015.11.006

Al Awani, A., Senteni, A., and Singh, A. D. (2016). An investigation about the usage and impact of digital video for learning. Paper presented at the *Proceedings of the European Conference on e-Learning, ECEL, 2016-January* 1-9.

Bai, Y., Mo, D., Zhang, L., Boswell, M., and Rozelle, S. (2016). The impact of integrating ICT with teaching: Evidence from a randomized controlled trial in rural schools in china. *Computers and Education, 96*, 1-14. doi:10.1016/j.compedu.2016.02.005

Berenson, M. L., Levine, D. M., and Krehbiel, T. C. (2012). Basic Business Statistics; Concepts and Applications (12th ed.). USA: Pearson Education limited.

Christiansson, P. (2005). Building Management and ICT learning in Civil Engineering Education. In Soibelman, L. and Peña-Mora, F. (Eds.), *ASCE International Conference on Computing in Civil Engineering July 12-15, 2005*, 1-12. Mexico, Cancun. http://www.it.civil.aau.dk/it/reports/2005_07_asce_cancun.pdf

Czerniewicz, L., and Jaffer, S. (2007). *Partnership for Higher Education Think Tank Conceptual Framework*. http://www.foundation-partnership.org/media/pdfs/elearning_framework.pdf

Isaacs, S. (2007). *ICT in Education in South Africa*. www.infodev.org/en/document.429.aspx

Jones, C. (2008). Education minister encourages ICT learning. *ITWEB November 2008*, http://www.itweb.co.za/sections/computing/2008/0811041044.asp?S=Training%20and%20e-LearningandA=ELRandO=google

Makura, A. (2014). Students' Perceptions of the Use of ICT in a Higher Education Teaching and Learning Context: The Case of a South African University. *Mediterranean Journal of Social Sciences, 5*(11), 43-47.

Molebatsi, M., and Phorah, K. (2016). Incorporating mobile learning in institutions of higher learning in south africa. Paper presented at the *Proceedings - 2015 Annual Global Online Conference on Information and Computer Technology, GOCICT 2015,* 21-25. doi:10.1109/GOCICT.2015.13

Mourshed, M.M., Matipa, W.M., Keane, M., and Kelliher, D. (2003). *Towards Interoperability: ICT in Academic Curricula for Sustainable Construction*. http://buildnet.csir.co.za/cdcproc/docs/3rd/matipa.pdf

Murray, M., Arif, A., and Lai, A. (2002). Possibilities for ICT incorporation in a Construction Management course, *ITC@EDU 1st International Workshop on Construction Information Technology in Education 12 – 13 September*, Slovenia, Portorož. http://www.irbnet.de/daten/iconda/CIB481.pdf

Oyediran, O. S. (2005). Awareness and Adoption of Information and Communication Technology (ICT) by Architectural, Engineering and Construction (AEC) Industry Educators in Nigeria, *Conference on Information Technology in Construction 19 - 21. July*, Germany, Dresden. http://www.irbnet.de/daten/iconda/06069015908.pdf

Ozumba, A. O. U., and Shakantu, W. M. (2008). Improving site management process through ICT, In Verster, J. J. P., and Marx, H. J. (Eds.), *CIDB Postgraduate Conference. Bloemfontein, South Africa, 7 – 8 March 2008*, 22-31. South Africa, Cape Town: Construction Industry Development Board. http://www.cib2007.com/papers/Proceedings%205th%20POST%20GRADUATE%20CONFERENCE.pdf

Ozumba, A. O. U., Dlamin, T. C., and Shakantu, W. M. W. (2010). Information and communication technology education within South African built environment schools. *RICS COBRA Research Conference 10–13 September 2010.* France, Paris: Dauphine University.

Raju, S. V., Raju, M. S. V. S. B., Abbaiah, G., and Gudavalli, M. (2016). Role of ICT in outcome based education. Paper presented at the *Proceedings - 6th International Advanced Computing Conference, IACC 2016,* 815-819. doi:10.1109/IACC.2016.155

Remenyi, D., Onofrei, G., and English, J. (2013). An introduction to statistics using Microsoft Excel, (4th ed.). UK: Academic Publishing Ltd.

Saz, A., Engel, A., and Coll, C. (2016). Introducing a personal learning environment in higher education. an analysis of connectivity. *Digital Education Review,* (29), 1-14.

Smit, D., Wall, J., and Betts, M. (2005). A45 ICT and curriculum design to bridge the gap between industry and academia. *Construction Research Conference of the RICS Foundation – the Australasian Universities' Building Educators Association Conference, 4-8 July 2005*, Australia, Brisbane. http://eprints.qut.edu.au/27345/

Sseswanyana, J., and Busler, M. (2007). Adaptation and usage of ICT in developing countries: case of Uganda firms., December 2007. http://ijedct.dec.uwi.edu/iclude/getdoc.php?id=2232andarticle=349andmode=pdf

Stoltenkamp, J., and Siebrits, A. (2015). The infusion of emerging technologies in complex higher education settings. Paper presented at the *Proceedings of the International Conference on e-Learning, ICEL, 2015-January* 296-304.

Sun, M., and Howard, R. (2004). *Understanding I.T. in Construction*. London: Spon Press.

Tedre, M., Bangu, N., and Nyagava, S. I. (2009). Contextualised IT education in Tanzania beyond standard IT curricula. *Journal of Information Technology Education*. Vol.8, 101-124. http://jite.org/documents/Vol8/JITEv8p101-124Tedre440.pdf

Tinio, V. L. (undated). *ICT in Education*. http://www.saigontre.com/FDFiles/ICT_in_Education.PDF

Wong, K., Wong, K., and Nadeem, A. (2011). Building Information Modelling for Tertiary Construction Education in Hong Kong. *Journal of Information Technology in Construction*, *16*, 467–476.

FACTORS AFFECTING ADOPTION OF COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM AMONG PUBLIC ORGANISATIONS IN NIGERIA

AbdulHafeez Ibrahim[1] and Mustapha Tasiu[2]
[1]*Department of Building/ Faculty of Environmental Design, Ahmadu Bello University, Zaria – Nigeria*
[2]*Afribased Projects Ltd*

Advancements in information and communication technology (ICT) have influenced every facet of life and have made it possible for changes in how industries and organizations work today. A Computerized Maintenance Management System (CMMS) is one of the approaches to implement information technology in maintenance and facility management. The study is to assess the adoption of Computerized Maintenance Management System (CMMS). It also examines the challenges and drivers in adopting CMMS in maintenance management. A structured questionnaire was administered to Maintenance Department of selected Federal owned institutions in Nigeria. Data was analysed using Percentage and Mean and Relative Importance Index (RII). A total of Fifty-four (54) questionnaires were distributed while Thirty-six (36) were returned, giving response rate of 67%. Findings from the study revealed that 62% (majority) of responding organisations still use the manual method of maintenance management. Difficulty in tracking maintenance activities, lack of ease and accuracy of updating maintenance records and difficulty in sorting work request and work order are the challenges organisations are facing in operating a manual maintenance system. The study concludes that lack of awareness of CMMS capabilities, high cost of software and infrastructure, lack of management commitment to implement CMMS and inadequate power supply are the factors militating against the adoption of CMMS in maintenance management among institutions in Nigeria.

Keyword: adoption, computerized maintenance management system, maintenance, Nigeria

INTRODUCTION

Facilities and structures start to deteriorate from the moment they are completed or put in use and from that time they need maintenance in order to keep them in sound condition. According to BS 38811 (1993) maintenance

[1] mscenv10656@gmail.com
[2] mustaphatasiu@yahoo.com

Ibrahim, A. and Tasiu, M. (2017) Factors affecting adoption of computerized maintenance management system among public organisations in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 715-729

is the combination of all technical and associated administrative actions needed to retain a physical asset, or restore it to, a state which it can perform its required function. Maintenance involves the use of scarce resources, hence follows decisions to be made on the level and nature of maintenance expenditure which include cost of labour, materials and miscellaneous expenditure e.g plant, tools and labour.

Information and communication technology (ICT) fundamentally changed the lives of much of the world's population (UNCTAD, 2011). In its various forms, ICT has affected many of the processes of business and how individuals live, work and interact, including the quality of the natural and built environment. One area ICT has also affected is maintenance management. Lee and Scot (2008) asserted that information technology has become a tool to improve building maintenance operations. The application of information technology in maintenance management has over the years changed from being a tool to automate preventive maintenance management, such as task scheduling, plant inventory and stock control or cost and budgeting, to support predictive and proactive maintenance by providing real time data processing, effective communication channels and business function integration. A Computerized Maintenance Management System (CMMS) is a software package that maintains a database of information about maintenance operations. For very small facilities, paper records may be adequate. But in large organisations or where more complex operations are involved, a CMMS can be an invaluable tool to a facilities manager. CMMS is a tool to organize, schedule, and track the details of day-to-day facilities management. Decision makers (DMs) for facility maintenance needs facilities data and information for adequate decision making to achieve optimal results in maintenance quality, time and cost reduction (Abisuga, 2014). This can be achieved through computerized maintenance management system adoption.

Maintenance problem has been a concern to the stakeholders in the built environment. A developing country like Nigeria faced with massive infrastructure deficit is also grappling with deteriorated and obsolete infrastructure due to poor maintenance culture. Akingbohungbe and Akinluyi (2012) declare that maintenance culture is poor towards public infrastructure in Nigeria. Omoregie, Ebohon, and Radford (2005) add that lack of maintenance has been identified as a major factor responsible for infrastructure failure in Nigeria.

Maintenance and facilities management department have been accused of inefficiency in carrying out their duties (Yahaya, 2016). Inefficiency in terms of to lack of proper planning and scheduling has lead to maintenance request backlog and lack of prompt response to request, shortage of spare parts and overworking of maintenance staff. As industries are changing constantly with development of technologies there is need for institutions to adopt Computerized Maintenance Management System (CMMS) to be more efficient.

Most studies on Computerised Maintenance Management System have focused on the manufacturing and oil and gas sectors. Few studied have been carried out on CMMS in the built environment. Jones and Collis (1996) found low use of CMMS in property maintenance among both public and private organisations. The research found that substantial opportunities exist for CMMS implementation in property maintenance. A study by Yahaya (2016) also revealed that many of the organizations that attempt to implement computerized maintenance management system experience difficulties and are not able to achieve the anticipated benefits. The aim of the study to assess factors (challenge and drivers) affecting adoption of computerized maintenance management system among public organisations with a view to enhance adoption in property maintenance management.

The objectives of the study are to:

a) assess the challenges of the manual (paper based) maintenance management.
b) assess the level of adoption of computerized maintenance management system
c) asses challenges to the adoption of computerized maintenance management system; and
d) identify the drivers to adoption of computerized maintenance management System.

LITERATURE REVIEW

E- maintenance/computer-aided facilities management

Information Technology can be used to support decision-making in maintenance management which includes planning activities, selecting policies, scheduling, documentation of history, and predicting facility reliability and maintainability (Lee *et al*., 2013). Al-Qahtani (2012) defined e- maintenance as "maintenance managed and performed by virtue of computing". E-maintenance integrates ICT within the maintenance management. E-maintenance is a maintenance strategy or practice where maintenance tasks are performed through electronics means employing real time data. E-maintenance gives decision makers the ability to automate many of the data-intensive facility management functions and typically results in continuous cost savings and improved utilization of assets through-out their entire lifecycle.

One major advantage of e-maintenance framework is sharing maintenance and logistic information between all stakeholders involved which include management, maintenance engineers and department, and the users which could be used to analyse, predict and support future maintenance decisions (Vasiljevic *et al.,* 2012). Computer-Aided Facilities Management (CAFM) includes the creation and utilization of Information Technology (IT) based

systems in the built environment (Watson and Watson, 2013). According to Dewulf (2000) computer aided facility management means software and systems that enable facility managers to increase the utilisation of space and facilities, reduce office/building moves and reallocations, plan preventative maintenance, efficiently execute reactive maintenance, standardise services, and streamline processes. Ultimately, information from CAFM software allows managers to improve long term planning of real estate, space, facilities, maintenance, and service requirements against budgets to ensure alignment with core business needs.

Adoption of Computerized Maintenance Management System

Challenges have been faced by organisations using the manual method of maintenance management. According to Chauhan and Singh (2016) challenges of manual maintenance management includes; lack of maintenance records, difficulty analysing and reporting, difficulty in drawing out work plan, difficulty in preserving and updating maintenance data and lack of ease in preparing maintenance plan. Azeez (2012) also posit that lack of quick accessibility, difficulty in simultaneous document sharing, incorrect or lack of filling system, lack of ease and accuracy of updating records, requirement of storage space, and high staff turnover required to handle cumbersome record are challenges faced in traditional record management. Information technology have can provide solutions to some of these challenges through CMMS adoption (Tse, 2002; O'Donoghue, and Prendergast, 2004)

Using correct strategies of maintenance management systems is beneficial not only to reducing maintenance cost but also for increasing productivity of limited resources (Beni, 2014). One of such strategies is adoption of CMMS. Maintenance optimization is greatly facilitated when companies adopt a World Class Maintenance (WCM) philosophy or management strategy in conjunction with CMMS implementation (Fouad *et al*., 2012). CMMS software was first seen in the 1970's. Today it is widely used in manufacturing plants all over the world.

Barriers to CMMS implementation

It has been reported in the literature that computerized maintenance management system implementation is not an easy task by any means. The failure of computerized maintenance management system implementation in medical equipment management was due to lack of commitment to implement CMMS, budget limitation, lack of IT infrastructure and limited feed back in case of locally developed CMMS (WHO, 2011). According to Chauhan and Singh (2016) challenges of manual maintenance management in manufacturing includes; lack of maintenance records, difficulty analysing and reporting, difficulty in drawing out work plan, difficulty in preserving and updating maintenance data and lack of ease in preparing maintenance plan. Sullivan (2010) investigated computerized maintenance management system implementation among maintenance organisation and found that improper selection of computerized maintenance management system vendor, inadequate training of the staff on proper use of the computerized maintenance management system, lack of commitment to properly

implement the computerized maintenance management system and lack of commitment to persist in computerized maintenance management system use and integration were the challenges being faced.

Further, Ahuja (2008) studied six (6) challenges in adopting Total Productive Maintenance a similar maintenance technique. The obstacle faced by the organizations have been categorized into organizational (lack of commitment from top management), cultural(inability to align employees to organizational goals and objectives), behavioural (resistance from employees to adapt to the new concept and changes), technological (lack of training on new technologies), operational (Absence and lack of implementation of standard operating procedures), financial (include inability of top management to support improvement initiatives due to insufficient resources), and departmental obstacles (reluctance of production operators to accept autonomous maintenance initiatives as part of their routine jobs.).

Drivers to Enhance Computerized Maintenance Management System Adoption

In order to realize the true potential of CMMS and ensure successful CMMS implementation, CMMS goals and objectives need to be fully integrated into the strategic and business plans of the organization because CMMS affects the entire organization. Long (2000) declare that upper management must champion the cause and commit the resources to ensure a successful implementation. Without full support from all participants within the organization, failure is imminent from the start. Every person involved must buy into the program and want to realize the benefits that it can provide.

Factors that could enhance adoption according to WHO (2011) include detail search on available solution before purchasing a package, need for more awareness, proper budget allocation, developing local CMMS and establishing internal feedback and update mechanism for locally developed systems. Factors that could enhance CMMS adoption are increasing awareness and education on the use of CMMS and advantages to maintenance management/facilities management among stakeholders in maintenance management, software affordability, improved power supply in the country, proper communication with stakeholders before adoption and vendor support (Yahaya, 2016).

RESEARCH METHOD

The research looks into the adoption of computerised maintenance management systems in maintenance departments of public institutions in Nigeria. A quantitative research method was adopted for the study. A structured questionnaire were administered to head of maintenance department of public (government owned) organisation within Abuja. Abuja is the capital of Nigeria where majority of the headquarters of Ministries Department and Agencies are located (MDA). Questionnaire was used in a study by Jones and Collis (1996) where he examined the use of computerised

maintenance management among organizations. A questionnaire was also used by Ahuja and Khamba (2008) while assessing strategies and success factors for overcoming challenges in Total Productive Maintenance (TPM) implementation in Indian manufacturing industry.

The questionnaire administered assessed adoption of CMMS, benefits to be derived from adoption, challenges, drivers and the challenges of manual maintenance management system in building maintenance and facilities management. The four point Likert-scale (Strongly agree to strongly disagree) adopted was analysed and transformed into mean, RII and then ranked appropriately. The questionnaire was tested using a pilot survey. The questionnaires were initially completed by a small sample of respondents in order to have an opportunity to test the prepared questionnaire before decision was taken on the final version. Fellow and Lui (2007) suggested that all questionnaire should initially be piloted.

The sampling size was determined based on the formula Cochran's formula for calculating sample size when the population is infinite (Cochran, 1977) because the number of public institutions within the study are couldn't be determined.

$n= (z^2pq)/ d^2$ ---------- 1

where; n = the desired sample size

z = the ordinate on the Normal curve corresponding to α or the standard normal deviate. For the purpose of this study, a confidence level of 90% will be adopted.

Usually a 90% level of confidence has $\alpha = 0.10$ and critical value of $z_{\alpha/2} = 1.64$.

P = the proportion in the target population estimated to have particular characteristic (normal between the range of 0.1 - 0.5)

q = 1.0-p

d = degree of accuracy corresponding to the confidence level and Z selected.

Consequently, the sample size is determined as thus, z = 1.64 d = 0.1 p = 0.3 q =0.7

Hence,

Sample size $n = [(1.64)^2 \times 0.3 \times 0.7]/ (0.1)^2 = 56$

The study administered fifty-six questionnaires.

Out of the fifty three questionnaires administered thirty-six were retrieved and found worthy to be included for analyses.

ANALYSIS AND RESULT

Maintenance policy

The study looked into the type of maintenance policy adopted by the respondents' institutions. As seen in Table 1. Most (47%) organisations adopt the reactive maintenance policy. 17% use the planned maintenance policy while 36% combine both the predictive and reactive maintenance policy. A combination of both the reactive and the predictive maintenance policy is good. Maintenance has to be planned (proactive) and should also be able to react to failure or breakdown when it occurs. Having a balance between the two is very important. Maintenance management is shifting to more of preventive and predictive maintenance as suggested by Mutwale and Mainda (2017) because reactive maintenance gives slow result and leads to inefficiency.

Table 1: Type of Maintenance policy

Maintenance policy	Frequency	Percentage (%)
Planned/Predictive	6	17
Unplanned/reactive	17	47
Combination of both	13	36
Total	36	100

Maintenance management system

On the maintenance management system used by the organisations, 44% of respondents indicate that they still use the paper based manual system, 36% of organisation use automated or the electronic system while 7% use both.

With the adoption of Information Technology (IT) in every facet of life, maintenance management shouldn't be left behind. Improved adoption of IT in maintenance management is a welcome development. There is need for improvement in adoption as 64% of respondents still use the paper based system.

Table 2 Maintenance/facilities management system

Maintenance/ Fac. Management System	Frequency	Percentage (%)
Manual	16	44
Automated	13	36
Automated and Manual	7	20
Total	36	100

Challenges of the manual maintenance management method

The study assesses the challenges of the manual method of maintenance management which most organisations use (as shown in Table 3).

Table 3: Challenges of Manual (paper based) Method of Maintenance management

	Challenges	4	3	2	1	∑f	∑fx	Mean	RII
1	Difficulty in tracking maintenance activities (work order and request)	29	3	2	2	36	133	3.69	0.92
2	Lack of ease and accuracy of updating maintenance records	27	4	3	2	36	128	3.55	0.89
3	Poor maintenance record and history	28	2	4	2	36	128	3.55	0.89
4	Lack of quick accessibility to records	22	6	7	1	36	121	3.36	0.84
5	High percentage of reactive maintenance	12	15	8	1	36	110	3.05	0.76
6	Large space requirement in traditional maintenance record management system	11	10	7	8	36	96	2.67	0.66
7	High staff turnover required to handle cumbersome record	9	15	6	6	36	91	2.53	0.63
8	The storage of maintenance data is in hardware's (paper documents cumbersome	3	9	11	13	36	75	2.8	0.52
9	High cost of maintenance work	2	6	10	18	36	64	1.78	0.44

It is evident from Table 3 that difficulty in tracking maintenance activities (RII=0.92), lack of ease and accuracy of updating maintenance records (RII=0.89), poor maintenance record and history (RII=0.89) and lack of quick accessibility to records (RII=0.82) where the most significant challenges faced by organisations using the manual maintenance management system.

Computerised Maintenance Management System Awareness

Regarding the awareness of Computerised maintenance management systems (as shown in Table 4) most institutions 78% are aware of CMMS, only 22% lack of awareness of CMMS. This shows that CMMS is not new to the institutions. Awareness is key to implementing change to any process (CMMS). Institutions being aware of computerised maintenance management systems are a step in the right direction to adopting or moving towards a computerised maintenance management system.

Table 4: CMMS Awareness

Level of Awareness	Frequency	Percentage (%)
Aware	28	78
Not aware	8	22
Total	36	100

Implementation of Computerised Maintenance Management Systems

On the implementation of CMMS in maintenance management of respondents organisation 78% of the responding institutions have not implemented computerized maintenance management system before (as seen in Table 5). This shows that there is low adoption of Computerised

maintenance management systems. This is one of the aims of the study because anecdotal evidence had earlier shown that CMMS implementation is low among public organisations in Nigeria.

Table 5: Adoption of CMMS

Level of Adoption	Frequency	Percentage (%)
Have implemented before	8	22
Have not implemented	28	78
Total	36	100

Benefits of adopting CMMS

To further explore the awareness of CMMS the study also probed into the benefits of adopting a CMMS. The results are shown in Table 6. Respondents believe that higher level of planned maintenance activities that enables a more efficient use of staff resources (RII=0.86), Enhanced performance and reduce stress associated with manual computation and documentation (RII=0.81), better work request and work order management (RII=0.79) and better inventory control and spare parts forecasting to eliminate shortages and minimize existing inventory (RII=0.71) are the benefits to be derived from implementing CMMS.

Table 6: Benefits to be derived from adopting CMMS

	Benefits	4	3	2	1	∑f	∑fx	Mean	RII
1	Achieving a higher level of planned maintenance activities that enables a more efficient use of staff resources.	18	17	0	1	36	124	3.44	0.86
2	Enhance performance and reduce stress associated with manual computation and documentation	18	10	6	2	36	116	3.20	0.81
3	Better work request and work order management	12	18	6	0	36	114	3.10	0.79
4	Better inventory control and spare parts forecasting to eliminate shortages and minimize existing inventory.	12	9	13	2	36	103	2.86	0.71
5	Detection of impending problems before a failure occurs resulting in fewer failures and customer complaints.	9	17	8	2	36	97	2.69	0.67
6	Improved safety and environmental compliance	11	6	14	5	36	95	2.64	0.66
7	Better maintenance management of project	13	6	16	1	36	93	2.58	0.64

Feature required in CMMS

Respondents were asked to rank the features they most require in a Computerised Maintenance Management Systems. Result from Table 8. Shows that managing work request and order (RII=0.89), planning and scheduling function (RII=0.84), Managing a preventive maintenance programme (RII=0.78), Inventory planning/control (RII=0.75) and tracking labour resources (RII=0.80) are the most required feature by institutions.

This finding shows that managing work order and request is a challenge being faced by maintenance departments, the ability of CMMS to manage this is a feature organisation are looking forward to. Organisations are also looking at more of planned maintenance management which is also one of the major capabilities of CMMS, This finding is in line with a study by Raouf, (1994) where work order management and preventive maintenance management were the most significant features being used in computerised maintenance management systems.

Table 7. Required feature in CMMS

	Features	4	3	2	1	∑f	∑fx	Mean	RII
1	Managing Work request and order	26	6	2	2	36	128	3.55	0.89
2	Planning and scheduling function	22	6	7	1	36	121	3.36	0.84
3	Managing a preventive maintenance programme	19	7	4	6	36	111	3.08	0.78
4	Inventory planning/control	10	18	6	2	36	108	3.00	0.75
5	Track labour resources	11	10	13	2	36	108	3.00	0.75
6	Equipment Management	8	12	13	2	36	97	2.68	0.67
7	Facilities Management Contract	10	7	15	4	36	95	2.64	0.65
8	Key performance indicators metrics KPI	5	10	7	14	36	85	2.36	0.59
9	Purchasing	2	13	9	12	36	77	2.14	0.54
10	Budget and cost analysis	1	14	9	12	36	76	2.11	0.53

Barriers to CMMS adoption

Respondent were asked to rank, the challenges that has affected the adoption of CMMS. Result shows that five major factors were ranked highest. These factors are: Lack of awareness of CMMS capabilities (RII=0.84), High cost of software and implementation (RII=0.83), lack of management commitment to implement CMMS (RII=0.79), Inadequate power supply (RII=0.75) and Lack of trained professional to handle the tool (RII=0.73).

Management of organisations are key to adoption a new process or practice. Most management are not aware of the capabilities and advantages of implementing CMMS. They many resist and find it difficult to approve its implementation. The high cost of both the software and the infrastructure to implement a CMMS is a major challenge. If they were cheaper it could have been to sell to management to approve adoption. It cost thousands of

dollars to implement a CMMS. Inadequate power supply is a major challenge, as the system need to be online 24hrs to be effective and work optimally.

Table 8: Barriers to CMMS adoption

	Barriers	4	3	2	1	∑f	∑fx	Mean	RII
1	Lack of awareness of CMMS capabilities	19	10	4	3	36	121	3.36	0.84
2	High cost of software and implementation	21	8	4	3	36	119	3.30	0.83
3	Lack of management commitment to implement CMMS	19	7	6	4	36	113	3.14	0.79
4	Inadequate power supply	16	7	10	3	36	108	3.00	0.75
5	Lack of trained professional to handle the tool	13	9	12	2	36	105	2.92	0.73
6	Resistance to change	4	18	10	4	36	94	2.60	0.65
7	Lack of technical knowledge of personnel	3	10	20	3	36	85	2.36	0.59
8	Complexity of the programme	6	18	10	2	36	82	2.27	0.57
9	Inadequate internet connectivity to all parties	4	9	10	13	36	76	2.11	0.53
10	Unavailability of required digital technologies	5	6	10	15	36	73	2.03	0.51
11	Lack of clearly defined objectives before adoption	3	8	4	21	36	56	1.81	0.45

Drivers to adoption of CMMS in maintenance management practice

Table 9 is the result of the drivers of CMMS adoption in maintenance management practice as found in the survey.

Table 9: Drivers to adoption of CMMS in maintenance management practice

	Support service	4	3	2	1	∑f	∑fx	Mean	RII
1	Software affordability	25	10	1	-	36	132	3.66	0.92
2	Increased awareness on the capability and merits of CMMS among stakeholders	23	8	4	1	36	125	3.47	0.87
3	Management support	20	13	2	1	36	124	3.40	0.86
4	Availability of well trained professionals to handle CMMS	21	12	1	2	36	124	3.44	0.86
5	Increased vendor support in adoption.	17	10	8	1	36	115	3.19	0.80
6	Communication with stakeholders	17	10	6	3	36	113	3.13	0.79
7	Improved and stable power supply in the country	19	7	4	6	36	111	3.08	0.77
8	Choosing the right software package	15	12	3	6	36	108	3.00	0.75
9	A user friendly software	9	17	8	2	36	97	2.69	0.67
10	A fully defined maintenance work process	11	6	14	5	36	95	2.63	0.66
11	Proper selection of vendor	2	9	16	9	36	84	2.3	0.58

It is evident from Table 9 that there is a consensus of opinion among respondents on five (5) factors can enhance adoption of CMMS in maintenance management with RII of 0.8 and above. They are software affordability (RII=0.92), increase awareness on the capability and merits of

CMMS among stakeholders availability of well trained professionals to handle CMMS (RII=0.86), management support (RII=0.86), and increased vendor support in adoption (RII=0.80).

DISCUSSION AND CONCLUSION

Many organisations are facing challenges using the paper based manual maintenance management system. The study concludes that the challenges of the manual method of maintenance management are difficulty in tracking maintenance activities, lack of ease and accuracy of updating maintenance records, poor maintenance record management and history and lack of quick accessibility to records. The challenges of the manual maintenance management system come with most of the challenges of using a paper based system of record management. This also comes with the difficulty of updating, tracking and retrieving information and records which in this case are work order, request.

It was found that adoption of CMMS by maintenance and facilities management departments of Public organisations is low. Even though they are quite aware, this shows that there are challenges being faced in adoption. This finding is in line with Jones and Collis (1996) where they posit that there was low implementation of computerized maintenance management system in property management.

Computerized Maintenance Management System implementation is not an easy task by any means. Lack of awareness of computerized maintenance management system capabilities, high cost of software and infrastructure, lack of management commitment to implement computerized maintenance management system and inadequate power supply are the factors militating against the adoption of computerized maintenance management system in maintenance management among public institutions in Nigeria. Lack of awareness of CMMS capabilities and lack of management commitment to implement CMMS are organizational obstacles affecting the successful CMMS implementation. The high cost of software and infrastructure are financial constrain been face. The cost of implementation is quite high which requires strong management commitment. Inadequate number of trained professional to handle the tool, poor power supply are technological constrains. While resistance to change is a behavioural obstacle because people may be use to performing task in a certain way and may disregard better and more efficient methods especially if they believe the system is working method. These challenges (Organisational, behavioural, financial and technological) are not unique to CMMS, similar challenges are faced in adoption Total productive maintenance in a study by Ahuja and Khamba (2006).

The key enablers and drivers of CMMS adoption from the study are software affordability, availability of well trained professionals to handle CMMS, management support and merits of CMMS among stakeholders, and increased awareness on the capability and increased vendor support in adoption. The CMMS software is expensive; making it affordable could drive

adoption of CMMS because management would usually support software packages that are affordable. Local developers can develop affordable software's. Availability of well trained professionals to help in training the users would help in easing the implementation. The successful implementation of computerized maintenance management system like any other programme or policy requires top management support, commitment and involvement. Management of the organisations needs to have a strong commitment to CMMS implementation program and should go all-out for evolving mechanisms for multi-level communication to all stakeholders explaining the capability, benefits and merits of implementing CMMS thereby propagating CMMS to employees by linking CMMS to the overall organizational maintenance management strategy. When all stakeholders are on the same page, adoption is easier. Increase vendor support in adoption is in line with Raouf (1993) where vendor support was found to be a key driver to successful implementation of CMMS.

The application of the system will be possible if the institution's and their maintenance or facilities management departments are committed to its implementation by providing adequate funding for maintenance purpose and installation of necessary digital technology required. Also, technical knowledge of the stakeholders about the system is vital this makes having well trained professionals and training of maintenance personnel very important. The epileptic power supply shows the need for constant electrical power supply for an effective operation of the system which seems impracticable for now in the country, but most institution's generate power through alternative power sources especially during working hours when there is outage.

Computerised maintenance management systems have the potential to improve maintenance management practice as it has been show in various studies, therefore adopting it in maintenance management in the built environment is a step in the right direction. Organizations also need to strategically integrate proactive maintenance initiatives into their maintenance policy and strategies which would successfully boost their organization's productivity, improve maintenance performance, reduce costs, minimize unnecessary downtime, and ensure better utilization of resources.

REFERENCES

Abdul-Azeez, A.D. (2012). Developing a prototype electronic document and record management system (EDRMS) for small and medium building firms. Unpublished Dissertation, Department of Building. Ahmadu Bello University Zaria.

Abisuga A.O. (2014). Decision Support System Approach to Facilities Maintenance Management of University Buildings in South-West Nigeria. Proceedings of the CIB W107 2014 International Conference, Lagos, Nigeria,124-133

Ahuja, I.P.S. & Khamba, J.S. (2008). Strategies and success factors for overcoming challenges in TPM implementation in Indian manufacturing industry. Journal of Quality in Maintenance Engineering, 14(2), 123 –145

Akingbohungbe, D. & Akinluyi, M., 2012. Residents' Perception of Off-campus Students' Housing Performance in Ile-Ife, Nigeria. Journal of Environment and Earth Science, 2(7), 69-77.

Al-Qahtani, M. S. (2012). Information and Communication Technology Infrastructure in E maintenance eKNOW 2012: The Fourth International Conference on Information, Process, and Knowledge Management 7-11.

Beni, S. S. (2014). Implementation of Computerized Maintenance Management System in National Iranian Gas Company and sub-companies Proceedings of the 2014International Conference on Industrial Engineering and Operations Management Bali, Indonesia

British Standard 3811 (1993) British Standard Glossary of terms

Chauhan, S.P. & Singh, S. (2016). Study of Computerized Maintenance Management System (Cmms) And Computer Aided Maintenance Planning (Camp) In Production System. International Journal of Scientific & Engineering Research, 7(12) pp 315-318

Dewulf, G. (2000). Successful Corporate Real Estate Strategies. Arko Publishers, Nieuwegein.

Fellow, R. and Liu A.A. (2007) Research Methods for Construction. Second Edition. Blackwell science Ltd. Oxford London.

Fouad, R. H., Rawashdeh, M., AL Bashir, A and AL-Sharif, B. (2012). Designing a computerized maintenance management system for medical devices in royal medical services. IJRRAS 10 (1). 115-118

Garg, A, & Deshmukh, S.G. (2006). Maintenance management: literature review and directions, Journal of Quality in Maintenance Engineering, 12(3), 205 – 238

Jones, K. and Collis, S. (1996). Computerized Maintenance Management Systems Property Management, 14(4), 33-37.

Lee, H. J., Lee, M. S., Lee, S. H., Oh, S., Kim, B. H., Nam, S.H and Jang, J.S. (2013). Development of Computerized Facility Maintenance Management System Based on Reliability Centered Maintenance and Automated Data Gathering. International Journal of Control and Automation 6 (1)

Lee, Y. H. H. & Scott, D. (2009). Overview of Maintenance Strategy. Journal of building Appraisal, 4: 269-278.

Long, B, (2000). Why CMMS implementations fail. Retrieved from http://www.plantengineering.com/single-article/why-cmms-implementationsfail/b1e909088db1f3e41b17b14d321bfebd.html

Mutwale, J. and Mainda, N. (2017). Assessing of the Adequacy of Maintenance Activities in Public Higher Learning Institutions: A Case Study of the Copperbelt University. Joint CIB W099 and TG59 international safety, health and people in construction conference. Towards better safety, health, wellbeing and life in construction, Cape Town South Africa, 265-274.

O'Donoghue, C.D. & Prendergast, J.G. (2004). Implementation and benefits of introducing a computerised maintenance management system into a textile manufacturing company. Journal of Materials Processing Technology 153–154,

Raouf, A., Ali, Z & Duffuaa, S.O. (1993). Evaluating a Computerized Maintenance Management System, International Journal of Operations & Production Management, 13 (3), 38 - 48

Sullivan, G. P., Pugh, R., Melendez, A. P. & Hunt, W. D. (2010). Operations &Maintenance Best Practices A Guide to Achieving Operational Efficiency Release 3.0 Efficiency Solutions, LLC.

Tse, P.W. (2002). Maintenance practices in Hong Kong and the use of intelligent scheduler, Journal of Quality in Maintenance Engineering, 8(4),359-380

United Nations Conference on Trade and Development (UNCTAD). (2011). Measuring the Impacts of Information and Communication Technology for Development. UNCTAD Current Studies on Science, Technology and Innovation. United Nations New York and Geneva.

Vasiljevic, D., & Cvetic, B. (2012). Towards a new conceptual framework of e-maintenance. South African Journal of Industrial Engineering, 23(2), 73-83.

Yahaya, U. (2016). An Assessment of Readiness of Maintenance Department of Selected Federal Institutions in Kaduna State to Adopt Computerized Maintenance Management System. Masters thesis, Ahmadu Bello University Zaria.

World Health Organisation (2011). Computerised Maintenance Management. WHO Medical Device Technical Series.

FACTORS INFLUENCING SUSTAINABILITY OF RURAL SANITATION PROJECT OUTCOMES: A PILOT STUDY ON THE PERCEPTIONS OF IMPLEMENTERS

Aghaegbuna Obinna U. Ozumba[1], Maxwell Zukani[2], Winston Shakantu[3] and Chineme Ozumba[4]

[1]*School of Construction Economics and Management, University of the Witwatersrand, 1 Jan Smuts Ave. Johannesburg, 2050, South Africa*

[2,3]*Department of Construction Management, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

Department of Construction Management, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

[4]*Department of Public Health, Monash University, Ruimsig, South Africa*

The paper reports on findings from a pilot study to explore factors affecting the sustainability of sanitation projects in rural communities in South Africa, with a focus on the perceptions of implementers within the OR Tambo District, Eastern Cape Province. Concepts explored include Environmental health, sanitation, sustainability, rural community development, project management, project life cycle, and the water – sanitation nexus. On the basis of deductions from literature review a survey research strategy was utilised for field work. Questionnaires were administered to a randomly chosen sample of implementers from the target area. An analytical procedure, designed for robustness was applied, which included categorization; the use of means, medians, interquartile ranges, and proportioning; Spearman's Rho chi square; and analysis at both individual item and category levels. Findings reveal key factors that are critical to the sustainability of rural sanitation facilities, their relative significance, and possible associations with various groups of respondents, and the possibility of other deterministic factors which are not included in the criteria for the current research. The study highlights very significant sustainability factors for such development projects for rural communities and patterns of ranking for relative severity of the factors.

Keywords: development, health, project, rural, sanitation, sustainability, South Africa.

[1] Obinna.ozumba@wits.ac.za

[2] Maxwell.zukani@nmmu.ac.za

[3] Winston.shakantu@nmmu.ac.za

[4] chineme.ozumba@monash.edu; chinemeozumba@gmail.com

Ozumba, A. O., Zukani, M., Shakantu, W. and Ozumba, C. (2017) Factors influencing sustainability of rural sanitation project outcomes: a pilot study on the perceptions of implementers *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 730-749

INTRODUCTION

The research interest for the authors is the apparent failure or lack of sustainability in rural development projects, especially pertaining to environmental health. In this case we are concerned with the provision of sanitation services in rural communities. For this study, environmental health is defined as focusing on "*the physical, chemical and biological factors external to a person and all the related factors…*" which impact on the behavior of actors, and potentially influencing health outcomes. Some of these factors include water, waste water, excreta (World Health Organisation, 2016). The environmental health factor in focus for the study is human waste or excreta and the projects in question are sanitation services. Sustainability or sustainable Development is defined as; "*…that development that meets the needs of the present without compromising the ability of future generations to meet their own needs, and improving the quality of lives while staying within the carrying capacity of the supporting ecosystems*" (United Nations (UN), 1992). This approach to development would minimise breakdown, cost and any negative environmental impacts, while maximising the positive social impact (UN, 1992). Sustainability is therefore essentially multi-dimensional in nature. Arguably the concept can be extrapolated to various core environments and sub-environments. Thus, a sustainability perspective could be used to explore factors which influence projects, such as sanitation projects. The term sanitation can be defined as the provision for safe disposal of human biological waste (Cairncross and Valdmanis, 2006). The provision of sanitation can also be viewed from a sustainability perspective as a service that protects and promotes human health, while not contributing to environmental degradation. It should therefore be a technically and institutionally appropriate, economically viable, and socially acceptable service (Stockholm Environmental Institute (SEI), 2009). This position substantially informs the focus of the paper on a sustainability perspective to the provision of rural sanitation.

Background to the study

Sustainable development applies across local, regional, and international dimensions and particularly in the need for sustainable rural development, in the case of developing countries (Zolfani and Zavadskas, 2013). Sustainable rural development can be described as the application of the principles of sustainable development, in rural development (Cawley and Gillmor, 2008). Characteristics of rurality include: low population density, value of economic activity and physical development; and poor access to services (Hoggart, 1988); environmental degradation (Bilsborrow, 2002); health issues (Tanya, et al., 2007; Havenaar et al. 2008); water issues (Kahinda et al., 2007); sanitation problems (Montgomery et al., 2009); role of local character (Keller, 2000); and extreme poverty (Houngbo, 2014). There is therefore inarguable need for development in rural places or sectors of society. Pugliese (2001) and Borec and Turk (2009) consider initial approaches to rural development as failed attempts. Apart from other factors which pose challenges to rural development, the need for infrastructure and amenities, which include sanitation services, is

highlighted in literature. See Nair (2014); Namdar and Sadighi (2013); Okyi (2003); Van Schalkwyk (2015); Ojonemi and Ogwu (2013); and Zolfani and Zavadskas (2013). The peculiar needs of sustainable rural development are emphasised in the five critical factor groups highlighted by Akgüna et al. (2011): Physical system, Social system, Economic system, Locality system, and Creative system. In this study, we focus on the physical system group which is made up of the built environment, infrastructure, technology and accessibility, including sanitation.

The UN Sustainable Development Goals (SDG) is focused on sustainable development and transformation of all people and nations of the world, through the implementation of the 17 SDGs of the 2030 Agenda (UN, 2015), including clean water and sanitation. The need for sustainable sanitation service is embodied in MDGs especially Target 7C (UN, 2016); while the UN Agenda 21 provides a general framework for examining the sustainability of projects, which include the following keywords: Equitable access to resources and opportunities; enablement of sustainable livelihoods, appropriate ethical principles; society with good governance; positive human development; acceptable quality of life; protection of the geo-physical environment and natural resources; sustainable resource use; and support for the earth to support acceptable quality of life for human beings in perpetuity (UN, 1992). The stated keywords can be logically linked to sustainable provision of sanitation services, especially when considering the need for sound environmental health with environmental sustainability, which fits well with the social and economic realities of rural communities. In addition, the need for sustainable sanitation service is embodied in MDGs such as: Eradicate extreme poverty and hunger; Promote gender equality and empower women; Reduce child mortality; Improve maternal health; Combat HIV/AIDS, malaria and other diseases; and Ensure environmental sustainability. Furthermore, provision of sanitation service would minimise disease and positively influence environmental sustainability and the reduction of child mortality. Moreover, eradication of extreme poverty is also linked to sanitation issues which could cause illnesses resulting in reduced productivity, costly health care, and ultimately contribute to poverty (UNDP, 2010). The MDG Target 7C also states: "*Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation*" (UN, 2016).

The UN SDGs re-affirm the above stated needs, while highlighting the linkage between water and sanitation, and the need for stakeholder involvement, which relates to community participation. The stance is buttressed by the following SDGs: End poverty in all its forms everywhere; Ensure healthy lives and promote well-being for all at all ages; Achieve gender equality and empower all women and girls; and Ensure availability of clean water and sanitation service (UNDP, 2017).

However, UNICEF and WHO estimated that about 2.6 billion of the human population lack satisfactory sanitation, which is linked directly to about a tenth of the global burden of disease (Mara et al., 2010; Moe and Rheingards, 2006). According to UNDP (2006) tackling the sanitation crisis will require

more awareness of the scale of cost which the deficit would create, and a wider recognition that sanitation is a basic right. It is described as a necessity for communities living in poverty, with ailments such as HIV and TB. Montgomery et al. (2009), states that the improvement to public health, promotion of economic development, and reduction of poverty, is significantly linked to sustainable basic sanitation. Batram and Cairncross (2010) support the notion of prioritising the public health implications of poor sanitation, hygiene and water supply, describing them as a substantial burden. Mara et al. (2010) argue that, the impact of poor sanitation extends to social and economic environments of life. Montgomery and Elimelech (2007) also support the notion of substantial lack of proper sanitation and quality water supply in developing parts of the world, with appreciable health implications. At a global level, lack of sustainable water and sanitation services was identified as an inhibitor towards achieving the MDGs. Such limitations deny the most economically disadvantaged, particularly women and girls, their health and dignity (SEI, 2009). In addition, high rates of absenteeism and dropouts of girls from school have been linked to inadequate sanitation facilities and lack of separate facilities for girls of puberty age (Adukia, 2014; Jasper et al., 2012).

It has been noted that there is a general stunting in the pace of progress at providing infrastructure for rural prosperity in Africa (Economic Commission for Africa (ECA), 2013). Other influencing factors suggested in extant literature include: motivation, maintenance, cost recovery, and continuing support Carter *et al.* (1999); appropriate technology choice, social marketing, local borrowing and saving schemes, financial planning, community cross-subsidies, accessible and reliable spare parts; skilled repair technicians; continuous monitoring, evaluation and technical support, management support, and dynamic operations and maintenance (UNDP, 2006); health and hygiene, environmental and natural resources, operation, economics, socio-cultural and institutional arrangements (The Sustainable Sanitation Alliance, 2011); clear division of stakeholder responsibilities (Sustainability Environmental Institute (SEI), 2009); and community led total sanitation (Sah and Negussie, 2009). These factors would arguably work against the sustainability of rural sanitation projects, which will create inequity in the overall outcomes. The Global Water Supply and Sanitation Assessment 2000, highlights the inequity in access between advanced and developing countries, and between urban and rural areas. One of the highlighted places is rural Africa (United Nations Environment Programme (UNEP), 2008), part of which is located in South Africa. In terms of solutions proffered, Moe and Rheingards (2006) highlight the need for innovative low-cost sanitation systems, sustainability in the provision of water supplies and sanitation, reduction of disparities in access to water and sanitation globally and regionally, and financial sustainability of such services. Similarly, Montgomery and Elimelech (2007) emphasised that collaboration and sustainability, constitute the path forward for addressing challenges to the provision of rural sanitation services. In view of the peculiar context of rural areas in terms of sanitation, the challenges and

solutions proffered, and identified sustainability factors; there is the need to understand the implementation at the rural community level.

Setting of the study

South Africa has the legislative framework that should enable improvements in the provision of access to water and sanitation. The right of access to basic sanitation services in enshrined in The Constitution of South Africa (Act no.108) (1996)(The Republic of South Africa, 1996); policy on sustainable approach to the provision of water and sanitation (Department of Water Affairs and Forestry (DWAF), 2001); strategic framework for water services (DWAF, 2003); free basic sanitation strategy of 2009 (DWAF, 2009); and guidelines for human settlement planning and design of 2000 (CSIR Building and Construction Technology, 2000). However, there is appreciable lack of water and sanitation services in South Africa, especially in the rural areas Phaswana-Mafuya (2006). In 1994, essentially 52% of households in South Africa were without sanitation facilities. About 31% reduction in the backlog was achieved by 2010(UNDP, 2010). Rural provinces share the highest sanitation backlog; Eastern Cape (17.0%), Limpopo (7.9%) and Northern Cape (7.6%) (Statistics South Africa, 2011). Phaswana-Mafuya (2006) identified five major groups of challenges pertaining to sanitation in rural South Africa: Structural, economic and financial, educational, social, and technical challenges.

From the foregoing, the enabling framework for the delivery of basic sanitation, especially to rural South Africa, is apparently underutilised. The ultimate result of not addressing identified influencing factors would be poor sustainability outcomes in the project life cycle. Within a project's life cycle there are phases of development from initiation to closure (PMBOK, 2013). Our position is that Implementation of basic sanitation in rural areas would benefit from the application of sustainability principles across the project life cycle, especially if the influencing factors and their relative severities are known. Thus, the following research question is posed:

"What is the application of sustainability principles to the provision of rural sanitation in South Africa?"

To answer this question, information is required from extant literature on South Africa, which address the operationalization of sustainability principles in the provision of rural sanitation in South Africa. However, there is scarcity of information from South Africa in this context. The study was therefore aimed at identifying and exploring factors influencing the sustainability of sanitation projects in rural South Africa.

METHODS

For the purpose of the field work, I was necessary to collect data for an essentially descriptive line of questioning and to evaluate the relative significance of identified factors. A survey strategy by questionnaire was chosen, considering the need to obtain facts and opinions about a phenomenon from people who are informed about the particular issue (Strydom et al., 2002). The questionnaire was designed with a view to

producing instruments that can be used to obtain accurate and non-biased information from respondents (Leedy and Ormrod, 2010).

The scope of the study accommodates implementers. The study aim was to obtain the views of implementers that are knowledgeable and involved in rural sanitation projects, as unit of observation. The unit of analysis is made up of factors affecting sustainability in the life cycle of sanitation projects. The study focused on the O.R. Tambo District Municipality area, specifically looking at the Ventilated Improved Pit (VIP) toilet technology sanitation projects constructed within the rural wards of King Sabata Dalindyebo Local Municipality (KSD). The KSD is one of the five rural municipalities under the O.R. Tambo District Municipality, in the hinterland of the Eastern Cape Province (KSD Municipality, 2016).

Data collection, ethics and sampling for the study

In observance of relevant ethical codes, rules of anonymity, confidentiality, voluntary participation and informed consent were adhered to (Strydom et al., 2002). The questionnaire consisted of two sections; general and demographic details, and respondents' views of identified sustainability factors for sanitation project outcomes. The survey instruments were distributed through email and fax. A list of email addresses for possible respondents was obtained from the Eastern Cape Department of Local Government in Bisho, and from the O.R. Tambo District Municipality records. A pool of possible participants was created with role players in such projects between 2005 and 2010. The final sample of respondents was randomly selected, following Leedy and Ormrod (2010), from the originally pool. The final sample consisted of 50 individuals. Out of 50 questionnaires administered, 32 were returned and 8 discarded due to incomplete responses. Analysis of data was based on 26 complete responses, representing more than 50% of initial sample.

The instrument, validity, and reliability of results

The questionnaire consisted of two sections. Section 1 collected data on general details such as gender, age, designation, rural sanitation-relevant work experience, educational qualifications, sanitation capital and maintenance funding experience, as well as knowledge and experience-based opinion on the sustainability of various VIP sanitation technologies. Section 2 collected data on respondents' assessment of the significance of identified sustainability factors in sanitation project outcomes. The following section presents analysis of data collected from survey response and discussion of findings. Since the main data section of the instrument utilised a ranking system, Cronbach alpha was used with a focus on internal validity. This is further discussed after the presentation of Figure 3 in the data analysis section. Similarly, the reliability of results was strengthened through the use, only, of complete responses, as opposed to accommodating incomplete data, by cleaning. In addition, a robust analytical procedure that is made up of several layers was applied.

RESULTS AND DISCUSSION

Presentation of data analysis starts with general and demographic data in Table1, followed by exploration of identified sustainability factors, and their relative significance. Collation and cleaning of data and initial categorisation was performed in MS Excel 2010, while further analysis was performed in STATA 2013. While there are other approaches to analysis that could be undertaken here, the study is viewed as a pilot that is limited to one case. It was deemed adequate to utilise a series of related analytical procedures which provide for robustness and cross validation, albeit within the scope of the study.

The final sample had a good mix of male and females and an even distribution of age ranging from 21 years, to 40 years and above. Most respondents also had between 3 and above 10 years of experience in rural sanitation projects. Most also had post-secondary education ranging from diploma to university degrees.

Table 1. Respondents' distribution according to designation

Respondents' Designation	Respondent	Proportion
Municipal Project Manager (MPM)	6	23.08%
Project Management Unit Manager (PMU-M)	2	7.69%
Technical Consultants' Project Manager (TCPM)	4	15.38%
Contractors' Project Manager (CPM)	1	3.85%
Design Engineer (DE)	3	11.54%
Design Technician (DT)	1	3.85%
MIG Project Evaluator (MIG PE)	2	7.69%
Provincial MIG Manager P-MIG-M)	1	3.85%
Department of Human Settlements Official (DHSO)	1	3.85%
ISD Specialist / Consultant	4	15.38%
Others	1	3.85%
TOTAL	26	100.00%

Categorisation of identified factors

Based on findings from literature review, 55 sustainability factors were identified. Categorisation was performed on the list of 55 factors, resulting in five categories of factors. The five clusters were then grouped as follows: Technology, Operation and Maintenance factors (T**OM**); Financial and Economic factors (**FE**); Socio-cultural and Institutional factors (**SCI**); Environmental and Natural Resource factors (**ENR**); and Health and Hygiene factors (**HH**). Factors and their categories were used as criteria for data analysis. Table 2 below shows the derived categories and their individual sustainability factors. More factors (18) were identified under the TOM category. TOM is followed by SCI (12 factors), FE (10 factors), HH (9 factors), and ENR (6 factors). Note that provision of adequate budget for health and hygiene promotion is entered under the HH category because the budget is for HH at operations stage.

Table 2. Categorisation of sustainability factors affecting rural sanitation projects

No.	TOM	FE	SCI	ENR	HH
1	Appropriate selection	Fully subsidised construction costs	Community involvement in technology selectior	Equitable access to resources	Promotion of health and hygiene awareness
2	Ease of construction	Fully subsidised maintenance costs	Gender consideration in technology selection	Adherence to groundwater protocols	Proper closing of VIP seats and doors when unoccupied
3	Adaptability of facility	Cost of spare parts	Disability consideration in tech. selection	Adherence to EMP recommendations	Community education for washing of hands after VIP usage
4	Quality of facility	Poverty levels	User needs achievement	Protection of groundwater	Community education for appropriate sanitary material
5	Hand-washing unit	Household financial capacity for maintenance costs	Community acceptance/buy in	Appropriate selection of position for installation	Establishment of village health worker for on-going health and hygiene awareness
6	Poor workmanshi	Cost of the materials	Level of understanding of service by community	Pollution protection for immediate environment	Community education for cleanness of VIP system
7	Contractor understanding design	Use of locally made materials	Maintenance knowledge of VIP o community		Promotion of health and hygiene in schools
8	Adherence to design	Use of local labour for construction	Public participatior I project meetings		Regular impact assessment to establish health and hygiene training requirements of communities
9	Number of users per VIP	Structured training for loca labour	Public awareness o programme under implementation		Adequate budget for health and hygiene promotion
10	Pit lining	Users digging own pit for a fee	Open communication channels between community and implementing agen		
11	water-tightness of pit		Cultural acceptability of VIP technology		
12	Effective project management		Compliance with legislation for provision of sanitation services		
13	Spare part accessibility				
14	Ease of operation				
15	Availability of skilled local maintenance				
16	Continuous M&E by municipality				
17	Movability of the structure when pit is full				
18	Regular emptying of pits by municipality				

The row numbering in Table 2 is used to identify factors by category and number. For example, ENR-1 refers to (equitable access to resources). This categorisation and identification system is utilised for subsequent analysis.

ANALYSIS OF THE SIGNIFICANCE OF IDENTIFIED FACTORS

To determine the relative significance of factors influencing the sustainability of rural sanitation, respondents ranked the significance of individual factors on a scale of (1_2_ 3_4 _5), as Likert items, which could then be grouped into Likert scales, following the categories created in Table 6. A mono-directional five-point rating system was utilised: 1= Not Significant; 2= Slightly Significant; 3= Moderately Significant; 4= Very Significant; and 5= Highly Significant. Since the data is ordinal and not normally distributed, descriptive and exploratory analyses were applied by using frequencies, medians, and quartile ranges on the ranking of factors (Boone and Boone, 2012; Clason and Dormody, 1994).

Ranks of 1, 2, and 3 are categorised as lower significance while ranks 4 and 5 are categorised as higher significance. A median of >= 4 is of considerable significance while median of 5 = most significant.

Under the TOM category, (17/18) of factors are appreciably significant with a median of (>=4). About (6/17) of factors are most significant with the maximum median values of (5). For FE category, (8/11) of factors are appreciably significant with median (>=4), while (3/8) of factors are most significant with median values of (5). For SCI category, (11/12) of factors are very significant while (6) factors are most significant. All identified factors under the ENR category are very significant, with (5/6) being most significant. The HH group shares the same outcomes as ENR, however (4/8) of the factors are most significant.

Factors ranked as considerably significant, number up to (50) and are spread across the (5) categories. Analysis of (50) top ranking factors according to medians in Figure 1, shows that most respondents would rank majority of factors as highly significant.

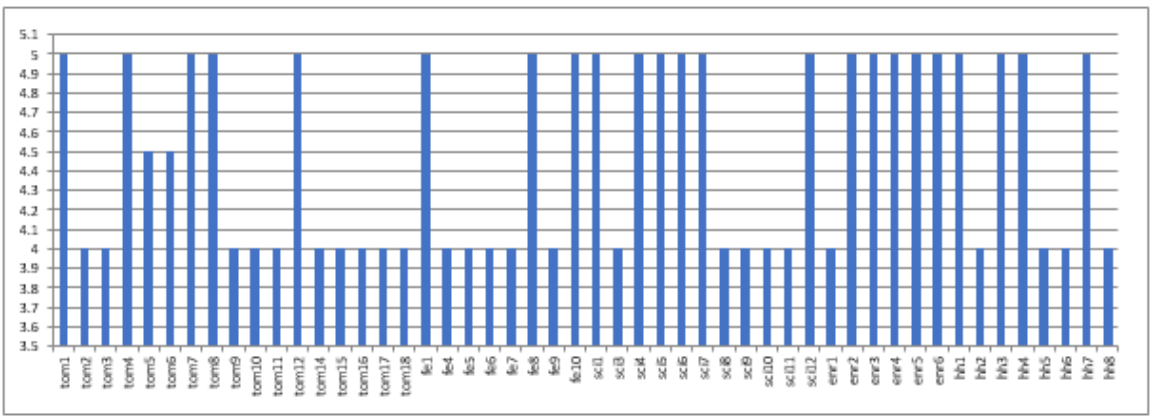


Figure 1. Sustainability factors with top ranking medians

Figure 2 below presents the least ranked sustainability factors, by medians. Five factors were ranked as less significant: FE2 (Fully subsidised maintenance costs), FE3 (cost of spare parts), FE10 (Users digging own pit for a fee), SCI2 (Adherence to groundwater protocols), and TOM13 (spare part accessibility).

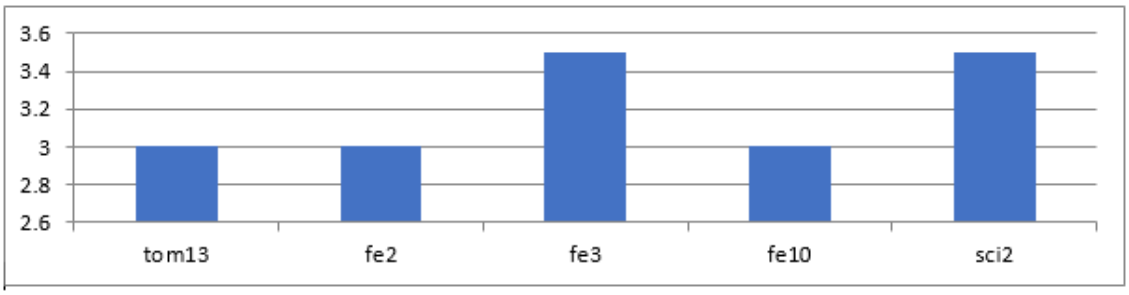


Figure 2. Sustainability factors with least ranked medians

Using inter-quartile ranges as a measure of the agreement between responses, only (8) out of the (55) factors reported an IQR up to the value of 2, for range (1 – 5), see Figure 3. Most of the outcomes (42), are (<=1), while only (13) factors reported an IQR within the range of (1.5 – 2). Essentially there seems to be a consensus with the ranking of most items as more significant, by the greater proportion of respondents.



Figure 3. IQR for factors presented in Figure 1

The relative severity of factors was considered in order to suggest possible hierarchy of influence on project outcomes, and association of ranking to participant groups.The Likert items were converted to scales. Cronbach alpha was performed within each derived category, for internal validity of related items. All groups of factors had reliability coefficient of above (0.70), which is generally recommended (Warmbrod, 2014; Gliem and Gliem, 2003). For analysis, means were chosen in place of arithmetic sum since the scale increases along one direction. The means were compared with results of the median and IQR in each case. Analyses performed on the scales include rank categorisation (higher and lower), description of medians and IQR, and proportion of respondents in relation to ranked categories.

In Table 3, the medians of all the categories of factors suggest a consensus of rankings in the higher significance range. All medians except for the FE category are above (4). The FE category referred to has a relatively high median value of about (3.8), supporting outcomes of item analysis. Most respondents would rank most of the identified factors as highly significant.

Table3. Medians and IQR of derived Likert scales for factor categories

Quartiles	TOM	FE	SCI	ENR	HH
p25	3.8889	3.4546	4.1667	4.3333	3.875
p50 (median)	4.1667	3.8182	4.4167	4.8333	4.375
p75	4.3333	4.0	4.5833	4.8333	5.0
IQR	0.4444	0.5455	0.4167	0.5	1.125

Considering the IQR for each category, only 1 out of the 5 outcomes, reports a value that is more than (1), which is of little significance (0.125) above (1). Responses cluster around the median, which results in minimal difference between the first and third quartile, hence supporting the items analysis. Essentially most respondents rank most items as more significant. Considering the medians, the pattern of ranking from most to least is as follows: ENR, SCI, HH, TOM and FE, suggesting that ENR factors are most influential.

Spearman's rho and chi sq. test of goodness of fit (a non-parametric test), was used to further examine the alignment of responses in terms of rankings.

Table 4. Spearman's rho and chi sq test of goodness of fit

	TOM	FE	SCI	ENR	HH
TOM	1				
	29				
FE	0.3449	1			
	29	29			
	0.0669				
SCI	0.1156	0.3375	1		
	29	29	29		
	0.5505	0.0733			
ENR	0.1439	0.1746	0.4385	1	
	29	29	29	29	
	0.4563	0.3649	**0.0173**		
HH	0.333	0.149	0.3449	0.5589	1
	29	29	29	29	29
	0.0776	0.4404	0.0669	**0.0016**	

The correlation coefficients in Table 8 are mostly insignificant, except ENR and HH, and ENR and SCI. This fairly supports the order of most probable ranking of significance (most to least) for groups of factors in Table 7.

Following the grouping of items under each category, the ranking given to items (1------5), was used to create two formats of rank categorisation, by merging responses as follows:

Format 1 - (4+5 = High significance, 3 = Moderate significance, 1+2 = low significance).

Format 2 - (4+5 = More significant, 1+2+3 = less significant).

Proportions of respondents' in relation to rank categories were then computed. The mean, median, and interquartile ranges were also computed. The proportion of respondents for each rank indicates the relative strength according by groups of factors. The two analyses did not vary significantly. Therefore, only one chart is presented in Figure 4 where majority of respondents rated all factor categories as highly significant. The order from most to least ranked is ENR, SCI, HH, TOM and FE, supporting results in Tables 3 and 4.

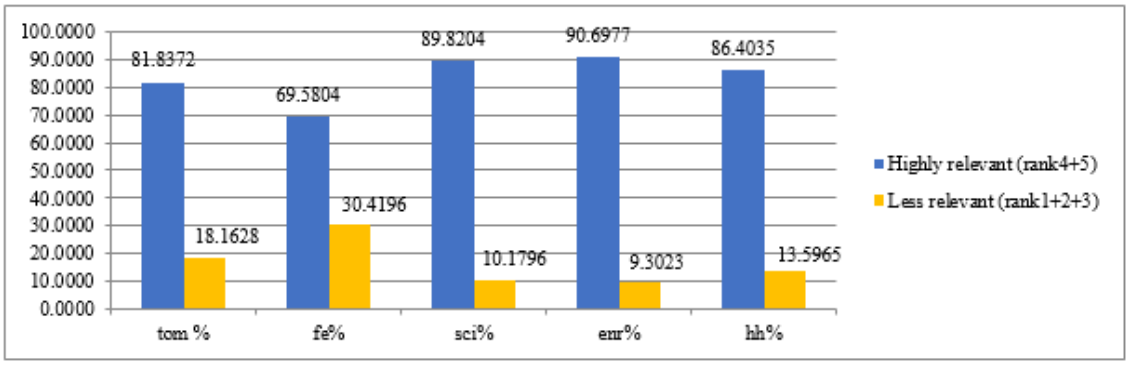


Figure 4. Proportion of respondents rating highly relevant and less relevant factor groups by medians

Exploration of possible patterns in the results by associating various groups of respondents to their rankings for respective factors was performed at category level. The highest and lowest ranks given for each factor category are identified and linked to specific respondent groups, in order to identify any uniqueness and patterns. Apart from the CPM group in Figure 5 which consists of one respondent, there is a good measure of visual correlation of responses by other groups.

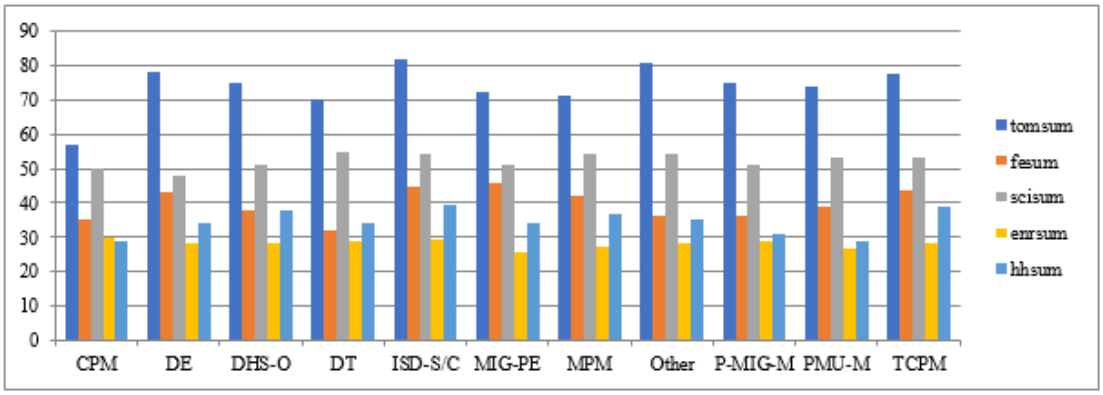


Figure 5. Rankings of categories by individual respondent groups

The most variation is in the TOM category. However, this category also records the highest ranking by respondents. The order of most to least significance ranking is; TOM, SCI, FE, HH, and ENR, which apparently contradicts results of Tables 3 and 4. An analysis of highest and lowest rankings for each factor category, by individual respondent groups, using sums, is presented in Table 5.

Table 5. Highest and lowest rankings per category by respondent groups

Participants	TOM	FE	SCI	ENR	HH
CPM	57	35	50	30	29
DE	78	43	48	28	34
DHS-O	75	38	51	28	38
DT	70	32	55	29	34
ISD-S/C	82	44.5	54.5	29.5	39.5
MIG-PE	72.5	46	51	25.5	34
MPM	71.5	42	54.5	27	36.5
Other	81	36	54	28	35
P-MIG-M	75	36	51	29	31
PMU-M	74	39	53	26.5	29
TCPM	77.5	43.5	53	28.5	39

The degree of agreement on the ranking is evaluated by considering the difference between the highest and lowest rank scores for each factor category. The less the value of difference, the more agreement there is amongst respondent groups. Computed differences are: SCI = 7, HH = 9.5, FE = 14, ENR = 24.5 and TOM = 25. Results show more agreement for SCI and HH category of factors. TOM category suggests the most variation, as in Figure 4.

DISCUSSION

The results of analysis suggest that most sustainability factors are appreciably significant. However, the factors of highest significance can be found in all aspects of sustainability explored. The identified factors of highest significance are as follows:

Appropriate selection; quality of facility; contractor understanding design; adherence to design; effective project management; fully subsidised construction costs; use of local labour for construction; users digging own pit for a fee; user needs achievement; community acceptance/buy in; level of understanding of service by community; maintenance knowledge of VIP on the part of the community; compliance with legislation for provision of sanitation services; adherence to groundwater protocols; adherence to EMP recommendations; protection of groundwater; appropriate selection of position for installation, pollution protection for immediate environment; promotion of health and hygiene awareness; community education for washing of hands after VIP usage; community education for appropriate sanitary material; promotion of health and hygiene in schools.

The paragraph above constitutes 19 out of 55 factors explored. These highest ranking factors address technical issues of facility design and technology selection, and contractor competence and adequate project management. There are economic factors which address the overall project cost and the need to use local labour and beneficiaries in an economically enriching manner. Socio-cultural acceptance, user knowledge and maintenance capacity, and compliance issues were also highlighted. The need for environmental compliance and health promotion were also ranked highly. Considering the initial categorisation of factors, TOM factors have the most influence on sustainability of sanitation projects; See Moe and Rheingards (2006); SEI (2009); and Phaswana-Mafuya (2006). However, TOM category could be grouped into: Technology, Operations and Maintenance, wherein Technology would have the least number of factors, while maintenance factors would have the high rankings. TOM is followed by socio-cultural and institutional factors. Health and hygiene factors and financial and economic factors have essentially the same weighting in terms of numerical strength. Environmental factors are the least represented.

Out of the 50 factors ranked as appreciably significant, 23 are highly significant and evenly distributed across the five categories. Most financial and economic factors are judged, less significant. This contradicts emphasis on financials in Nair (2014); and Moe and Rheingards (2006). The results could be influenced by the value attached to financials by respondents, since such projects are usually resourced from public funds.

While results of scale and item analyses agree, the ordering of factors according to relative influence by medians, suggests that ENR factors are the most influential, followed by SCI, HH, TOM and FE factors. This hierarchy of medians supports emphasis in Phaswana-Mafuya (2006); and UNDP (2006). The test of goodness of fit at the category level shows two

significant results for categories ENR, HH and SCI, which support results in Tables 3 and 4, and Figure 4. Nevertheless, analysis from Table 5 suggests a different hierarchy of significance. However analysis of differences between highest and lowest ranked values for each category tends towards results in Tables 3 and 4.

CONCLUSION

The research explored sustainability factors for rural sanitation projects in South Africa, using the OR Tambo District as specific setting. Literature review resulted in the criteria of sustainability factors. Limitations to the research were due in part to the inherent challenges of survey strategy. The final sample size of 26 was deemed acceptable, being essentially a baseline study. The apparent disagreement between the derived hierarchies of relative significance, hints at possible variations in the perceptions of different role players. Emergent patterns of response suggest possible differences in the emphasis placed on individual factors, by implementers. Response variations also allude to some degree of association between respondent group and role in project, and their perception of individual factors. There is the possibility of latent influences being more visible at the scale level. Furthermore, the specific makeup of the TOM category as referenced in the discussion section, could have contributed to the variations. Nevertheless, the overarching results are quite significant:

Generally, there is appreciable strength of agreement between outcomes of most steps in the analysis. In this regard, there is a high-level significance attached to most factors. There are currently more TOM factors identified, most of which seem to be highly significant. However, it is most of the factors under the maintenance sub-category which are perceived as highly significant. Few factors are relatively less significant factors, most of which are under the FE category. In terms of the order of relative severity/significance for categories of factors (most – least), the following hierarchies were derived: (a) ENR, HH, SCI, TOM and FE; (b) ENR, HH, SCI; TOM and FE; (c) SCI, HH, FE, ENR and TOM.

Arguably the study has value firstly, as basis for building baseline knowledge in the context of South Africa. Secondly it has value in informing the project at various stages, for the purpose of sustainable outcomes. The results of data analysis also suggest the possibility of other factors, which need to be identified. Other factor categories apart from the TOM may need to be populated. Technology, Operation and Maintenance could be used instead of one TOM category. Patterns of response by various respondent groups could be explored further to understand the influence on ranking by area of expertise, roles played, project-related experiences, discipline and organisational views. Lastly the research focused on the implementer side of the stakeholders. Views of beneficiaries, and beneficiary representatives and organisations, would make for a balanced base line.

REFERENCES

Adukia A., 2014 Sanitation and Education. Harvard University. http://scholar.harvard.edu/files/adukia/files/adukia_sanitation_and_education.pdf

Akgüna, A.A. and Baycana, T. and Nijkampb, P. 2015 Rethinking on sustainable rural development. *European Planning Studies,* Vol.23(4), 678-692. Taylor and Francis. http://www.tandfonline.com/doi/full/10.1080/09654313.2014.945813

Bartram, J. and Cairncross, S. (2010) Hygiene, sanitiation, and water: forgotten foundations of health. PLoS Med, November, vol.7, No.11. http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000367

Bilsborrow, R.E. 2002 Migration, population change, and the rural environment. *ECSP Report*, Issue 8, pp.69-94. Environment Change and Security Program, Woodrow Wilson International Center for Scholars. https://www.k4health.org/sites/default/files/Report_8_BIlsborrow_article.pdf

Boone, H.N. and Boone, D.A. 2012 Analyzing Likert data. *Journal of Extension*, vol.50, No.2, pp. http://www.joe.org/joe/2012april/pdf/JOE_v50_2tt2.pdf

Borec, A. and Turk, J. 2009 Sustainable rural development – EU agricultural perspective. *Journal of Geography*, vol.4-1, pp.37-52. http://www.ff.um.si/zalozba-in-knjigarna/ponudba/zbirke-in-revije/revija-za-geografijo/clanki/stevilka-4-1-2009/041-04_borec.pdf

Caincross, S. and Valdmanis, V. 2006 Water supply, sanitation and hygiene promotion, Chapter 41, In:*Disease control in developing countries*,Jamison DT, Breman JG, Measham AR, Alleyne, G. and Claeson, M. and Evans, D.B. and Jha, P. and Mills, A. and Musgrove, P. (Eds.), World Bank. http://www.ncbi.nlm.nih.gov/books/NBK11755/#A5928

Cawley, M. and Gillmor, D.A. 2008 'Culture economy', 'integrated tourism' and 'sustainable rural development': evidence from Western Ireland, Chapter 8 In: *Sustainable rural systems, sustainable agriculture and rural communities*, Robson, G.M. (Ed.).

Carter, R., Tyrrel, S. & Howsam, P. 1999 *The Impact of Sustainability of community water supply and sanitation programs in developing countries*. Chattered Institute of Water and Environment Management, London.

Clason, D.L. and Dormody, T.J. 1994 Analyzing Data Measured by Individual Likert-Type Items. *Journal of agricultural education*, vol.35, No.4. http://www.jae-online.org/back-issues/66-volume-35-number-4-1994/624-analyzing-data-measured-by-individual-likert-type-items-.html

CSIR Building and Construction Techology, 2000 *Guidelines for Human Settlement Planning and Design*. CSIR, Pretoria.

Department of Water Affairs and Forestry. 2001 *White Paper on Basic Household Sanitation 2001*.

Department of Water Affairs and Forestry. 2003 *Strategic Framework for Water Services: Water is Life; Sanitation is Dignity*.

Department of Water Affairs and Forestry.2009 *Free Basic Sanitation Implementation Strategy*.

Economic Commission for Africa 2013 Infrastructure development and rural transformation, *Issue paper inaugural Africa rural development forum* (ARDF), May 2-4, Cotonou Benin. http://www.nepad.org/sites/default/files/4e%20infrastructure%20theme%204%20Eng.pdf

Gliem, J.A. and Gliem, R.R. 2003 Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-Type Scales. *2003 Midwest research conference in adult, continuing, and community education*, The Ohio State University, Columbus, OH, October 8-10, pp.82-88.

Havenaar, J.M., Geerlings, M.I., Vivian, L., Collinson, M. and Robertson, M. 2008 Common mental health problems in historically disadvantaged urban and rural communities in South Africa: prevalence and risk factors. *Social Psychiatry and Psychiatric Epidemiology*, March, vol.43, Issue 3, pp.209-215. http://link.springer.com/article/10.1007/s00127-007-0294-9

Hoggart, K. 1988 Not a Definition of Rural. *Area,* Vol. 20, No. 1, pp. 35-40 http://www.jstor.org/stable/20002535?seq=1#page_scan_tab_contents

Houngbo, G. 2014 The need to invest in Africa's rural transformation. *Comment, International labour Organisation News*, 12 February 2014. http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_235398/lang--en/index.htm

Kahinda, J.M., Taigbenu, A.E. and Boroto, J.R. 2007 Domestic rainwater harvesting to improve water supply in rural South Africa. *Physics and Chemistry of the Earth*, Parts A/B/C, vol.32, Issue 15-18, pp.1050-1057. http://www.sciencedirect.com/science/article/pii/S1474706507000915

Keller, J.W. 2000 The Importance Of Rural Development In The 21st Century - Persistence, Sustainability, And Futures. *First National Conference on the Future of Australia's Country Towns*, June 29.http://www.regional.org.au/au/countrytowns/keynote/keller.htm

KSD Municipality. 2016 *About us*. http://www.ksd.gov.za/

Jasper C., Le T and Bartram J., 2012 Water and sanitation in Schools: a systematic review of the health and educational outcomes. International Journal of Environmental Research and Public Health. 9, pp.2772-2787. http://www.mdpi.com/1660-4601/9/8/2772

Leedy, P. D. & Ormrod, J. E. (2010). *Practical Research Planning and Design (Ninth ed.).* Pearson Education,New Jersey, USA.

Mara, D. and Lane, J. and Scott, B. and Trouba, D. (2010) Sanitation and health. PloS Med, November, vol.7, No.11. http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000363

Moe, C.L. and Rheingards, R.D. 2006 Global challenges in water, sanitation and health. *Journal of Water and health,* vol.4, Issue S1, pp.41-57. http://jwh.iwaponline.com/content/4/S1/41.abstract

Montgomery, M. and Elimelech, M. (2007) Water and sanitation in developing countries: including health in the equation. Environmental science and technology, January, vol.41, No.1, pp.17-24. http://pubs.acs.org/doi/pdf/10.1021/es072435t

Montgomery, M.A. and Bartram, J. and Elimelech, M. 2009 Increasing Functional Sustainability of Water and Sanitation Supplies in Rural Sub-Saharan Africa. *Environmental Engineering Science*, April, vol. 26, Issue 5, pp.1017-1023. http://online.liebertpub.com/doi/abs/10.1089/ees.2008.0388

Nair, I. 2014 Challenges of rural development and opportunities for providing sustainable livelihood. *International journal of research in applied, natural and social sciences*, vol.2, Issue 5, May, pp.111-118. http://www.impactjournals.us/download.php?fname=2-14-1399703619-13.%20Applied-CHALLENGES%20OF%20RURAL%20DEVELOPMENT%20AND%20OPPORTUNITIES-Indira%20Nair.pdf

Namdar, R. and Sadighi, H. 2013 Investigation of major challenges of rural development in Iran utilising delphi technique. *Journal of Agricultural science and technology*, vol.15, pp.445-455. http://jast.modares.ac.ir/article_4981_70a708b3ac9a504197fe3c8599beeb0d.pdf

Ojonemi, P.S. and Ogwu, S.O. 2013 Rural Development Policies and the Challenges of Realizing the Millennium Development Goals in Nigeria. *Mediterranean journal of social sciences*, May, vol.4, No.2, pp.643-648. http://www.mcser.org/journal/index.php/mjss/article/viewFile/251/236

Okiy, R.B. 2003 Information for rural development: challenge for Nigerian rural public libraries, *Library Review*, vol. 52, Issue 3, pp.126 – 131. http://www.emeraldinsight.com/doi/pdfplus/10.1108/00242530310465933

Phaswana-Mafuya, N. 2006. An investigation into the perceived sanitation challenges in the Eastern Cape Province rural communities. *Health SA Gesondheid*, November, vol.11, No.1, pp.18-30. http://www.hsag.co.za/index.php/HSAG/article/view/212

Project Management Institute 2013 *Project Management Body of Knowledge (PMBOK GUIDE)*. Fifth Edition. Project Management Institute.

Pugliese, P. 2001 Organic Farming and Sustainable Rural Development: A Multifaceted and Promising Convergence. *Sociologia Ruralis*, vol.41, No.1, January. European Society for Rural Sociology. http://www.devab.org/moodle/pluginfile.php/1626/mod_resource/content/1/ABILE_organic_farming_and_sustainable_developpment.pdf

Sah, S. and Negussie, A. 2009 Community led total sanitaion (CLTS): addressing the challenges of scale and sustainability in rural Africa. *Desalination*, November, vol.248, No.1-3, pp.666-672. http://www.sciencedirect.com/science/article/pii/S0011916409006481

Statistics South Africa.2011 General Household Survey 2010.*Statistical Release P0318*, 5 May 2011. http://www.statssa.gov.za/publications/P03182/P031822010.pdf (accessed 30 September 2015).

Stockholm Environmental Institute. 2009 Comparing Sanitation Systems Using Sustainability Criteria. Stockholm: Stockholm Environmental Institute, *EcoSanRes Series*, 2009-1. http://www.ecosanres.org/pdf_files/ESR2009-1-ComparingSanitationSystems.pdf

Strydom, H., Fouche, C., Delport, C. & Vos, A. D. 2002 In: Vos, A. D. (Ed.), *Research at Grass Roots: for the social science and human services professions (Second ed.).* Van Schaik Publishers, Pretoria.

Sustainable Sanitation Alliance. 2011 Compilation of 27 Case Studies on Sustainable sanitation projects from Sub-Sahara Africa. *Eschborn*, Germany. https://www.sei-international.org/mediamanager/documents/Publications/SEI-OtherPublication-Fogde-CompilationOf27CaseStudies-2011.pdf

The Republic of South Africa. 1996 *The Constitution of the Republic of South Africa, No.108. (1996).* Government Printers, Pretoria. http://www.gov.za/sites/www.gov.za/files/images/a108-96.pdf (accessed 30 September 2015).

Tanya, W., Victoria, H., Shabbar, J., Jörg, B., Kobus, H. & Marie-Louise, N. 2007 Continued very high prevalence of HIV infection in rural KwaZulu-Natal, South Africa: a population-based longitudinal study. *AIDS*, 11 July, vol. 21, Issue 11, pp. 1467–1472. http://journals.lww.com/aidsonline/Fulltext/2007/07110/Continued_very_high_prevalence_of_HIV_infection_in.10.aspx

United Nations. 2016 *Goal 7: Ensure environmental sustainability* http://www.un.org/millenniumgoals/environ.shtml

United Nations. 2015 *Resolution adopted by the General Assembly on 25 September 2015* http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

United Nations. 1992 Sustainable Development, Agenda 21. *United Nations Conference on Environment & Development, Rio*. Rio de Janeiro, Brazil, 3-14 June. United Nations. https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

United Nations Children's Fund. 2016 Gender and water, Sanitation and Hygeine (WASH) www.unicef.org/esaro/7310_Gender_and_WASH.html

United Nations Development Programme (UNDP). 2017 *Sustainable Development Goals*. http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

UNDP. 2010 *Millennium Development Goals country report.*

UNDP. 2006 *Human Development Report: Beyond Scarcity: Power, poverty and the global water crisis*. http://www.undp.org/content/dam/undp/library/corporate/HDR/2006%20Global%20HDR/HDR-2006-Beyond%20scarcity-Power-poverty-and-the-global-water-crisis.pdf

United Nations Environment Programme. 2008 Inequity in access to clean water and sanitation. *Vital water graphics*, 2nd edition. http://www.unep.org/dewa/vitalwater/article63.html

Van Schalkwyk, B.B. 2015 Challenges in Realising Sustainable Community Development in Rural South Africa. *Agriculture, Forestry and Fisheries*, vol.4, Issue 4-1, August, pp.73-79. http://article.sciencepublishinggroup.com/html/10.11648.j.aff.s.2015040401.19.html

Warmbrod, J.R. 2014 Reporting and interpreting scores derived from likert-type scales. *Journal of agricultural education*, vol.55, No.5, pp.30-47. http://www.jae-online.org/attachments/article/1862/2014-0886-warmbrod.pdf

WHO. 2016 *Health Topics Environmental Health*. www.who.int/topics/environmental_health/en/

Zolfani, S.H. and Zavadskas, E.K. 2013 Sustainable Development of Rural Areas' Building Structures Based on Local Climate. 11th International Conference on Modern Building Materials, Structures and Techniques MBMST 2013, *Procedia Engineering*, 57 (2013) 1295 – 1301. Elsevier Ltd. http://www.sciencedirect.com/science/article/pii/S1877705813008965

FRAMEWORK FOR INTEGRATION OF COMMUNITY SQUARES IN URBAN GOVERNANCE OF EMERGING CITIES IN NIGERIA

Agoha, Basil Onyekozuru[1]
Department of Architecture, Faculty of Environmental Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli campus, Anambra State, Nigeria

In traditional settlements, community squares have been used as meeting places for all sorts of public interactions, gatherings and decisions on governance. However, the decimation of these facilities in emerging cities is closing up this avenue and may lead to increased agitation and discontentment as cities grow. The research sought to develop a framework for the integration of community squares in emerging cities to improve urban governance using Owerri capital territory. Owerri Capital Territory has 7 Local Government Areas and 39 community squares out of which 4 and 13 respectively were randomly selected. The research collected data on indicators of public meetings in community squares in Owerri Capital Territory using questionnaires, maps, Geographic Information System, (GIS) and Geographic Positioning Systems, (GPS) and interviews. The data were analysed with Analysis of Variance,(ANOVA) and Pearson statistical tools and it was found that location, sizes of community squares, hierarchy of the open spaces and green and forest areas in them if legally integrated into the emerging Owerri Capital Territory would provide avenues for social interaction, meetings, formal and informal consultations, advocacy, decision-making and public opinion vent that could reduce agitation, discontent and provide avenues for feedback to improve urban governance in the emerging city of Owerri Capital Territory in particular and cities in Nigeria in general.

Keywords: community squares, feedback system, heritage, public opinion, urban governance.

INTRODUCTION

Although governance involves the government, it is not government but defines how government interacts with the people, other institutions and stakeholders to improve the wellbeing of the people to give proper public

[1] baseconsultants@yahoo.com; bo.agoha@coou.edu.ng

Agoha, B. O. (2017) Framework for integration of community squares in urban governance of emerging cities in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 750-760

account, (UNDP,2003). The ingredients of good governance are; legitimacy and voice of the people, improvement of free interaction, participation and consensus building. Hence the entrenchment of clear direction on strategic vision for development, performance that leads to responsiveness, effectiveness and efficiency in governance, accountability through transparency and fairness which improves equity and rule of law, (Graham, Amos and Plumptre,2003). Without avenues to effectively harness these and reduce discontent, improve consensus and agreement on one-to-one basis, conflicts and disorientation are bound to brew and develop to unmanageable level. The electronic mass media approach and recently introduced town hall meetings seem too formal, highly centralized, rigid, less expressive and less informative hence the emergence of digital social media which looks more chaotic and faceless and not reaching the grassroot. Given the high density and congestions in urban areas is there an alternative? Can differences in the conditions of community squares provide the openness and freedom needed in effective interaction and communication?

This research established that at the grassroot level, community squares provide good alternative free informal meeting point and interaction for all stakeholders to actualise the above issues in good governance. This is so because as informal public open spaces which evolved with the people over the years, as they transform, transmit democratic principles, culture, tradition and philosophy of the people, (Farmer and Gibb,1979). As public squares exist at family, kindred, village and community levels as public good and environmental resources, these virtues also exist at these levels to varying degrees. Traditionally, the squares provide conducive environment for free interaction. This is why without the integration of the squares therefore, not only that the egalitarian and democratic culture, nature, design and development are gradually lost but these values many a time are disrupted by urbanisation. Hence the growth and development of cities especially in developing countries stir up struggles and agitations for the control of power and resources by stakeholders and government thus leading to protests, disagreements and conflicts. As cities grow in emerging democracies, there is the need to provide avenues for a broad and effective participation of the people in governance, as feedback system from elected representatives especially in developing countries has not been good enough to warrant good governance. This is important to reduce the perception by the ruled of high handedness, dictatorship and tenure elongation with accompanying lawlessness. The concept of town union, neighbourhood associations and recently town hall meetings as a feedback mechanism done in formal settings have not been effective hence the growing rate of agitation for power and resource control in urban areas. An informal and natural outdoor setting provided by the community squares therefore may be of great improvement in the march for the growth of democratic principles and institutions in Nigeria and other developing nations.

LITERATURE REVIEW

Social interactions for urban governance are currently highly formal with rigid structures such as electronic and mass media, hotel halls meetings, stadiums, fields and social media. These do not encourage expressive social interaction, one-on-one, inter and intra personal interactions that can lead to free, effective and democratic communication. An integration of micro and macro elements, Turner, (1988), are therefore necessary for effective interaction and communication especially in urban governance. This integrative and free interactive environment is what community squares provide in less tense environment.

Community squares are not only outdoor environmental elements interpreting the philosophy and life of the people but a symbol of the egalitarian and democratic life of the people, (Oguejiofor and Onah,2005). That is why community squares are found at different levels of family, kindred, village and community strata where the principles idealism, realism, existentialism, phenomenology and pragmatism in the life of the people are expressed. Dialogue, dialectics of life, socio-political, socio-economic, socio-cultural questions are raised, debated and resolved. It is here the religious, legal, public opinion and resolutions are taken for the progress of the traditional society. As philosophical approach simplifies complex ideas and statements about our experiences, through rational approach and guiding principles to solving problems, the community square is a platform for philosophical expression. In community squares environment, it provides a critical and systematic platform to study general and fundamental problems concerning matters on existence, knowledge, values, reason, mind, and language, through rational argument, (Teichmann and Evans,1999). As these problems may be ultimate, abstract and very general, they require an environment of freedom of expression which community squares provide. These problems which may be concerned with the nature of existence, knowledge, morality, reason and human purpose are not only discussed but are expressed in artistic form in the community squares and transmitted from generation to generation. This helps not only philosophical inquiry in and insight, but are artistically found in the community squares where these interactions occur, (Grayling,1998, Camillo,). Community squares therefore provide sustainable opportunity for intra, intercultural and multidisciplinary study of socio-cultural philosophy to not only to solve problems but to advance knowledge.

In its simple form community squares are similar to the Greek Agora and Roman fora as they evolved traditionally with the people. As public open spaces they exist at kindred, village and community level as squares and are the main organising elements and centre of traditional activities and settlements as in ancient Babylon, Assyria, Africa and most parts of northern, and southern Nigeria, (Anthony and James,1979; Urguhart,1977).

As organizing element, the central business district, where socio-political, socio-economic and socio-cultural activities take place in the community

squares form the nuclear area with the adjoining villages as multiple nucleic nodes aggregating around the central nuclear area, (Donald, Alan and Robert,2003). While the nucleic theory talks of a dominant centre of development, the multiple nucleic advocates several simultaneous centres of development which could merge into a megacity in the future. These generally follow the concentric circle theory which formed the basis of the development of Nigerian cities and the Owerri Capital Territory masterplan, (Imo State Government, 1977). Although each of these has its limitation, they find expression in traditional settlements of the communities in capital territories in Nigeria such as Owerri Capital Territory.

Community squares being informal public open spaces that evolved with the people over the years have been transformed and transferred from generation to generation, serving the people of all ages. This has been possible following the lifecycle that makes them sustainable, (Gunderson and Holling,2002). This however happens as the result of creation of new environmental equilibrium in the succeeding generation to adjust to the changing realities and hence making community squares resilient. Environmental sustainability and resilience not only nourish but perpetuate community life and transform the environment with the ability to adapt, (Engel,1990).

AIM

The aim of the research was to develop a framework for the integration of community squares into the emerging Owerri Capital Territory so as to improve urban governance.

OBJECTIVES

1) To identify indicators that favour urban governance in the community squares within Owerri Capital Territory
2) To identify differences in the conditions of the community squares that can encourage urban governance in Owerri Capital Territory

PROBLEM STATEMENT

The location of community squares traditionally makes them accessible and usable by residents as meeting places for socio-political and socio-economic activities. At the creation of Imo State with Owerri as the state capital, the community squares in Owerri urban were not identified and integrated into the urban design of the city but decimated with new public open spaces created. While the new public open spaces were abandoned by the residents, the old locations of the community squares were still used as meeting places and interaction leading to blocking of streets and conflict of use between the residents and the planning authorities of government. Since the capital territory has the core urban, the semi-urban/suburban and rural areas, there is still the opportunity to identify and integrate the community

squares in the rural and suburban/semi-urban segments of the emerging capital territory. With the community squares in core Owerri urban decimated, those in the semi-urban/sub-urban areas are no doubt endangered. With the community squares in the rural areas almost still intact, great opportunity for identification and integration therefore exists in the emerging Owerri capital territory. This is the problem the research sets to address.

RESEARCH QUESTIONS

1) What indicators favour urban governance in the community squares within the Owerri Capital Territory?
2) What differences in the conditions of the community squares in Owerri Capital Territory favour urban governance?

HYPOTHESES

Ho1; There are no indicators that favour urban governance in the community squares within Owerri Capital Territory.

Ho2; There are no differences in the conditions of community squares in Owerri Capital Territory.

RESEARCH SCOPE, DESIGN AND METHODS

Owerri Capital territory covers 7 local government areas of Owerri Municipal, Owerri West, Owerri North, and parts of Aboh Mbaise, Ngor Okpuala, Mbaitoli, Ohaji/Egbema with 49 community squares. With random sampling, the number of local government areas and community squares were reduced to 4 and 13 respectively for the research. Most researchers agree that 10% of population is adequate, Nworuh, (2001), and Uji,(2009), but in this research 26.5% was used to give a wider spread. Arranging the local government areas and community squares in descending alphabetical order every 2nd number and every 5th number was used in local government areas and community squares respectively to give the above figure.

The local government areas studied were; Aboh Mbaise,Owerri Municipal, Mbaitoli and Owerri West while the community squares studied were Afor Enyiogugu, Ugwuekwema, Nkwo-Ukwu Orodo, Orie Mbieri, Idem Ogwa, Nkwo Ubomiri, Afor Irete, Eke Amakohia-Ubi, Amaocha shed, Amaocha Afara, Umuokpo and Okolochi. Survey questionnaire, Geographic Information System, (GIS), Geographic Positioning System, (GPS), physical visits and interviews were used in data collection. Data collected were; size, location, hierarchy of open spaces, reception for very important persons, (VIPs) and meeting places, in the community squares. Out of the 390 copies of questionnaires administered, 350 were retrieved, GIS, Geo-eye satellite images 2015 and Garmin V72 hand held GPS, spot 2.5 instrument were used to determine the exact locations, sizes and conditions of the community

squares. The analysis of data was done with analysis of variance, ANOVA and Pearson correlation using the Statistical Programme for Social Sciences, SPSS.

DATA COLLECTION, ANALYSIS AND DISCUSSION OF RESULTS

Data collection

The variables for which data was collected for the research were; location of community squares, size of community squares, hierarchy of open spaces, reception of very important persons, (VIPs) and community meetings

Location of community squares

Most of the community squares in Owerri capital territory were located in suburban, rural and semi-urban areas of Owerri capital territory in the proportion of 39.8%, 29.5% and 26.1% respectively while core urban area was 4.6%. This is given in Table 9.1

Table 9.1: Aggregated Location of community squares

Value label	%	Cumulative %frequency
Suburban	39.8	39.8
Semi-Urban	26.1	65.9
urban area	4.6	70.6
Rural areas	29.5	100
Total	100.0	

Source: Fieldwork, 2015

The sizes of the community squares in the rural, semi-urban and suburban areas were large as most of them had not been adversely encroached upon.

While congestion and encroachment in the urban areas made it almost impossible for the development of the community squares into modern public open spaces, for urban governance those in the rural, semi-urban and sub-urban areas are good for transformation into public squares. The aggregated 95.3% in the rural, semi-urban and suburban areas were available for integration and upgrade into public parks in the emerging Owerri capital territory. Particularly of note was, Amaocha Afara 100% rural with its reach forest and green areas (Plate: 9.1).



Plate 9.1: Amaocha Afara community square; a typical rural area
Source: Fieldwork 2015

Size of community squares:

Cumulatively, 90.7% of the community squares in Owerri capital territory were situated on more than five (5) plots of land and only 9.3% in less than five (5) plots of land, the combined 95.3 percent, in rural, semi-urban and suburban areas provided great opportunity for integration and upgrade to public square and open spaces for urban governance.

Table 9.2: Size of community square Aggregation

Value label	%	Cumulative % frequency
Less than 5plots	9.3	9.3
More than 5 plots	90.7	100.0
	100.0	

Source: Fieldwork, 2015

Hierarchy of open spaces in the community squares:

Most of the community squares in Owerri capital territory had hierarchy of open spaces (79.8%) created organically over the years as a result of usage by the people as in Table 9.2, Plates;9.1, and 9.2. This provides opportunity for multiple outdoor interaction, meetings and gatherings needed for good consultation in urban governance.

Table 9.2: Aggregated Hierarchy of open spaces in the community squares

Value Label	%	Cumulative % frequency
Disagree	13.1	13.1
Fairly agree	7.1	20.2
Agree	79.8	100
Total	100.0	

Source: Fieldwork, 2015

VIPs reception in the community squares:
In the use of community squares for VIP reception, only very few people (18.3%), Table 9.3 disagreed on the aggregate that the community squares were used for the reception of very important persons, (VIPs), while another negligible number of respondents, (26.6 percent) fairly agreed but just a little above average number (55.1%) respondents agreed fully that the community squares were used for such public functions as the reception of VIPs Table 9.3. This was made possible as a result of large, variety of hierarchy of open spaces where many sociocultural and socio-political functions such as consultations, meetings and dances could take place at the same time during such occasions.

Aggregated VIPs reception in the community squares

Value label	%	Cumulative % frequency
Disagree	18.3	18.3
Fairly agree	26.6	44.9
Agree	55.1	100
Total	100.0	

Source: Fieldwork, 2015

DATA ANALYSIS

Ho1: i). Table 9.4: Result of Pearson correlation bivariate analysis of the relationship between Hierarchy of open spaces and VIPs receptions

The relationship was significant and positive, indicating that hierarchy of open spaces in the community squares encouraged meetings such as receptions for community interactions and urban governance

		VIPs reception	Remarks
Hierarchy of open spaces in the community squares	Karl Pearson correlation coefficient	0.452	Significant at 0.01 confidence level
	sig.(2-tailed)	0.00	
	N	322	

Source; (Fieldwork, 2015)

ii). Table 9.5: Result of Pearson correlation bivariate analysis of the relationship between location and sizes of community squares

Though the relationship was significant, the correlation was negative indicating that location affects the sizes of community squares in Owerri Capital Territory. The more location in the rural areas the larger the sizes; urban, sub-urban, semi-urban and rural in increasing order.

		Sizes of community squares	Remarks
Location of community squares	Karl Pearson correlation coefficient	-0.236	Significant at 0.01 confidence level
	sig.(2-tailed)	0.00	
	N	319	

Source; (Fieldwork, 2015)

Ho2: The extent of the differences in the conditions of community squares in the Owerri Capital Territory

Condition was analysed against location, size of community squares, hierarchy of open spaces, reception and meetings in the community squares. The result was significant and showed that differences in the conditions of community squares existed both within urban, semi-urban/suburban and rural areas of Owerri Capital Territory, Table:9.6, Plates:9.1 and 9.2.

Table 9.6: Posthoc result of ANOVA on the extent of differences in the conditions of community squares in Owerri Capital Territory

		Sum of Squares	df	Mean Square	F	Sig.
Location of community squares	Between Groups	42.212	2	21.106	23.078	.000
	Within Groups	305.467	334	.915		
	Total	347.680	336			
Size of community squares	Between Groups	4.412	2	2.206	12.840	.000
	Within Groups	54.635	318	.172		
	Total	59.047	320			
Hierarchy of open spaces	Between Groups	12.918	2	6.459	9.525	.000
	Within Groups	221.058	326	.678		
	Total	233.976	328			
Reception for VIPs	Between Groups	7.131	2	3.565	5.365	.005
	Within Groups	217.321	327	.665		
	Total	224.452	329			
Meetings	Between Groups	10.030	2	5.015	11.210	.000
	Within Groups	139.132	311	.447		
	Total	149.162	313			

Source: Fieldwork 2015



Plate: 9.2: Nkwo Ukwu Orodo in a typical semi-urban area
Source: Fieldwork, 2015

CONCLUSIONS AND RECOMMENDATIONS

The research found that there were significant differences in the sizes, location of the community squares, hierarchy of open spaces, very important

persons receptions activities and meeting places in the community squares in Owerri Capital Territory. While those in the rural, suburban and semi-urban areas have sizes more than five (5) plots of land; from 79.1 plots of land in semi-urban to 612.3 plots of land in the rural area the core urban area at Ugwuekwema had less than five (5) plots of land. This showed that although the community square in Owerri Municipal Local Government area is almost decimated, the conditions in the rural and semi-urban areas provide opportunity for integration and improvement in the quality of the emerging urban environment. Since most undeveloped areas of Owerri Capital Territory is sub-urban, semi-urban and rural, there is therefore great potential in developing the community squares into gardens for public gatherings and interaction for urban governance in the emerging Owerri Capital Territory.

Since the indicators that favour meetings and urban governance in the community squares within Owerri Capital Territory such as location of the community squares, sizes of the community squares, presence of hierarchy of open spaces in the community squares, are conducive for the reception of very important persons in the sub-urban, semi-urban and rural areas of the emerging capital territory, it is recommended that the government with the communities and stakeholders identify, designate and legally acquire these community squares with a view to developing them into public open spaces for the Capital territory to be used for public interaction, discusses and good urban governance. Since there are many community squares further study on the relative distances of community squares to be selected for those that can be acquired and efficiently developed could be necessary.

REFERENCES

Anthony, J.C., and C.S. James. 1979. introduction to Urban Planning. New York: McGraw - Hill.

Camillo, C. 2003. "City building according to artistic principles." In Time-Saver Standards for Urban Design, by W. Donald, P. Alan and S. Robert, 2.1-11. NewYork: McGraw-Hill.

Donald, W., P. Alan, and S. Robert. 2003. Time - Saver Standards for Urban Design. New York: McGraw - Hill.

Engel. 1990. "Introduction: The Ethics of Sustainable Development." In Ethics of Environment and Development; Global Challenge, International Response, by J.R. and Engel, J.G. Engel, 10-11. London: Belhaven Press and Tuscan University of Arizona, Press.

Farmer, W.P., and J.A. Gibb. 1979. "Land use planning." In Introduction to urban planning, by A.J., Synder,J.C. Catanese, 234-257. New York: McGraw-Hill.

Governance, Instiyute of. 2003. http://institute of governance. August 15. Accessed January 15, 2017. iog.ca/defining-governance.

Graham, J, B. Amos, and Plumptre.T. 2003. Principles of good governance in the 21st century, No.15. Technical report, Otawa: institute of good governance.

Grayling, A.C. 1998. Phylosophy1; A Guide through the Subject. London: Oxford University Press.

Gunderson, L.H., and C.S. Holling. 2002. Panarchy: Understanding transformation in human and natural systems. Washington, D.C.: Island Press.

Imo State Government. 1977. Imo State Official Gazette; the Owerri capital development Authority, Edict. Owerri: Imo State Government.

Nworu, G.E. 2001. Basic research methodology for reseachers, and trainers in management sciences. Owerri: AMBIX Publishers.

Teichmann, J., and K.C. Evans. 1999. Philosophy;A Beginner's Guide. London: Blackwell.

Turner, J.H. 1988. A Theory of social interaction. Califonia: Stanford University Press.

Uji, Zanza Akaka. 2009. Tools and Instrumentsof Research in Design and Allied Disciplines. Jos: Ichejum Press.

Urquhart, A.W. 1977. Planned urban Landscapes of Northern Nigeria; a case study of Zaria. Zaria: Ahmadu Bello University, press.

HINDRANCES TO THE DEVELOPMENT OF GREEN RESIDENTIAL BUILDINGS: THE END-USERS' PERCEPTIONS IN ABUJA, NIGERIA

Salisu Gidado Dalibi[1], Jamilu Bala Mai Auduga[2] , Isa Ibrahim Danja[3], Hadiza Balarabe[4], Ibrahim Saleh[5], Abdurrahman Aliyu Jalam[6] and Abubakar Yahaya Muhammad[7]

[1]Business school of Hohai University Nanjing, China. 3Architecture Department of South East University Nanjing, China

[1,2,4,5,6]Department of Quantity Surveying, Abubakar Tafawa Balewa University (ATBU) Bauchi, Nigeria

[3]Global Research Works and Partner and Project Procurement Consultants (PPC), Gombe, Nigeria

[7]Department of Architecture, Abubakar Tafawa Balewa University (ATBU) Bauchi, Nigeria

The demand for decent and qualitative housing has been increasing annually in Nigeria. Despite many residential estate developments by the public and the private sectors, dis-satisfaction with some features still exist among the end-users; which is further compounded by sustainability issues. The construction industry responded with new initiative/concept/practice in design and construction called Green / sustainable buildings to ensure and promote sustainability within the built environment. Despite all these glaring challenges and the need for drastic measures, green building developments are embraced very slowly and practiced at a slow pace in the Nigeria's built environment. This is worrisome and is due to some factors hindering such pace. The aim of this paper is to identify, examine and assess the factors that are hindering green building (GB) developments based on the end-users' perceptions with a view of exposing the impacts of such hindrances on the Nigeria's built environment. Reviewed literatures were used to identify the various factors that hindered the adoption of green measures and practices within the Nigeria's built environment. A questionnaire survey was used to obtain primary data; administered to end-users selected randomly. The results show that GB is strongly affected by its stakeholders such as the negative attitude of developers towards incorporating GB features in residential developments; lack of consideration for end-users' preferences; Divergent and Incompatibility of interests and views of success of GB developments among stakeholders; Lack of Sufficient information regarding GB costs and performances.

[1] salgidos@yahoo.com
[2] jbmaiauduga@yahoomail.com
[3] danjaisah@yahoo.com
[4] hadizabalarabekudan@yahoo.com
[5] i.saleh59@yahoo.com
[6] abduljalam@gmail.com
[7] yayarisadiq@yahoo.com

Dalibi, et al. (2017) Hindrances to the development of green residential buildings: the end-users' perceptions in Abuja, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 761-772

Keywords: built environment, end-user, green building, hindrance, housing sector

INTRODUCTION

The worldwide Population growth accompanied by massive resource consumption, waste generation, loss of arable lands and increased urbanization has led to environmental pollution, degradation and climate change with negative effects on the planet earth. These has led to the global recognition and consensus about the devastating effects of such and the need for drastic changes in policies and practices across various industries to ensure and promote environmental sustainability. Various industries have different approach, policies and practices regarding environmental sustainability. The Built Environment (BE) to which the construction industry belongs is not an exception; it responded to the environmental sustainability challenges with a concept and practice known as Green building/ sustainable construction / eco building / High performance building.

Green building (GB) is the foundation of sustainable construction and building development (USGBC, 2012). GBs refers to a structure that uses all processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from Siting to Design, Construction, Operation, Maintenance, Renovation, and Demolition. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort (epa.gov). Greg Kats (2003); defined GBs as those sensitive to the "Environment, Resource and energy consumption, Impact on people, Financial impact and the world at large. Zane *et al.,* (2009), referred the term "Green Building" is environmentally friendly practices from building design to the landscaping choices. It also encompasses energy use, water use, and storm-water and wastewater re-use. Dalibi (2012), described GBs as buildings designed, constructed using Sustainable Materials and resources; operated sustainably to provide optimum performance of the building with positive impact to the occupants and the environment by combining energy and water efficiency systems, Day Lighting strategies, Indoor Environmental Quality (IEQ) systems and efficient Building Envelope system.

Sustainability in construction is all about following suitable practices in terms of choice of materials, their sources, construction methodologies, as well as design philosophy so as to be able to improve performance, decrease the environmental burden of the project, minimize waste and be ecologically friendlier (Abolore, 2013). GB is a holistic approach to programming, planning, designing, and constructing (or renovating) buildings. It is part of the larger concept of sustainable development as it enhances the environment against the negative side effect of construction activities (Dahiru et al., 2013). It has been described as a clear answer to health,

economic and environmental challenges (Karolides, 2002). "GBs are buildings that, throughout their lifecycle, maximize the resource savings (including energy, land, water, and materials saving), protect the environment, reduce pollution, provide people with healthy, comfortable and high efficient space, and exist harmoniously with nature" (MOC, 2006; Li and Currie, 2011; Liu, 2012). The term "green building", or "more sustainable building", does not have an exact definition, but, nevertheless, these terms have been used frequently (Berardi, 2013).

Thus, the GB elements and features considered in this work based on (epa.gov; Greg Kats 2003; MOC, 2006; Zane *et al.,* 2009; Li and Currie, 2011; Liu, 2012; Dalibi, 2012; USGBC, 2012; Abolore, 2013) include: Sustainable sites and materials, Energy Efficiency systems, Water Efficiency systems, Day Lighting systems, Indoor Environmental Quality (IEQ) systems and The Building Envelope systems.

In developing countries like Nigeria, there is a significant housing deficit. This has led to higher numbers of quantitative housing schemes. As such green building developments are predominant in bigger cities like Abuja, Lagos, Kano, Enugu, Port Harcourt and Calabar etc. such cities have the higher construction activities in Nigeria and Abuja as the Federal Capital Territory (FCT) with the highest.

Over the years, many housing estates were developed by the Public and the Private sectors or a partnership of both in the Abuja FCT. However, Such Housing estate developments were insufficient and or inadequate in terms of the desired housing needs of the end-users; in most cases affordable but not qualitative; do not possess green building features; affected by insufficient electricity (power) and water supply for residential consumption etc. (Dalibi et al., 2016). These outlined the need for housing estate development projects with features that represent the needs and the interests of the end-users as major stakeholders in such developments.

THE RESEARCH PROBLEM

Every concept in project development comes with its unique benefits, challenges and factors that hindered its success and GB concept is not an exception. Such benefits, challenges and hindrances differ perceptively among its stakeholders. End-users as stakeholders are those that make use of the GB as a physical product.Despite all the glaring challenges of the need to adopt and embrace sustainable practices within the BE, GB developments and sustainable practices are embraced very slowly and practiced at slow pace in the Nigeria's construction industry. This is worrisome and is due to some factors hindering such pace or affecting the sustainable practices within its built environment. Some of the hindrances may also be attributed to project stakeholders especially satisfaction of the end-users from whom the performance of the GB is obtained and assessed.

RESEARCH AIM

The aim of this paper is to identify, examine and assess the factors that are hindering green building developments based on the end-users' perceptions with a view of exposing the impacts of such hindrances on the Nigeria's GB development.

Research hypotheses
The following hypotheses were formulated for this research:

- *Null hypothesis (H_O);* Residential Green building developments ***are not*** hindered significantly by end-users' perceptions.
- *Alternative hypothesis (H_A);* Residential Green building developments ***are hindered*** significantly by end-users' perceptions.

This research work is limited to residential end-users in Abuja, the federal capital territory (FCT) of Nigeria.

LITERATURE REVIEW

Green building and its end-users
Sustainable design elements are gradually accepted in the mainstream of project design, in which building owners and tenants are beginning to demand and value those features. It is important to note, however, that advanced or innovative sustainable features can add significantly to the cost of a project and that these must be valued independently to ensure that they are cost and or environmentally effective (Morris, 2007). As such for GB to thrive there is need for better understanding and satisfaction among the stakeholders in such developments.

Successful delivery of projects, their operations and management (including green building projects) is attributed to many factors of which stakeholders' perceptions, participation, roles and responsibility is among (Bourne, 2005; Dalibi, 2014). Stakeholders' input, participation, roles and responsibility in Green buildings projects must be of high cognizance than conventional building projects because of the variations of interests, requirements and level of satisfaction among them.

Incorporating green building features / elements are basically at the developer's disposal and may have a significant impact on the total development cost which in turn affects end-users / occupants in terms of Rental value, Sales value, Envisaged savings due to green elements, Future asset value of the green building etc. Thus, those elements must be checked with potential end-users in order to ensure they meet their housing needs, requirements and also their affordability which will also reflect on the developers' interests in terms of market value and faster sale of the Housing units (Dalibi et al., 2016). These warrants the need for embracing green elements in estate development projects in Abuja based on the end-users' requirements and satisfaction.

Green building hindrances from the end-users' perceptions

The sustainable construction practice is a trend that is two-three decades old in construction, but still lack sufficient data about the costs; absence of measured building performance data from currently operating sustainable designed buildings (BD&C, 2003; ENSAR, 2003; Andeau et al., 2004). "To be sustainable, buildings should usefully last for many generations. This requires some knowledge of the future climate and the resources available to maintain the operations, in particular the energy consumption, of buildings" (Byrd and Leardini, 2011). Industry professionals, in both the design and construction disciplines, are generally slow to change, tend to be risk-adverse, lack sound knowledge, experience, and understanding of how to apply ecology to construction design; moreover, environmental or economic benefit of some green building approaches has not been scientifically quantified (Wang, 2013).

Lisa and Morris (2004), opined that the first question often asked about sustainable design is: what does "green" cost? Typically meaning does it cost more? This raises the question: More than what? More than comparable buildings? More than the available funds? Or more than the building would have cost without the sustainable design features? The answers to these questions have been thus far elusive, due to the lack of hard data. Morris (2007), argued that "The most common reasons cited in studies for not incorporating green elements into building designs is the increase in first cost". While a Davis Langdon Report stated that "there is no one size that fits all answer to the question of the cost of green". Fenn et al., (1997), pointed out that incompatibility of interests amongst stakeholders caused conflicts and disputes in construction. Notwithstanding, Berke (2002), advocated the holistic inclusion of different interests from stakeholders and involving the public in planning. Incorporating the various interests of stakeholders should be extremely important for the preparation of green specifications, construction and maintenance.

GB projects design and construction is new in Nigeria and is characterized by the problem of lack of shared perception and agreement on the objectives and success/failure of the green building projects by stakeholders (Dalibi and Kumo, 2016); also Different Set of Criteria for success/failure for the project (Kumo, 2012) etc. Going by these characteristics, each stakeholder perceives the success according to a hierarchy of dimensions, which comply with their personal agenda.

The initial emphasis of sustainability was on Technical issues such as materials, building components, construction methodologies and energy related design concept (USGBC, 2012; epa.gov). However, the appreciation of the significance of non-technical issues (soft issues) has grown, giving recognition to Economic and Social sustainability concerns as well as Cultural heritage of the built environment as being equally important (Abolore, 2013). Sustainable world progress is dependent upon continued Economic, Social, Cultural, and Technological progress (Shelbourne, et al., 2006). According to Nuruddeen and Gidado (2015), these four main factors that were previously described, which include; Economic, Social, Cultural

and Technological factor, each of which is found to have a significant effect towards adopting Green Building Technology. Thus, the adoption of GB technology is also dependent upon these independent variables.

Qian Shi (2008), opined that more and more people are gradually attaching importance to sustainable construction. Compared with some developed countries, the percentage is not very high at present. Therefore, the awareness of green building by the general public will form the market-driven power for such developments especially in the urban area, which can be demonstrated by the urban housing market. Other difficulties include: Lack of basic data of using GB assessment system, Lack of professionals, Lack of interest from real estate developers and Difficulty of having a unified GB assessment standard etc.

However, the appreciation of the significance of non-technical issues (soft issues) has grown, giving recognition to Economic and Social sustainability concerns as well as Cultural heritage of the BE as being equally important and provide further challenges (Abolore, 2013).

Table 2: Hindrances to GB developments

S/N	Hindrances to GB developments
1	GB as a new change (A new concept which comes with its uncertainties)
2	Lack of Sufficient information regarding GB costs and performances (especially envisaged cost savings)
3	In availability of Built Environment Professionals with GB Technical Know How
4	The Perception of GB as Expensive Concept (Perceived Increased cost for incorporating GB features etc.)
5	Divergent and Incompatibility of interests and views of success factors and success criteria of GB developments among stakeholders
6	Negative attitude by developers towards adopting / incorporating GB features
7	Lack of involvement of end-users at the inception of GB developments and exploring their preferences
8	Cultural, Economic, Social and Technological (CEST) barriers.
9	Lack of In-depth Awareness of the GB Concept
10	Lack of adequate information regarding GB Future asset value, Rental value and its sales value

Source: Authors' review of literature.

Dalibi et al., (2016), asserted that despite many housing estates development schemes in the Abuja FCT, Nigeria, they do not reflect the desired housing needs of the end-users. This is further compounded by negative attitude to GBs by developers'/ clients' attitudes, lack of comprehensive data about the financial obligations with regards to incorporating green features into renovation or proposed projects. Incorporating green building features / elements are basically at the developer's disposal and may have a significant impact on the total development cost which in turn affects end-users / occupants in terms of

Rental value, Sales value, Envisaged savings due to green elements, Future asset value of the green building etc.

GB as a system is characterized with some features/ components (energy efficiency systems, water efficiency systems, day-lighting strategies, indoor environmental quality, and building envelope etc.) which also have their respective sub-features / sub-components. Some of these features/ components and their respective sub-features/ sub-components can align the interest of both the developers and the End-users while others cannot; this is due to non-uniform preferences in such developments (ibid).

The hindrances to GB developments identified from the reviewed literature above were listed in Table 1

RESEARCH METHODOLOGY

Secondary sources of data such as publications from journals, conferences, seminars, workshop papers, text books, newspapers, magazines and internet sources etc. were used to review literatures on the GB field, which helps in identifying and narrowing the various factors that hindered GB developments. These identified hindrances form the main body of the Questionnaire which was manually distributed to the end-users; selected randomly in Abuja. A 5-point Likert scale Questionnaire format (Strongly Agree =5, Agree=4, Neutral/Undecided=3, Disagree=2, strongly Disagree=1) was used to obtained the various perceptions of the end-users. Frequency and percentage count tables, Mean item scores and T-test statistics were used for data analyses.

This research work is limited to the perception of residential end-users in Abuja, the federal capital territory of Nigeria. 200 End-users residing in five Qualitative housing estate developments were randomly targeted. Emphasis was given to the end-users working in any related field of the built environment and or those that have a good background or understanding of the Natural and built environment.

DATA PRESENTATION, ANALYSES AND RESULTS

Results from the questionnaire survey

The Primary data for this research work was obtained through manually distributed questionnaires to residential end-users and the responses obtained were shown in Table 2. From the data in Table 2 it is evident that the total response rate was 127, out of which 15 were incomplete making the usable number to be 112 or 56%, a very fair response; whereas 73 questionnaires representing 36.5% were not returned

Table 2: The Questionnaires Responses

Questionnaires	Frequency	Percentage
Returned & Usable	112	56.00%
Non-Returned	73	36.50%
In-complete	15	7.50%
Total	200	100%

Table 3 shows the results regarding end-users' perception of green building hindrances.

Table 3: Hindrances to GB developments as perceived by end-users

S/N	HINDRANCES TO GB DEVELOPMENTS	Strongly Agreed	Agreed	Neutral	Disagreed	Strongly Disagreed	TOTAL	Mean Item Score	Remark	Rank
		5	4	3	2	1				
1	GB as a new change (A new concept which comes with its uncertainties)	38	17	11	26	20	112	**3.24**	**Neutral**	**9th**
2	Lack of Sufficient information regarding GB costs and performances (especially envisaged cost savings)	55	43	3	2	9	112	**4.19**	**Agree**	**3rd**
3	In availability of Built environment Professionals with GB Technical Know How	23	30	48	2	9	112	**3.50**	**Agree**	**7th**
4	The Perception of GB as Expensive Concept (Perceived Increased cost for incorporating GB features etc.)	61	33	3	5	10	112	**4.16**	**Agree**	**4th**
5	Divergent and Incompatibility of interests and views of success factors and success criteria of GB developments among stakeholders	59	41	5	1	6	112	**4.30**	**Agree**	**2nd**
6	Negative attitude by developers towards adopting / incorporating GB features	72	24	9	1	6	112	**4.38**	**Agree**	**1st**
7	Lack of involvement of end-users at the inception of GB developments and exploring their preferences	38	33	17	2	22	112	**3.56**	**Agree**	**6th**
8	Cultural, Economic, Social and Technological (CEST) barriers.	10	13	41	38	10	112	**2.78**	**Neutral**	**10th**
9	Lack of In-depth Awareness of the GB Concept	29	26	21	25	11	112	**3.33**	**Neutral**	**8th**
10	Lack of adequate information regarding Future asset value, Rental value and sales value of a GB development	51	29	11	6	15	112	**3.85**	**Agree**	**5th**

Source: Author, 2017

From Table 3 the following deductions are made

i. The respondents (end-users) agreed with seven of the identified hindrances to GB development and remain neutral on three. This clearly shows that the seven factors hindered to GB developments and the remaining three can also somewhat affect GB developments.

ii. The negative attitude of developers towards adopting / incorporating GB features in residential developments is the major hindrance and ranked first. This is due to such being at their disposal and end-users' preferences were not normally included or explored. Divergent and Incompatibility of interests and views of success factors and success criteria of GB developments among stakeholders ranked second. This is also another major hindrance to GB developments because every stakeholder measure success or failure according a personal view / perception and in most cases a hierarchy of dimensions, priorities and level of satisfaction. Lack of Sufficient information regarding GB costs and performances (especially envisaged cost savings) is the third ranked hindrance. This factor raises a lot of doubts in both the developers and end-users both in the short and long time aspects of

the GB developments. These three are deemed the major hindrances to GB developments as perceived by the End-users.

iii. The Perception of GB as Expensive Concept (Perceived Increased cost for incorporating GB features etc.) ranked 4th; Lack of adequate information regarding GB Future asset value, Rental value and its sales value ranked 5th; Lack of involvement of end-users at the inception of GB developments and exploring their preferences is 6th; These hindrances were as a result of lack of comprehensive requisite information (3rd factor) on The GB concept into residential developments which may have been bridged if the end-users were involved at the inception. In availability of Built Environment Professionals with GB Technical Know How is the 7th ranked hindrance as perceived by the end-users. A shift from conventional building trend to GB poses challenges to professionals in terms specifications and designs.

iv. The hindrances with the least scores includes: Lack of In-depth Awareness of the GB Concept (8th); GB as a new change (A new concept which comes with its uncertainties) – 9th; Cultural, Economic, Social and Technological (CEST) barriers – 10th; were deemed neutral that is neither agreed nor disagreed. GB as a new concept has a fair/moderate awareness among the end-users with CEST barriers affecting it moderately. However, they somewhat hindered GB developments. Because the stakeholders are humans, as such they are affected/impacted by cultural and economic barriers or limitations. Some technological appliances or systems used or to be incorporated in GB projects are affected by their availability and ease of use by the end-users. This may be overcome with adequate awareness of GB as a positive change towards ensuring a sustainable built environment by all the stakeholders.

TESTING OF HYPOTHESES

The hypotheses formulated for this research work was tested using T- test statistics.

Table 4: T-test Statistical computation

End-Users' Perceptions	N	D F	MEAN	Standard Deviation	Standard Error	Alpha (level of Significance)	Pvalue	Tcal	$Ttab_{0.05,\ 9}$
GB Hindrances	10	9	3.7295	0.5327	0.1684	5%	0.0000	7.2988	-1.8331

With 9 degrees of freedom and 5% level of significance, the T- test calculated (Tcal= 7.2988) is greater than T- test tabulated (Ttab= -1.8331). As such, the Alternative hypothesis was accepted; which states that "*Residential Green building developments* are hindered significantly by end-users' perceptions".

CONCLUSIONS

This study identified ten hindrances to GB developments in the Nigeria's Built Environment based on end-users' perceptions, out of which: The negative attitude of developers towards adopting / incorporating GB features in residential developments; which ranked 1st; followed by Divergent and Incompatibility of interests and views of success factors and success criteria of GB developments among stakeholders (2nd), Lack of Sufficient information regarding GB costs and performances (especially envisaged cost savings) is 3rd. Whereas, Lack of In-depth Awareness of the GB Concept (8th); GB as a new change (A new concept which comes with its uncertainties) – 9th; Cultural, Economic, Social and Technological (CEST) barriers – 10th; were the GB Hindrances with the least scores and as such least impact on GB Developments in Nigeria as perceived by the end-users.

On the Overall, the impact of these GB hindrances is significant which is further attested by the T-test statistical test of the research hypotheses by accepting the Alternative hypothesis; which states that "Residential Green building developments are hindered significantly by end-users' perceptions".

REFERENCES

Abolore, A. A. (2013). Comparative study of environmental sustainability in Building Construction in Nigeria and Malaysia, "Journal of Emerging trends in Economics and Management Sciences"3 (6),951-961.

Berardi, U., (2013). Clarifying the new interpretations of the concept of sustainable building. Sustainable Cities and Society 8, 72–78WU, Z. 2010. Current Status and Future Trend of Green Building in China. 2010 Shanghai EXPO.

Berke, P.R., (2002). Does sustainable development offer a new direction for planning? Challenges for the twenty-first century? "Journal of Planning Literature"17, 21–36.

Building Design and Construction (BD&C), editors. (2003). White Paper on Sustainability: A Report on the Green Building Movement. Building Design and Construction Supplement.

Byrd, H and Leardini, P (2011). Green buildings: issues for New Zealand. "Procedia Engineering", 21, 481-488.

Carmona Andreu, Isabel and Tadj Oreszczyn. (2004). Architects Need Feedback on Environmental Performance. Jul-Aug 2004, Vol. 32 (4). Building Research and Information.

D Dahiru, K Bala and AD Abdul'Azeez (2013). Professionals' Perception on the Prospect of Green Building Practice In Nigeria. SBE 13: Creating a Resilient and Regenerative Built Environment. 15-16 October 2013, Cape Town, South Africa.

ENSAR Group (2003). Sustainable Federal Facilities Task 2.1 Business Case. November 2002 workshop notes. Boulder, Co.

Environmental Protection Agency (EPA), n.d. GREEN BUILDING, available at http://www.epa.gov/greenbuilding/pubsabout.htm.

Fenn, P., Lowe, D., Speck, C. (1997). Conflict and dispute in construction. "Construction Management and Economics", 15 (6), 513–528.

Greg Kats (2003). The cost and financial benefits of green building" – A report to California's Sustainable building task force.

Karolides, A. (2002). Project Planning & Cost Estimating, In: "Green Building Approaches in Green Building" RS Means Co Ltd; USA Pp 1-22.

Kumo, Hassan Ali (2012). Perception of stakeholders on success criteria for world bank water supply projects in kaduna state – Nigeria. MSc thesis submitted to Department Of Building Faculty of Environmental Design Ahmadu Bello University, Zaria, Kaduna State –Nigeria.

LI, Y. & CURRIE, J. (2011). Green Buildings in China:Conception, Codes and Certification. Available: http://www.institutebe.com/Institute BE/media/Library /Resources/ Green%20 Buildings /Issue_Brief_Green_Buildings_in_China.pdf [Accessed Feb 11, 2012].

Lisa Fay Mathiessen and Peter Morris (2004). Costing green: "A Comprehensive Database and Budgeting Methodology"

Lynda Bourne (2005). Project relationship management and the stakeholder circle. PhD thesis submitted to Graduate school of business, RMIT University Melbourne, Australia.

MOC (2006). Evaluation Standard for Green Building (GB/T 50378-2006) [绿色建筑评价标准]. 1 ed.: MoC.

Nuruddeen Usman and Usman Mohammed Gidado (2015). An Assessment of the Factors Affecting Green Building Technology (GBT) Adoption. WASET 18th IC Jeddah Saudi Arabia Jan 26-27, 2015, 13 (01) Part XIII

Peter Morris (2007). "What does Green Really Cost?" PREA QUATERLY

Qian Shi (2008). Strategies of Implementing a Green Building Assessment System in Mainland China. Journal of Sustainable Development, 1 (2) Available at www.ccsenet.org /journal.html.

Salisu Gidado Dalibi (2012). Cost Impact Assessment of Green Buildings in China (A Case Study of Few Selected Green Building Projects in Shanghai, China). MSc Thesis submitted to Hohai University Nanjing – Jiangsu Province of China.

Salisu Gidado Dalibi (2014). Green Buildings: The Clients' & The End Users' Common Ground in Environmental Sustainability. Nigerian Institute of Quantity Surveyors (NIQS) National Training Workshop; in Uyo, Akwa Ibom State of Nigeria. 9th – 11th October 2014.

Salisu Gidado Dalibi, Hadiza Balarabe and Jamilu Bala MaiAuduga (2016). Green Buildings: A Concept aligning the interests of Stakeholders (Developers / Clients and End-users) in Estate Development Projects in Abuja - F.C.T (Federal Capital Territory), Nigeria. SBE16 Hamburg: Strategies – Stakeholders – Success factors. International Conference on Sustainable Built Environment in Hamburg, Germany. 7-11th March 2016.

Salisu Gidado Dalibi and Hassan Ali Kumo (2016). Success Criteria for Green Building Projects in the Nigeria's Construction industry: "The Stakeholders' perception". SBE16 Hamburg: Strategies – Stakeholders – Success factors. International Conference on Sustainable Built Environment in Hamburg, Germany. 7-11th March 2016.

Shelbourn A., Bouchlaghem, D. M., Anumba, C. J., Carillo, P. M., Khalfan, M. M.K., Glass, J., (2006). ITcon Vol. 11(2006), available at http://itcon.org/2006/4/ pg. 57

U. S. Green Building Council (2012). How to achieve certification, Accessed: February 21 2012, Available: http://www.usgbc.org/Display-Page.aspx?CMSPageID=1991, 2012.

Yujun Liu (2012). Green Building Development in China: A Policy-Oriented Research with a Case Study of Shanghai. Master's degree Thesis in Environmental Studies and Sustainability Science submitted to Lund University International Master's Program in Environmental Studies and Sustainability Science.

Zane Satterfield, P. E (2009). Tech Brief On Green Building, Published By: The National Environmental Services Centre (Winter 2009), Vol. 8, Issue 4 Tech Briefs.

Zhiyong Wang (2013). New cost structure approach in green buildings: Cost-benefit analysis for widespread acceptance and long-term practice. submitted to the System Design and Management Program in partial fulfillment of the requirements for the degree of Master of Science in Engineering and Management at the Massachusetts Institute of Technology January 2013.

HOME EQUITY CAPITALISATION: ANALYSIS OF INFLUENCING FACTORS

Stephen Ameyaw[1], Elvis Attakora-Amaniampong[2], Frederick Polukuu[3], Alhassan Tahiru[4], Victor Azindow Wumboribi[5]

[1,2,3,4,5] *Department of Real Estate and Land Management, Faculty of Planning and Land Management, P.O. Box UPW3, University for Development Studies, Wa Campus, Wa, Ghana*

It is argued that a significant number of home owners in the developing world with low incomes are asset-rich. The problem is that they hold these assets in defective forms. Strong property rights and titling are posited to be the means for unlocking the potentials of these assets as collateral for investment capital. There is however insufficient evidence to show how title/lease registration per se unlocks the potentials of these assets for enriching the lives of their holders. This study sought to find empirical evidence for or against this in Wa; an emerging city in a poverty endemic region where land documentation is reasonably practiced. The study adopted a cross-sectional design. Five communities and five financial institutions were randomly and purposively selected, respectively. The study reports a massive (88.7%) lease registration in among the respondents but few properties (14.7%) used as security for loans. Strong bequeath motive, unwillingness to access loan, risk aversion, prestige attached to ownership and bureaucratic nature of mortgage loans were the top five factors that hindered most property owners with registered leases to access equity release loans. Title/lease registration was found not to be the most important hindrance nor requirement for borrowing against an asset. Lenders requirements for legal documentation of a property was not limited to registered title/lease but included site plans. The main reason for lease registration was found to be the security of tenure and not for loan purposes. Therefore, the respondents who thought that their ownership rights were very secured by mere physical occupation on the land did not find any reason to register their leases. The concept of borrowing against an asset as poverty alleviation tool should be reconsidered by development advocates. Financial institutions and development advocates should invest in financial education as a step to increase the understanding of home ownership as an asset that can be safely traded. Further study is recommended to provide further evidence of the possibility of securing loans with property documentations other than registered lease (title).

[1] sameyaw@uds.edu.gh; stevopapa@hotmail.com
[2] eattak@uds.edu.gh
[3] damiendery@yahoo.com
[4]alhassantahiru95@yahoo.com
[5]victorazindow2017@gmail.com

Ameyaw, S., Attakora-Amaniampong, E., Polukuu, F., Tahiru, A. and Wumnoribi, V. A. (2017) Home equity capitalisation: analysis of influencing factors *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 773-802

Keywords: equity release loans, lease registration, investment capital, Wa

INTRODUCTION

A significant number of home owners with low incomes in the third world are said to be asset-rich, but such assets are described as "dead" because they are considered to be held in defective forms, namely; houses built on land whose ownership rights are not adequately recorded, unincorporated businesses with undefined liability and industries located where investors cannot see them (Terry and Gibson, 2006; De Soto, 2000). De Soto (2000) points out that these surprisingly abundant assets that the poor have in third world nations cannot be traded, used as collateral for a loan, or used as a share against an investment in their dead state. It is argued that these asset owners can enhance their quality of life by unlocking the hidden value of their properties through title registration. Although this proposition has received positive attention in development discourse (WDR, 2006; World Bank, 2007; Payne et al., 2007; Mahama, 2008; Bromley, 2008; Manya and Chris, 2007), it has also been criticised by many others (Barrows and Roth, 1990; Sukumaran, 1999; Abdulai et al., 2007; Abdulai and Hammond, 2010). Despite the empirical evidence provided by these critics against the theory, as Abdulai (2010) noted, land registration is still seen as a necessary aspect of poverty reduction in the developing world. It is therefore pursued religiously in developing economies with heavy donor funding from international development partners. Given this background, Abdulai (2010) examined the link that exists between land registration and access to investment loans from the perspective of the supply side of the mortgage market, arguing that a number of studies have considered the demand side. However, the literature on the demand side is still thin and focuses on borrower financials (sufficiency of borrower income to service the loan) and required documentation of the property securing the loan (Asare and Whitehead, 2006; Bank of Ghana, 2007a; Bank of Ghana, 2007b; Boamah, 2010a; Boamah, 2010b). Such perspective mostly limits the analysis to financial and documentation issues. However, some few housing finance literature seem to suggest that borrower characteristics, value systems and investment objectives affect the financial decisions of borrowers and hence the choice of using property as collateral for loan for whatever purpose (Hendrix (1995; Chaplin, 2000; Mitchell & Piggott, 2003; Gardner, 2003). That is, given that a property owner has a bankable property and registered [title] documents that may qualify him/her for a loan, the decision to take loan may be influenced by other factors. It is therefore argued in this paper that the use of property as collateral for loan may not only be a function of title and borrower financials, but other socio-cultural factors may also hinder the ability of a property owner to capitalise the property.

Third-world countries have been religiously pursuing land registration policies and programmes for many years, supposedly, to guarantee property ownership security and accessibility to investment loans for poverty reduction and development. However, despite many years of implementing land registration programmes in the third world, the continent remains poor and underdeveloped (Abdulai and Hammond, 2010). Payne et al (2007) note that De Soto's theory is based on the fundamental assumption that the provision of individual property rights can bring about a 'triple transformation'; where property can be transformed into collateral, collateral into credit and credit into income. However, despite the intellectual and financial investments made to date on land titling programmes, there are very few studies to support or challenge the application of land titling as the most appropriate policy option to achieve the important objective of social and economic development and urban poverty reduction (Payne et al, *ibid*). This suggests that De Soto's argument is too simplistic, and therefore, there is the need to probe further in the issue of poverty reduction. The reasons why these asset holders do not take advantage of it to improve their living standards need to be investigated, given that they have bankable properties and the ability to service a loan.

This study therefore examines some other possible factors that may hinder access to investment capital using a case study approach in order to provide empirical evidence for or against the argument that title registration is the most important factor for access to finance.

To achieve this aim, the following specific objectives are pursued:

1. To establish the extent of borrowing among property owners in the study area.
2. To examine the factors that hinder home owners from borrowing against property (equity release loans).

The rest of the paper is organized as follows. The next section discusses the theoretical basis of the study to place the study in context. Section explains the research methodology adopted. The results are presented and analyzed in section four and the last section concludes the study with a discussion of the key findings, policy implications and conclusion.

REVIEW OF LITERATURE

The concept of equity release loan

Equity is the proportion of the value of the house you truly own. It's the difference between your loan balance and your home's market value (Glenn et al., 1998). Equity release is the release of cash at a point in time in return for giving up some or all of the value of one's home. Terry and Gibson (2006) state that in simple terms, "it is described as a way of getting cash from the value of person's home". Thus, home equity in general could be seen as the current value of a house less any outstanding mortgage on it. Rowlingson and Mckay (2005) indicate that equity release is not simply about the product now defined in the market place as equity release, it can mean a

broad spectrum of options. Equity release, in a broader sense refers to the act of converting housing wealth into liquid assets (Rowlingson and Mckay, *ibid*). It allows homeowners to borrow against a proportion of their property to access money tied up in their home. The inability to do this, for whatever reason, makes the capital invested in this asset dead, according to De soto (2000).

In later life, a person's home often represents the bulk of their savings and for many people this equates to owning a valuable asset but having a restricted income. Home equity increases with time as mortgage payments are made and or as the value of the home increases. Property owners can use this strategy to extract cash out of their properties effectively by securing borrowing against the homes. In the developing world, land in particular, is the most basic aspect of subsistence, especially, in poor societies where wealth and survival are measured by control of and access to land (USAID, 2005). It is therefore not surprising that, it accounts for between 50-75 percent of the national wealth in such countries (Bell, 2006). However, the ability to convert this wealth into liquid asset is hampered by many factors. Michell and Piggott (2004) claim that in most developed countries, enormous wealth is held in residential property. They argue that, from the perspective of strategic asset allocation, an owner-occupied dwelling is illiquid and undiversified. For instance, elderly home owners are found to have lower incomes and yet, on average, possess greater housing wealth which includes land and buildings (Michell & Piggott, *ibid*). Benze (2012) state that, because property has value, it is essential for our free market economy and our ability to generate wealth. Indeed, the ability to create equity through property ownership is essential to the wealth-creating ability of a country. For instance, in the United States, equity loan or personal homes provide the funding for about 70% of all small business starts (Benze, 2012). This wealth creating ability given to them by their homes enables them to attain the standard of living they enjoy, including healthcare and others. Home equity lending has therefore been promoted as a means of accessing investment capital in the developing world (Gibler and Reed, 2003). This is because most homeowners use their own equity to build these homes and only stay in them. This tie up their equity in such assets and continue to live in poverty with their businesses also struggling due to lack of capital. A survey conducted by the World Bank in sixty low and middle-income countries indicated that the composition of assets banks accepted as collateral comprised 73% land and buildings, 18% machinery, and 9% accounts received (World Bank, 2014).

However, there is a paradox that will always challenge the equity release product market, namely, homeowners with the lowest incomes are likely to live in properties with the lowest value, and their properties are most likely to have fallen into disrepair. Those in the greatest need of equity release therefore find that their property does not meet the underwriting criteria for schemes offered by commercial organizations (Abdulai and Hammond, 2010). Furthermore, they may find that any income or capital they raise

through an equity release product affects their entitlement to means-tested state benefits (Actuarial Profession, 2005).

Types of equity release loans

As seen in the preceding section, equity release is the release of cash now in return for giving up some or all of the value of one's home (the equity). There are two distinct forms of equity release products in the developed world. A lifetime mortgage and home reversion. A lifetime mortgage is a loan that provides cash now, secured by mortgaging the home, with no payments of interest or principal until the property is sold when the home owners have (both) either died or moved permanently into residential care (Terry and Gibson, *ibid*). At that point, the provider of the loan must be repaid the principal, together with the interest that has been rolled up during the period of the loan. On the other hand, home reversion is the sale of the home now on terms that give the home owners the right to remain in rent-free occupation until (both) have either died or moved permanently into residential care (Terry and Gibson, *ibid*). At that point, the provider of the reversion can sell the home and retain whatever share of the proceeds was agreed under the reversion deal, paying any excess to the person's estate. In either case, the home owner can choose whether to release all or only part of the equity in the home. Whichever they choose, they remain responsible for keeping the property adequately maintained (Terry and Gibson, *ibid*).

Equity release products are mainly available in many advanced countries like Australia, Canada, the US, the UK, Japan and Singapore. These products are also gradually being introduced in some developed and developing economies like the Netherlands and China. Most markets are dominated by reverse mortgages with lump-sum payments instead of income stream reverse mortgages.

There are several reverse mortgage products in the United States but the predominant reverse mortgage is the Home Equity Conversion Mortgage (HECM). HECM are standardised government-backed reverse mortgages, via the Federal Housing Administration (Huibers, 2013). To encourage the development of the equity release market, the US government insures mortgages with a No-Negative Equity Guarantee (Huibers, *ibid*). The FHA provides for the No-Negative Equity Guarantee, financed by the borrowers. The HECM is considered the safest reverse mortgage and accounts for 95% of the market share (Ma and Deng, 2006).

The reverse mortgage is the predominant home reversion schemes which also exist in Australia but are relatively new. In Australia, the Senior Australians Equity Release Association (SEQUAL) members have to issue the 'no negative equity guarantee' to ensure the borrower can never owe more than the value of his house. The most popular product in Australia is variable rate loans, which are on average 1% above the standard variable home loan (Alai et al, *ibid*).

In the UK equity release products have been available for about 30 years and are basically made up of two types of equity release plans (Huibers, *ibid*). The most popular plan is a lifetime reverse mortgage. The other type

is a reversion plan - where the homeowner sells all or part of the property to the equity release provider in return for the right to remain there rent free.

In these countries, there are industries or self-regulating bodies that oversee the issuance of No-Negative Equity Guarantees or other regulation to protect consumers. The US has the National Reverse Mortgage Lenders Association (NRMLA) whereas Australia knows the Senior Australians Equity Release Association (SEQUAL). These associations commit their members to appropriate product design, high standards of practice and responsible borrowing and often serve as an educational source (Huibers, *ibid*). In the UK, many providers signed up to the Safe Home Income Plans (SHIP), a voluntary code of conduct which provides several guarantees. SHIP was formed in an attempt to improve the equity release market and its previous poor reputation. SHIP has been rebranded as Equity Release Council (ERC) in 2012 (Huibers, *ibid*).

A vibrant mortgage market is the engine on which equity release runs. This is a feature of most developed countries have in common. These markets have been developed by conscious and collective efforts by both governments and industry players in the various economies. Again, the establishment of regulations on equity release to protect the interest of customers, as well as lenders, has consolidated the gains of developed countries in the mortgage market. The likes of NRMLA in the US, the SEQUAL in Australia, the SHIP or ERC in the UK are but examples of regulatory bodies in developed countries overseeing the progress of the equity release markets. It is therefore not surprising that developed countries are reaping the full benefit of a second mortgage such as equity release which is evident in the lower numbers recorded for housing deficit and a propelled economic development.

The above success story, though was not achieved without great challenges, is the path for developing countries such as Ghana with the desire to explore alternative ways of reducing its ever-rising poverty level, housing deficit and promoting massive economic transformation. Given these developments in the developed markets and faced with sad reality of an underdeveloped mortgage market in most developing economies such as Ghana, what then is the state of equity release markets in emerging economies? The next section takes a look at the concept in emerging markets.

Equity Release in Emerging Markets

There has been very few studies on the potential markets for equity release products (ERPs) in emerging economies. Countries such as South Africa, India, Singapore, Hong Kong, South Korea and lately China are taking their turns in the practice of equity release. Though these markets differ from that of the developed markets, they are however beginning to take shape.

As an upper middle-income economy, South Africa faces an array of social and economic ills ranging from high poverty and inequality rates to high levels of unemployment (Luiz and Stobie *2010*). It has elements of both first and third world economies, but its financial sector falls into the former. In line with the other developed countries that make use of ERPs, South Africa

has also experienced a decreasing trend in household savings rates (Luiz and Stobie *ibid*). In South Africa, property ownership is highly rated in the national consciousness. For most working South Africans, their house and retirement provision account for the bulk of the wealth they have accumulated throughout their working lives (Luus, 2003; Luiz and Stobie, *ibid*).

Due to South Africa's political legacies, housing wealth is still distributed largely along racial lines, with the white population owning the lion's share (Luiz and Stobie *ibid).* Families in South Africa vary in their structure and complexity. In some homes, for example, a number of generations may live together under one roof. According to Luiz and Stobie (*ibid),* the South African market has seen substantial growth. They attribute this growth to reasons such as the following: rising consumption debt, big bank entry (Nedbank), change in saving trends and housing wealth patterns and absence of government regulations or obstructions to industry growth. The ERP industry may yet have growth potential in South Africa, especially if the means can be found to extend the product to low income households (at the bottom of the pyramid scenario) and allow the poor to capitalise on their most important asset, namely their home (Luiz and Stobie *ibid*).

At the present stage of economic reforms, both India and China are well on their way towards a system of housing financing that is increasingly dependent upon private capital, particularly through the channel of lifelong savings.

The Case of Ghana

In many developing countries (like Ghana), ill-defined property rights, incomplete real estate markets and competing forms of private-public supply, together with lack of long-term finance have been the defining obstacles for homeownership, especially for the lower stratum of the middle class (Bardhan and Edelstein, 2007).

According to the Bank of Ghana (BoG) (as cited in Ansomaa, 2011) Ghana has a checkered history of mortgage financing with several but un-sustained methods of housing finance. Banking and non-banking financial institutions have at one point offered mortgage facilities to the working class of the population. Their mortgage activities were however hampered by relatively high costs of borrowing and therefore the combined impact on the housing industry was limited, benefiting only middle and higher income groups. With the exception of the Home Finance Company (currently HFC Bank) and the First Ghana Building Society (FGBS), the other institutions are no more participants in the mortgage financing industry (Ansomaa, ibid). Therefore, the implementation of the liberalization policy led to the reformed HFC Bank and the emergence of Ghana Home Loans, Fidelity Bank, Cal Bank and Stanbic Bank coming into the mortgage market (Ampofo et al, 2013). Home equity mortgage as a form of loan in Ghanaian context is designed to enable borrowers who currently own a home to release the equity in those properties to improve their liquidity position. With this package, owners of real property are given the opportunity to release the

equity used in building their homes in return for cash to improve their liquidity position. Individuals or companies who have properties that are either fully paid for or are currently financed, but do have equity are also eligible to take advantage of this loan package. This reflects the foreign form of home equity mortgage as a second mortgage or reverse mortgage.

Informally, most of the banking institutions in the country have this product available to customers. But the question now is, to what extent is the product patronized? What prevents homeowners from releasing their equity to improve their liquidity position? In Ghana, home equity release is not provided to retired or aged home owners as it is being done abroad. Individuals and companies who own homes are eligible to take advantage of this package. The maximum loan allowed under this programme varies from bank to bank, but the loan term is usually 15 years and the interest rates are always variable. The various lending institutions that offer this product ascribe the same name to it. All the institutions, namely; Ghana Home Loan, Fidelity Bank, Cal Bank and Stanbic Bank call it "Equity Release". Under this arrangement, the property often serves as security for the loan and the repayment is actually dependent on the borrowers' other source(s) of income but not the property per se.

Challenges of Equity Release

It is noted that loan contracts are not only characterized by their interest rate, but also, as emphasized by Field and Torero (*ibid*), by non-price elements including collateral requirements. Poor borrowers are frequently denied access to loans because they lack adequate collateral to offer the lender as a warranty for their loan and also because of high costs of monitoring and processing relative to the magnitude of loans requested (Field and Torero, ibid).

One major challenge of equity release is the lack of prove of formal property ownership or rights. Property owners have houses but not titles, land but not deeds, business but not statutes of incorporation (De Soto, 2000 and Holden, 1997). Conventional economic theory holds that secure property rights to land, especially individual rights, are a prerequisite for land development and economic growth (Miceli et al, 2004). The problem is that they hold these resources in defective forms; houses built on land whose ownership rights are not adequately recorded (De Soto, *ibid*).

Aside proof of title, there are traces of literature that suggest that there are other factors that could pose a challenge to homeowners' access to capital. The issue of inheritance is central to the debate on whether housing wealth could or should be used to supplement income in old age. Many authors agree that attitudes to inheritance or bequeath are very important with regard to equity release products (Chaplin 2000; Mitchell & Piggott 2003; Gardner 2003). Chaplin (2000) argues that two of the strongest reasons for avoiding the market may be a desire to move from a current home and a powerful bequeath motive. According to Chaplin, elderly homeowners with strong bequeath motives may not find equity release product to be attractive because it reduces the worth of wealth their successors can inherit.

Therefore, few potential home equity borrowers without bequeath motives may go in for equity release product (Huibers, *ibid*). This may explain why the product is popular among the western nations where there is no cherished inheritance system like those in Africa.

Another behavioural obstacle is the perception of consumers in relation to uncertainty about what they will prefer in the future. That is future increases in expenses as in children educational fees, business expansion, medical bills and others might cause homeowners to hold on to their home equity. Many older people strongly believe in preserving their assets for some emergency in the future. The contemplation of future health problems often underpins this attitude, which is linked to the last-resort theory, and others accept that their rainy day has come or that there is something to be said for enhancing their standards of living while they are still alive (Davey, 2005).

Huibers (*ibid*) concludes that equity release products, especially reverse mortgages, are complex financial products and can be particularly challenging to some category of homeowners, especially the elderly. A study conducted by Huibers, (*ibid*) noted that the major challenge to Germans in accepting reverse mortgage as a form of equity release product is the lack of understanding among the public. Huibers, (*ibid*) asserted that the people with higher educational background will easily understand what equity release products are and also understand their complex nature. High illiteracy rates in our context may present a great setback to the smooth development of equity release and its products.

Another major behavioural aspect has to do with complex psychology of equity release product (Shan, 2011). For instance, in Ghana and Africa for that matter, households are reluctant to take on debt of any kind. This is due to the prestige attached to the ownership of such properties. They value owning their homes free and clear from any encumbrances so much that they are averse to the idea of borrowing against them. This study therefore seeks to empirically examine the effects of these and other factors on access to home equity loans in an emerging market using the case study approach.

METHODOLOGY

Wa, the case study area, is an emerging northern town located in the Upper West region of Ghana. The region is the poorest region in Ghana, according to the Poverty Mapping report of the Ghana Statistical Service (GSS, 2015). This notwithstanding, the town is an emerging business hub in the region, with a reasonable number of bankable properties. Although title registration is not yet implemented in the region, deed and lease registration are well practiced. The people of the region cherish their socio-cultural practices and value systems handed down to them by their forefathers.

Wa town is divided into ten divisions with about 30 communities for rating purposes. These divisions were adopted for this study to ensure that all properties within the study area are covered. The units of analysis in the

study were owners of bankable residential homes and Financial Institutions within the Municipality.

Both probability and non-probability sampling methods were used in the study. For the probability sampling, the multi-stage sampling method was used. The technique was used, firstly, to randomly select five divisions out of ten in order to give all the divisions an equal chance of been selected. Secondly, communities under each of the selected divisions were listed with numbers assigned to them and a table of random numbers was used to select one community each from the five divisions. Dobile, Kumbiehi, Konta, Kabanye and Kpaguri were the communities that were selected. The total housing population for the five selected communities was 1,241 houses. The study operated at a 95 percent confidence level with a 5 percent margin of error. Using the Yamane (1967) method, the sample size for the study was estimated to be 302 houses. This was proportionally distributed among the five communities. However, only 238 homeowners were readily available and accessible within the time frame of the study.

Purposive sampling technique was used in selecting the owners of what appeared to be bankable properties (good location, design and construction) who were available and willing to respond to the questions from each of the five selected communities. This was done because some of the bankable properties in the study area are often not occupied by their owners. Therefore, readily available and accessible homeowners in the communities were interviewed. Financial institutions were also selected purposively. They included Stanbic bank, SG-SSB, NIB, GCB and the Wa cooperative credit union. This was based on availability of equity release loan products. Open-ended questionnaires were administered to the financial institutions. Both close and open-ended questions were administered to the homeowners.

A number of reasons identified in the literature as factors that may hinder access to home equity release include the following:

1. Lack of registered lease
2. Unwillingness to access loan
3. Bequeath motives
4. Complex equity products
5. Transaction cost
6. Bureaucratic loan process
7. Interest rate
8. Property value
9. Awareness of the products
10. Risk aversion
11. Culture and prestige to ownership
12. Form of ownership

The study sought to scientifically establish the most prominent factor that hinders the greater percentage of people from accessing equity release loans in the study area. The respondents were asked to rank-order the reasons why they are unable (or do not want to) to secure loans with their property, in respect of each reason, using a five-point Likert scale with *strongly agree, agree, fairly agree, disagree* and *strongly disagree* rated as 5, 4, 3, 2 and 1 respectively.

The ranking indices were evaluated using the approach in Attakora-Amaniampong et al (2015), which was also adopted from Ibem and Amole, (2011). The data was analysed as follows. The ranking indices for the factors were estimated as the sum of all the rates given to a particular factor, *a,* by all respondents, Σy_a, divided by the possible total maximum rating for the factor, ΣY_a; multiplied by hundred. This percentage gave the ranking index (RI_a) for that particular factor *a,* from the perspective of all respondents. This is expressed algebraically as:

$$RI_a = \left\{\frac{\sum y_a}{\sum Y_a}\right\} \times 100$$

Where:

RI_a – the ranking index of a particular factor '*a*' (determined by all respondents),

y_a – respondents' actual ratings for a particular factor *a*

Y_a – the possible maximum raking for a particular factor *a*.

Therefore, given the scale of 1 – 5, the possible total maximum rating for a factor (Y_a) is $5n$ (where n is the number of respondents); and the possible total minimum score for a factor is n (i.e. 1n). Therefore, the possible minimum factor ranking index (RI_a) is:

(n/5n) x 100 = 20

And the possible maximum factor ranking index (RI_a) is:

(5n/5n) x 100 = 100.

Using the above scale, the respondents' rankings of the factors were calculated from the above formula and the rankings were expected to be within the range of 20 – 100. This was used in assessing the order of each factor. The results are presented and analysed in the next section.

RESULTS

Background data

Educational Level

Educational attainment of the respondents was observed because it may determine the level of understanding of the respondents, hence an increased desire to access home equity products (Chou et al, 2006). The data, as summarized in table 1 shows that 25.6% of the respondents never attended school, 14.7% had basic education, 28% attended either secondary or

vocational training schools and 47.9% completed tertiary institutions. This data is juxtaposed with the perception of the respondents on the complexity of mortgage products in table 19.

Table 1: Educational Level

Educational level	Frequency	Percentage (%)
Never attended school	61	25.6
Basic level	35	14.7
Secondary/vocational training	28	11.8
Tertiary	114	47.9
Total	238	100

Source: field survey, 2016

Occupation

Level of income, its acertainability and continuity are major factors considered in underwriting residential mortgages. As a result, formal sector employees remain the target of the main lending institutions in Ghana. Occupational data was therefore necessary for this study to enable the researchers to establish how many of the respondents would easily attract loan from any of the financial institutions. About 47.9% of the respondents were employed in the formal sector. These respondents have a reliable periodic cash flow in the form of salary. This assured periodic income gives these respondents an added advantage in terms of accessing loan from any financial institution. The remaining 52.1% were in the informal sector. This class of respondents did not have reliable regular cash flows that could be relied upon by the lending institutions. It may therefore affect the demand for equity release mortgages loans in the study area. This makes the informal sector workers an unattractive class to lenders. The data is summarised in table 2 below.

Table 3: Employment Background of Respondents

Sector of Employment	Frequency	Percentage (%)
Formal	114	47.9
Informal	124	52.1
Total	238	100

Source: field survey, 2016

Mode of Acquisition

Housing may be acquired through outright purchase (using mortgage loans or personal savings), incremental building (self-help, cooperative construction, short term personal loans, etc), rental or inheritance (Boleat, 1985; Appiah Kusi, 2014). The results however exclude rental housing since the study focused on owner occupiers. To establish equity position, respondents needed to specify how they acquired their homes. Table 3 indicates that about 81.5% of the respondents acquired their properties through incremental building approach. This establishes hundred percent

equity position in their homes giving them the freehand to release their equity whenever necessary.

Table 4: Mode of Home Acquisition

Home Acquisition	Frequency	Percentage
Outright Purchase	12	5.0
Inheritance	32	13.4
Incremental Building	194	81.5
Total	238	100.0

Source: field survey, 2016

The study further probed into the funding sources for their home acquisitions. Table 4 below summarises the data. The dominant funding approach was personal savings (84.5%). This is not surprising since the greater proportion of the respondents were informal sector workers as indicated in table 2 above.

Table 5 Source of Funds

Source of Funding	Frequency	Percentage
Formal Loan	27	11.3
Personal Savings	201	84.5
Informal Loan	6	2.5
Remittance	4	1.7
Total	238	100.0

Source: field survey, 2016

The remaining 15.5% used other forms of funding, namely; formal loans, informal loan processes and remittance from family members. Informal sector employment means that respondents were either self-employed or involved in a form of menial jobs. This means no formal income as required by most lenders. Informal workers would have to resort to personal savings as a means of accumulating resources for home acquisition. This confirms the report that housing finance in Ghana, like in many developing African countries, is characterized by dominance of informal funding (HFC, 2007). The report further estimated that about 80% to 90% of housing developments in Ghana are self-financed. This trend is seen in the linkages suggested above.

Forms of home ownership

In assessing the ability of home owners to use their home as security for loans, the form of home ownership needed to be assessed. The field survey revealed that out of a total of 238 private residential properties surveyed, 153 homes (64%) were owned by single individuals, 85 homes (36%) were in the ownership of more than one person (see table 5 below). This implies that most home owners did not have any restriction as to what to use the property for because they had absolute ownership over their homes.

Table 6: Forms of Ownership

Ownership Form	Frequency	Percent
Group ownership	85	35.7
Single ownership	153	64.3
Total	238	100.0

Source: field survey, 2016.

PROPERTY RIGHTS DOCUMENTATION

Forms of Ownership Rights

The form of right in a building is determined by the right one has in the land. This is because the ownership of land translates into the form of ownership right in the building. Respondents were asked to specify their ownership rights in the land and buildings they occupied. The results indicate that out of the total of 238 respondents, 226 respondents had leasehold interests in their land while 12 respondents had freehold interest in their land. This implies that all the respondents have some form of acceptable ownership which is generally recognized. However, it is worth noting that the "freeholders" were members of the land-owning families and therefore have *usufructuary* interests in the land, herein referred to as "freehold". The result is depicted in table 6 below.

Table 6: Forms of Ownership Right

Ownership Rights	Frequency	Percentage
Freehold	12	5.0
Leasehold	226	95.0
Total	238	100.0

Source: field survey, 2016

Registration of Land Documents

Ownership of land is best secured and protected when it is registered. This establishes on authority the legal owner of the land at any point in time. On table 7 below, out of the 226 leaseholders, 211 of them (93.4%) had registered their leases. The remaining 15 (6.6%) had not registered their leases. The massive registration is a good indicator for equity release loans. But is that the main reason for lease registration in the study area? The next section presents the data on reasons for lease registration

Table 7: Lease Registration

Lease Registration	Frequency	Percentage
Yes	211	93.4
No	15	6.6
Total	226	100.0

Source: field survey, 2016

Reasons for Lease Registration

According to Sittie (2006), lease registration serves two purposes. First, it gives certainty and facilitates proof of ownership. Second, it renders dealings in land safe, simple, cheap and prevents fraud on purchasers and mortgagees. Out of the 211 respondents who had registered leases (in table 7), 105 (49.8%) cited security of ownership as the major reason for registering their leases (see table 8). Problems in the land market within the study area accounted for this reason. For instance, a respondent indicated that: "These landowners are not correct, they can sell land to you and sell it to someone again and cause confusion". Only 2.4% of respondents with registered leases cited access to credit as the reason for their lease registration. Generally, about 96.7% of the respondents had their leases registered for security related reason. Table 8: summarises the rest of the results.

Table 8: Reasons for Lease Registration

Reasons	Frequency	Percent
Proof of legal ownership in times of litigation	55	26.1
Security of ownership	105	49.8
Protect the property	19	9.0
Avoid multiple sale	6	2.8
Ensure smooth transfer to heirs	5	2.4
Requirement by law	14	6.6
Meet the requirement for accessing credit	5	2.4
Aid in the payment of tax	2	0.9
Total	211	100.0

Source: field survey, 2016

Reasons for not Registering Lease

The study further delved into the perceptions of the few (27) respondents who had not registered their leases to find the reasons for their inactions. The results are summarised in table 9. Bureaucratic procedure and high cost of registration were the two main reasons that discouraged them from registration. It is worth noting that some respondents however considered physical occupation as enough evidence of ownership and therefore did not see the need to register their leases. *I don't want to have a formal agreement with the land owner which will limit my stay on the land; my presence on the land confirms that I am the owner*, says one respondent. This finding provides empirical evidence for the assertion of Abdulai and Hammond (2010) that ownership of land is not evidenced in writing: prove of ownership is by physical possession and occupation and the recognition of that fact by members, particularly by adjoin owners.

Table 9: Reasons for not registering

Reasons	Frequency	Percentage (%)
Being part of the land-owning family	4	14.8
Bureaucratic process	12	44.4
High cost of registration	8	29.6
Avoid formal agreement with landowners/Physical presence enough prove of ownership	3	11.1
Total	27	100

Source: field survey, 2016

EXTENT OF BORROWING AGAINST PROPERTY

Use of Property as collateral

Securing a loan with an existing property as collateral creates equity release mortgage. Out of the 211 (88.7%) respondents who had registered leases, only 31 (14.7%) of them had used their homes as collateral for loan (see table 10). This implies that most respondents (85.7%) had not released any equity from their homes, even though they had registered leases. This suggests that the use of equity release loans is not necessarily dependent on registration of land documents. But there are other reasons that need investigation. Table 13 takes a closer look at the other reasons.

Table 10: Use of Property as Collateral

Use of Property as Collateral	Frequency	Percentage
YES	31	14.7
NO	180	85.3
Total	211	100.0

Source: field survey, 2016

Mooya and Cloete (2008) strongly argue that titling does not foster credit market. This is a big blow to the proponents of the De Soto's theory which hinges heavily on the ability of poor households to register their titles to enable them leverage on the collateral value of their landed properties. If De Soto's argument is anything to go by, then 88.7% of the respondents should have accessed equity release loans because they have registered leases. In contrast, only 14.7 percent have accessed credit with their lease registered property. The researchers probed further to find out the purposes of the equity release loans contracted by the 31 respondents. Three main reasons came out strongly, namely: property renovation/construction, paying school fees, business expansion (see table 11). These are value addition reasons. However, compared with the greater percentage of lease registration for other reasons, it is clear that very few respondents registered leases with the intent of capitalisation.

Table 11: Purpose of Loan

Purpose of Loan	Frequency	Percent
Renovate property/Construction	18	58.1
Pay school fees	6	19.4
Business expansion	7	22.5
Total	31	100.0

Source: field survey, 2016

Number of loans and lending institutions involved

On home equity release, the study sought to find out the number of home equity loans that respondents had received from any of the financial institutions within the study area. Table 12 below shows that, GCB, Société Générale, National Investment Bank and Stanbic Bank were the commercial banks that offered some form of equity release loans to the respondents. It is important to note that, aside the mainstream financial institutions, Wa Cooperative Credit Union granted 19.4% (6 out of 31) of the equity release loans for the respondents.

Table 12: Lending Institutions and Loans Granted

Financial Institution	Frequency	Percentage
NIB	2	6.5
SG-SSB	10	32.5
GCB	11	35.5
STANBIC BANK	2	6.5
WA COOP. CREDIT UNION	6	19.4
TOTAL	31	100

Source: field survey, 2016

FACTORS AFFECTING ACCESS TO HOME EQUITY RELEASE

The study sought to scientifically establish the most prominent factor that prevents the greater percentage of people from accessing equity release loans in the study area. Respondents were asked to rank their agreement with the identified reasons using pairwise ranking. The results are summarised in table 9.0 below in descending order.

The results reveal bequeath motive as the first factor that hinders access to equity release loans among the respondents. It received the highest rating of 862 (81.71%) and therefore ranked first among the others. It is the most important factor that prevented the respondents form borrowing against their properties. The results also show that the lack of lease registration is the least of the limiting factors. It was rated 360 (34.12%) out of 1055 and therefore ranked last. This low ranking lacks the endorsement of lease registration by respondents in the study area as the main hindrance to equity release loans. Interestingly, title (lease in this study) registration has

been argued by scholars such as De Soto as a factor that influence the release of equity from a property. Table 13 above presents the other factors in descending order of their limitation.

Table 13: Ranking of Factors Influencing Home Equity Release

Reasons	Total Rating	Percentage (%)
I have bequeath motive	862	81.71
I am not willing to access loan	822	77.91
I don't like risk	778	73.74
My culture attach prestige to ownership	754	71.47
Loan process is bureaucratic	746	70.71
Equity products are complex for me	738	69.95
The product has high interest rate	728	68.00
High transaction cost	676	64.08
My property has low value	668	63.32
My form of ownership restricts me	526	49.86
I am not aware of home equity release	424	40.38
I don't have registered lease	360	34.12

Source: field survey, 2016

Bequeath motive

The issue of inheritance is central to the debate on whether housing wealth could or should be used to supplement income especially within the setting of the study area which is still largely under the jurisdiction of traditional beliefs and practices. The results in table 4.13 show that respondents rated their desire to hand down their property in inheritance as the most important factor that hinders the pledge of property as security for loans. Table 14 presents the frequency distribution of the responses of 211 respondents to this factor. More than half of the respondents (116 out of 214) strongly agreed and 49 agreed with the proposition that bequeath motive prevented home owners from pledging their properties as security for a loan. This confirms the findings of similar studies (Chaplin, 2000; Mitchel and Piggot, 2003; Gardner 2003) that a strong reason for avoiding the market is a powerful bequeath motive.

Table 14: Bequeath Motive

Option	Frequency	Total Rating
Strongly disagree	21	21
Disagree	10	20
Fairly agree	15	45
Agree	49	196
Strongly agree	116	580
Total	211	862

Source: field survey, 2016

Unwillingness to access loans

The study also reveals that respondents were simply unwilling to access equity loans. Data from the study presented in table 13 shows that unwillingness to access equity release loan with their properties was ranked the second highest reason. Some respondents held the view that *"…the house is the property of the whole family"*, a respondent indicated. This confirms Trust's (2004) finding that most home owners view their homes as a family asset rather than as capital. Table 15 presents the distribution of the responses to this factor.

Table 15: Unwillingness to Access Loan

Option	Frequency	Total Rating
Strongly disagree	27	27
Disagree	18	36
Fairly agree	23	69
Agree	25	100
Strongly agree	118	590
Total	211	822

Source: field survey, 2016

Prestige of ownership and risk aversion.

Unwillingness to take risk (risk aversion) was ranked third on table 13. The rating details of this factor are presented in table 16. Bequeath motive and prestige of ownership partly explain the risk aversion. In the African setting, the prestige attached to the ownership of landed properties is partly as a result of the ability to pass on properties to heirs in the event of the death. Subsequently, some owners of landed properties find it very difficult to use their properties to secure loans. This is because some have the fear that if they are unable to redeem the pledged property, it will be taken away from them and their heirs. This therefore deters property owners from taking the risk of extracting some of the equity locked up in the properties. It is therefore not surprising that prestige of ownership emerged as the forth factor (See tables 13 and 17). These value systems, despite the communal advantages, have negative impacts on the growth of the general mortgage market in Ghana.

Table 16: Risk aversion

Option		Frequency
Strongly disagree	27	27
Disagree	24	48
Fairly agree	23	69
Agree	51	204
Strongly agree	86	430
Total	211	778

Source: field survey, 2016

Table 17: Prestige of Ownership

Option	Frequency	Total Rating
Strongly disagree	51	51
Disagree	18	36
Fairly agree	13	39
Agree	17	68
Strongly agree	112	560
Total	211	754

Source: field survey, 2016

Bureaucratic nature

The process of acquiring a mortgage loan can sometimes be very tedious. Depending on the financial institution involved, the underwriting process could be protracted. It is therefore not surprising that respondents ranked the long process of accessing loans as the 5th limiting factor to their desire to go for home equity release loans (see table 13). The duration for getting a loan by the informal sector workers may even extend beyond the average in order to reduce the risk involved for the lender due to their irregular sources of income. Table 18 below provides further details on this factor.

Table 18: Loan Process is Bureaucratic

Option	Frequency	Total Rating
Strongly disagree	31	31
Disagree	26	52
Fairly agree	33	99
Agree	41	164
Strongly agree	80	400
Total	211	746

Source: field survey, 2016

Complex nature of equity release products

Huibers (2013) concluded that the major challenge to Germans in accepting reverse mortgage as a form of equity product is the lack of understanding among the public. In the context of the study area, respondents rated this factor as the 6th limiting factor affecting equity release (on table 13). Though the simple nature of the Ghanaian equity products gives it an added advantage, this study shows that a good number of respondents (119) still did not comprehend what is currently available in the market. This reason could be attributed to the low level of education within the study area (See table 1). The details are provided on table 19 below.

Table 19: Equity Release Product is Complex

Option	Frequency	Total Rating
Strongly disagree	33	33
Disagree	34	68
Fairly agree	25	75
Agree	33	132
Strongly agree	86	430
Total	211	738

Source: field survey, 2016

It is suggested that people who have higher educational background find it easier to understand the concept of a complex financial product such as equity release (Chou et al, 2006). On the contrary, the responses of those who had received tertiary education indicates that the level of education did not translate into their understanding of equity release and its products. This is suggested by the 119 respondents who agreed or strongly agreed that equity release products are complex.

High interest rate

The level of interest rate is a major issue for both lenders and borrowers. To the lenders it measures both their risk level and rate of return on amount given out. To borrowers, it constitutes a greater percentage of the cost of obtaining financial assistance from lenders.

From the field survey, high interest rate is a factor hindering the desire to use property in securing loan to improve their living conditions. Although it is a factor, it was not ranked high (7th on table 13). This suggest that interest rate is not as important as bequeath motive for some respondents. Only 79 (out of 211) respondents strongly agreed that interest rate is a major hindrance. See table 20 for other details. This is another interesting finding since interest rate and other macroeconomic indicators still remain a challenge in the Ghanaian housing finance market.

Table 20: The Product Has High Interest Rate

Option	Frequency	Total Rating
Strongly disagree	44	44
Disagree	20	40
Fairly agree	23	69
Agree	45	180
Strongly agree	79	395
Total	211	728

Source: field survey, 2016

High transaction cost

The study also sought to find out whether transaction costs prevent home owners from taking equity release loans. The data presented in table 21 below indicates that 66 respondents strongly agreed, 35 agreed, 29 fairly agreed, 38 disagreed and 43 strongly disagree with that assertion. Transaction cost was ranked 8th by respondents on table 13. This suggests that transaction cost is not a major concern among borrowers.

Table 21: Transaction Cost is high

Option	Frequency	Total Rating
Strongly disagree	43	43
Disagree	38	76
Fairly agree	29	87
Agree	35	140
Strongly agree	66	330
Total	211	679

Source: field survey, 2016

Property value

One of the factors that qualify a property owner for equity release is the value of the property. Property values have emerged as a challenge to equity release loans. Given the nature of traditional houses within the study area, respondents are faced with low property values. However, the influx of modern housing development within the study area is what accounts for the changing trends on housing values in the study area. Out of the 211 respondents, only 64 of them strongly agreed that property value is a factor while 59 of them strongly disagreed (see table 22). It was ranked 9th (see table 9.0), indicating that it is not a strong limiting factor. This could be as the results of the type of properties sampled. These were mainly bankable residential properties built with modern architecture and materials and located in relatively good residential neighbourhoods.

Table 22: Property Value

Option	Frequency	Total Rating
Strongly disagree	59	59
Disagree	20	40
Fairly agree	23	69
Agree	45	180
Strongly agree	64	320
Total	211	668

Source: field survey, 2016

Restrictions by form of ownership

The study sought to find out if the form of ownership restricted them from using their homes for equity release. The data obtained is presented in table 23. The results show that most (153) of these homes were owned by individuals (see table 5) and therefore they had absolute ownership over their homes. As a result, 115 respondents strongly disagreed that the form of property ownership is a challenge for assessing equity release. It is therefore not surprising that it was ranked 10th limiting factor on table 13.

Table 23: Restriction by Form of Ownership

Option		Frequency
Strongly disagree	115	115
Disagree	14	28
Fairly agree	9	27
Agree	9	36
Strongly agree	64	320
Total	211	526

Source: field survey, 2016

Awareness of home equity release products

From the survey, unawareness of equity release products was not identified as a strong reason for not using their property in securing loan. This means that the respondents were very aware of these products but just not willing to secure loans with their properties due to other factors as discussed. The factor was ranked eleventh among the twelve reasons for not using their properties in securing loans. Only 41 respondents (agree and strongly agree) out of 211 agreed to be unaware of such products. See table 24.

Table 24: Awareness

Awareness	Frequency	Total Rating
Strongly disagree	121	124
Disagree	30	60
Fairly agree	19	67
Agree	19	76
Strongly agree	22	110
Total	211	427

Source: field survey, 2016

Lack of registered lease

De Soto (*ibid*) argued that title registration is the most important factor that can unlock the potential of properties for the benefit of property owners. This study therefore sought to find out the extent of lease registration. Out of 238 respondents, 211 (88.7%) had registered their leases within the study area. (See table 3.0). The remaining 27 respondents (11.3%) had not registered their leases. The massive registration is a good indicator for equity release loans. However only 31 out of 211 respondents had secured loans with their properties. And as table 13 indicates, the main reason for this is the bequeath motive of the respondents (and some other factors); and not because of the lack of registered lease, which was ranked last on the list of limiting factors. Table 25 below presents the rest of the specific responses on this factor. This is not surprising since all the 211 respondents here had registered leases. For them, it is other factors that may prevent them from securing a loan with the property and are not expected to see lease registration as a hindrance. The factors discussed above become the most relevant consideration in the decision to borrow against property. Thus, lease registration is not an end in itself in this decision.

Table 25: Lease Registration

Lease registration	Frequency	Total Rating
Strongly disagree	159	159
Disagree	14	28
Fairly agree	6	18
Agree	8	32
Strongly agree	24	120
Total	211	357

Source: field survey, 2016

Challenges facing lenders in granting home equity release loans
All lending institutions understudied collectively provided these factors as the challenges facing them in their quest to grant home equity loans. `

Table 26: Challenges of Financial Institutions

Financial Institution	Challenges
NIB	Default, delay in loan repayment, lack of ready market for foreclosed homes, unregistered title, high bureaucracy in land documentation and title search.
SG – Ghana	Default, lack of ready market for foreclosed homes, unregistered title high bureaucracy in land documentation and title search. Location of properties.
GCB	Default, delay in loan repayment, lack of ready market for foreclosed homes, unregistered title, high bureaucracy in land documentation and title search.
STANBIC BANK	Fear of default, delay in loan repayment, lack of ready market for foreclosed homes, unregistered title to land and property, high bureaucracy in land documentation and title search.
WCCU	Fear of default, delay in loan repayment, lack of ready market for foreclosed homes, unregistered title to land and property, high bureaucracy in land documentation and title search.

Source: field survey, 2016

Although unregistered lease and issues relating to land documentation were identified as a challenge by all the financial institutions, they did not appear to be the major concern of the lenders. On the other hand, default, delay in loan repayment and lack of ready market for foreclosed homes appeared paramount (See table 26). This suggest that title registration is not an end in itself. There are other issues to consider and contend with in the quest to collateralise residential properties for investment capital in the study area in particular and, perhaps, other regions of Ghana and Africa.

Lender requirements for home equity release loans
Home equity release in the study area primarily takes the form of collateralised loan (field survey, 2016). Therefore, the requirements for home equity lending is the same as collateralized loans. These requirements are outlined institutionally in table 27 below.

All five financial institutions surveyed regarded lease registration as a major requirement for accessing home equity loans. They indicated that even though it is a major requirement, some additional and more important requirements were needed which included employer's guarantee, financial statements and others. This means that one can have a registered lease and still will not qualify for an equity release loan as a result of lack of the other requirements which is even considered to be more important than a registered lease per se. The banks' interest was not in the property but rather the clients' ability to pay off the loan as stipulated. The property is only securing the loan. This confirms the findings of Abdulai & Hammond (2010) that, financial capability of potential mortgagor is the main criterion

used by banks to grant investment loans; and land registration (lease) is not a prerequisite in mortgage related transaction but rather a post requirement. These requirements suggest that equity release products in the study area (and Ghana for that matter) are meant for active and working home owners whereas the product is meant mainly for older and retired home owners in the developed markets.

Table 27: Requirements for Accessing Loan Facility by Respondents

Financial Institution	Requirements
GCB	Must be a formal sector worker, 3 most recent pay slips, employer's guarantee, valid national ID Card, registered title to landed property (site plan, land certificate and lease insurance cover), and employer's guarantee.
STANBIC BANK	3 most recent pay slips, valid national ID Card, valuation report on landed property, registered title to landed property, employer's guarantee.
NIB	3 most recent pay slips, employer's guarantee, valid national ID Card, registered title to landed property (land certificate, and lease), employer's guarantee.
SG – SSG	Be an account holder, account turnover, valuation report on a landed property, registered title to landed property (site plan, land certificate, and lease insurance cover) and employer's guarantee.
CREDIT UNION	Must be an account holder, two guarantors, make a contribution for more than 20 days

Source: Field Survey, 2016

KEY FINDINGS, IMPLICATIONS FOR THE MORTGAGE MARKET AND CONCLUSION

Key findings

There is massive lease registration in the study area. About 88.7% of respondents had registered their interests. Leases were registered to give certainty and facilitate prove of ownership and to render dealings in land safe, simple, cheap and prevent multiple sales. The few who had not registered their leases argued that the cost of registration was high and that physical occupation was enough prove of ownership. Therefore, there was no need for lease registration. Bequeath motives of property owners was found to be the most limiting factor to the use of properties as collateral for equity release loans in Wa.

There is a sharp difference in the equity release products in the western/developed market and the emerging Ghanaian housing finance market. Whereas the product is meant mainly for older and retired home owners in the developed markets, it is meant for active and working home owners in Ghana.

The study confirms that bequeath motives, unwillingness to contract loans, complex nature of equity release products, high interest rate, high transaction cost and risk aversion are some other factors that greatly prevented most respondents from accessing home equity loans. The form of ownership, bureaucratic loan process, prestige of property ownership, the

levels of awareness of equity release loans and lease registration were factors that least affected access to equity release loans in the study area. Therefore, lease registration is not the only requirement for unlocking the potential of landed properties for poverty alleviation, but other factors such as cultural practices (inheritance system), social values (prestige of ownership) and the financial capability of potential mortgagors are equally important considerations. Although most people in the study area had registered their leases, they did not use their homes to secure loans due to these other reasons.

Home equity release loans market is still emerging within the study area. Only 14.7 percent of respondents had accessed home equity release loans. The participation of the Wa Cooperative Credit Union presents a broader borrowing potential for prospective borrowers in the informal sectors of the study area. On the other hand, the large informal sector workers who are generally unattractive to lenders and the general unwillingness on the part of property owners to access loans with their property (as a result of their strong bequeath motive) pose a great challenge to the growth of the equity release market in particular and the mortgage market in general.

Self-help was identified as the major approach to property acquisition accounting for 81.5 percent of respondents. Such owners did not have regular income and makes it difficult for them to qualify for equity release loans. Majority of homeowners (84.5 percent) used informal means such as their own personal savings to construct their houses.

Implications on the mortgage market

The results show that majority (52.1%) of the respondents had low level of education. As a result, a good number of the respondents (52.1) were employed in the informal sector. This class of people is normally not the target of lenders since their level of income cannot be monitored consistently by these lenders. It is not surprising therefore that out of 88.7% of the respondents who had registered leases, only 14.7% of them accessed loans. The Ghanaian mortgage market is therefore limited as a result of the large informal workers who are mostly left out because of their financial incredibility. As discussed earlier, bequeath motive, general unwillingness, and avoidance of risk are the three highly ranked limiting factors in the study area. Therefore, about 17.1% of the total respondents registered their lease for credit related reasons. This means a greater percentage (82.9%) of the respondents are not interested in this product. This is a limiting factor for the growth of the mortgage market.

Despite the strong threats of the limiting factors identified in this study, the home equity release market still has growth potential if the means can be found to extend the product to informal sector workers who are in the majority. Again, the participation of the Wa cooperative credit union presents a borrowing potential for equity release products for the informal sector workers.

RECOMMENDATIONS

It is recommended that, to encourage the use of equity release in the study area, emphasis should be on educating respondents to appreciate home ownership is an asset. Also, the mortgage industry should be more innovative in product development to meet the needs of the informal sector workers who are in the majority. Some of them earn very regular and high incomes, which if regularly saved, can increase their ability to service, which is one of the major considerations of lenders. It is also recommended that there should be further research to provide further evidence of the possibility of securing loans with property documentations other than registered lease (title).

CONCLUSION

It is argued that countries in the western world are developed because they have comprehensive land registration systems and that the reverse is the reason for the high levels of poverty and underdevelopment in the third world. This study sought to empirically examine the factors that hinder borrowing against one's property using a case study approach in order to provide empirical evidence for or against the argument that title registration is the most important factor for access to finance. It was found that majority (88.7%) of homeowners with registered leases had not accessed any equity release product for reasons other than the lack of lease registration. From lenders' perspective, although lease registration was found to be a requirement, some additional and more important requirements were identified which included income guarantees (evidenced by pay slips and employer's guarantee), financial statements and others. Therefore, lease registration is not the only important factor for unlocking the potential of landed property for investment capital. The study found bequeath motives, unwillingness to access loans, risk aversion, complex nature of equity release products, high interest rate, high transaction costs and source/certainty of income as equally important factors that prevent most respondents from accessing home equity loans. The form of ownership, bureaucratic loan process, the level of awareness of equity products and lease registration are minor factors that prevent people from accessing loans. Therefore, the argument that land registration is the solution to the problem of poverty and underdevelopment on the basis that it establishes security and guarantees accessibility to formal capital is too simplistic.

REFERENCES

Abdulai, R.T. and Hammond, F.N. (2010), "Landed property market information management and access to finance" *Journal of Property Management* Vol. 28 No. 4, 2010 pp. 228-244

Abdulai, R.T., Ndekugri, I.E., Olomolaiye, P.O. and Proverbs, D.G. (2007), "Land registration and security of land tenure: case studies of Kumasi, Tamale, Bolgatanga and Wa in Ghana", *International Development Planning Review,* Vol. 29 No. 4, pp. 475-502.

Alai, D. H., Chen, H., Cho, D., Hanewald, K. and Sherris, M. (2013), Developing Equity Release Markets: Risk Analysis for Reverse Mortgages and Home Reversions. UNSW Australian School of Business Research Paper No. 2013ACTL01.

Ampofo A.J., Abdullah A.M., Osei A. S., Annan K.S. and Owusu A. M. (2014), The Nature, Constraints And Implication of Current Mortgage Repayment Plans in Ghana (Unpublished Thesis Submitted to the Department of Real Estate and Land Management, UDS, Wa Campus).

Ansomaa, E. (2011), Mortgage Financing in Ghana. A Case Study of HFC Bank and Ghana Home Loans. Regent University College Of Science and Technology

Attakora-Amaniampong, E., Ameyaw, S. and Akortsu, W. (2015), Qualitative Adequacy of Purpose Built Hostels in Wa, Proceedings of the WABER 2015 Conference, West Africa Built Environment Research (WABER) Conference, Accra, Ghana, 10 -12 August, University of Ghana, vol. 2, pp 1013 - 1035

Australian Securities and Investments Commission (ASIC) (2007), All we Have is this House. Australian Securities and Investment Commission, Report No. 109.

Bank of Ghana (2007a). "The Housing Industry in Ghana: Prospects and Challenges" Bank of Ghana Policy Briefing Paper, Accra, Ghana

Bank of Ghana (2007b). "The Housing Market in Ghana" Housing Sector Study Report, November 2007

Bardhan, A and Edelstein, R.H. (2007), Housing Finance in Emerging Economies: Applying a Benchmark from Developed Countries; Mortgage Markets Worldwide (Editors: Danny Ben-Shahar, Seow Eng Ong, Charles Leung), Blackwell, 2007.

Barrows, R. and Roth, M. (1990), "Land tenure and investment in African agriculture: theory and evidence", *Journal of Modern African Studies*, Vol. 28, pp. 265-97.

Besley, T. (1995), Property rights and investment incentives: Theory and evidence from Ghana. *Journal of Political Economy* 103(5): 903-937.

Bell, K.C. (2006), "World Bank support for land administration and management: responding to the challenges of the millennium development goals", paper presented at the 23rd FIG Congress, Munich, 19 October.

Boamah, N.A. (2010), Urban Land Market in Ghana: A Case Study of the Wa Municipality; Urban Land Conference, 2010.

British Property Federation (BPF) (2006), Property Development and the Community: What are the Hidden Benefits of Development? BPF, London

Bromley, D.W. (2008), "Formalising property relations in the developing world: the wrong prescription for the wrong malady", *Land Use Policy*, Vol. 26 No. 1, pp. 20-7.

Chaplin, A. (2000), 'The reverse mortgage market: problems and prospects', In Mitchell,O. (ed.), Innovations in Housing Finance for the Elderly. Pension Research Council, University of Pennsylvania.

Canner, G.B., Durkin, T.A., Luckett, C.A., (1998), Recent developments in home equity lending. Federal Reserve Bulleting, pp. 241–251.

Council of Mortgage Lenders (CML) (2010), "CML confirms repossessions are last resort and in line with forecasts", available at: www.cml.org.uk/cml/media/press/1999.

Davey, J. (2005), The prospects and potential for home equity release in New Zealand. Office of the Retirement Commissioner, Report No. 98/2, Wellington.

De Soto, H. (2000), The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else (New York: Basic Books).

Feder, G., Chalamwong, Y., Onchan, T. and Hongladarom.C. (1988), Land Policies and Farm Productivity in Thailand. Baltimore: Johns Hopkins University Press

Gardner, C. (2003), Unlocking the equity release market. B&W Deloitte Insurance Industry Report, London.

Ghana Statistical Service (2015), Ghana Poverty Mapping Report. May 2015

Gibler, K. and Reed, R. (2003), The case for reverse mortgages in Australia: applying the USA Experience. Presentation at the 9th Annual Pacific Rim Real Estate Society Conference, Brisbane, 19–22 January 2003.

HFC Bank, (2007), Challenges and Opportunities for Developing Mortgage Markets: The Ghanaian Experience. HFC Bank: Ghana. [Online]. Retrieved December 28, 2015 from http://www.hfcbankgh.com

Hendrix, S. (1995), 'Myths of Property Rights', Arizona Journal of International and Comparative Law 12: 183

Heywood, G and Pena, N.D.L. (1996), How problems in the framework for secured transactions limit access to credit. Working paper, Center for the Economic Analysis of Law, Peru.

Holden, P. (1997), Collateral without consequence: Some causes and effects of financial underdevelopment in Latin America. The Financier 4(1): 12-21.

Huibers, C.C.H (2013), Equity Release to Supplement Pension; Risk Anlaysis of Reverse Mortgages: Executive Master's Thesis for Actuarial Science.

Ibem, E. O. and Amole, O.O. (2011), "Assessment of the qualitative adequacy of newly constructed public housing in Ogun State, Nigeria", Property Management, Vol. 29 No. 3, pp 285-304

Kusi, A.G. (2014), The Role of The Informal Sector In Housing Provisioning In Kumasi: A Bachelor of Science Dissertation Submitted To The Department of Planning, Kwame Nkrumah University Of Science And Technology, Kumasi.

Luiz, J.M. and Stobie, G. (2010), The market for equity release products: lessons from international experience; *Southern African Business Review* Volume 14 Number 2 2010.

Ma, S., and Y. Deng. (2006), Insurance Premium Structure of Reverse Mortgage Loans in Korea. Working paper, available at SSRN: http://ssrn.com/abstract=938213

Mahama, C. (2008), "The mortgage market in Ghana", in Abdulai, R.T. and Hammond, F.N. (2010), "Landed property market information management and access to finance" Journal of Property Management Vol. 28 No. 4, 2010 pp. 228-244

Miceli, T. J., Sirmans, C.F., and Kieyah, J. (2004), The demand for land title registration: theory with evidence from Kenya. *American Law and Economics Review*, 3(2), pp. 275-287.

Mitchell, O. and Piggott, J. (2004), Unlocking housing equity in Japan, NBER Working Paper No. 10340, National Bureau of Economic Research, Boston, MA.

Manya M. M., Chris E. C (2007), Property Rights, Land Markets, and Poverty in Namibia's 'Extra- Legal' Settlements: An Institutional Approach. *Global Urban Development* Volume 3 Issue 1 November 2007.

Nyamu-Musembi, C. (2006), Breathing Life into Dead Theories about Property Rights: De Soto and Land Relations in Rural Africa. IDS Working Paper 272.

Payne, G., Durand-Lasserve, A. and Rakodi, C. (2007), "Urban land titling programmes", in Brother, M.E. and Solberg, J.-A. (Eds), Legal Empowerment – A Way Out of Poverty, Norwegian Ministry of Foreign Affairs, Oslo.

Rakodi, C. (1999), A Capital Assets Framework for Analysing Household Livelihood

Rowlingson, K. and McKay, S. (2005), Attitudes to Inheritance in Britain. Bristol: The Policy Press for Joseph Rowntree Foundation.

Shan, H. (2011), Reserving the Trend: The Resent Expansion of the Reverse Mortgage Market. Real Estate Economics, 39(4), 743-768.

Sittie, R. (2006), Land Title Registration –The Ghanaian Experience; Shaping the Change, XXIII FIG Congress, Munich, Germany, October 8-13, 2006

Sukumaran, K. (1999), Hunted, Hounded, and Homeless in Indore: A Report of Large Scale Forced Evictions, IPT Report, Mumbai.

Terry, R. and Gibson, R. (2006), Obstacles to Equity Release, Joseph Rowntree Foundation. York: York Publishing Services.

Tomlinson. R.M. (2007), A Literature Review on Housing Finance Development in Sub-Saharan Africa. Access to Housing Finance in Africa. Commissioned by FinMark Trust.

Tomlinson, M.R. (1999), 'From rejection to resignation: beneficiaries' views on the South African government's new housing subsidy system', *Urban Studies 36*, 1349-59.

United States Agency for International Development (USAID) (2005), Land and Conflict: A Toolkit for Intervention, USAID, Washington, DC.

World Development Report (WDR) (2006), Equity and Development, World Bank, Washington DC.

World Bank (2007), World Bank Assistance to Agriculture in Sub-Saharan Africa: An IEG Review, World Bank, Washington, DC.

IDENTIFYING THE FACTORS INFLUENCING REAL ESTATE PRICING IN KUMASI METROPOLIS

Aloysius Sam[1] and Sarfo Mensah[2]
[1,2]*Department of Building Technology, Faculty of Built and Natural Environment, Kumasi Technical University, Kumasi, Ghana*

Real estate developers have stepped up business efforts to close up the housing deficit in Ghana. However, affordability of houses remains a mirage to most low and middle-income earners. Pricing of these houses need investigation. This paper identifies the main factors that influence the pricing of real estate houses in the Kumasi Metropolis in Ghana, a developing country. Using snowball and purposive sampling methods, 29 members of the Ghana Real Estate Developers Association (GREDA) in Kumasi were involved in the study. Data obtained were analysed using descriptive statistics techniques. The results indicate that foreign exchange, cost of materials, location or proximity to city centre, access to land, interest rate on loans and types of buildings are the main factors affecting the pricing of real estate housing in the Kumasi Metropolis. Real estate housing providers need to consider reducing the frequency of use of imported products in housing delivery. Significant shift to the use of local construction materials, after adding value to them, would play an important role in reducing the demand for foreign currencies, which has been found to be a major contributor to non-affordability of real estate houses in the study area.

Keywords: affordability, Ghana, Kumasi, pricing, real estate housing.

INTRODUCTION

Housing is a basic necessity of life of every nation and the quality of housing establishes a fundamental basis for assessing the standard of living of that household and to some extent, the nation as a whole (UN-Habitat, 2011). Thus, high housing costs can strain a family budget and constrain availability of resources for other household needs such as utilities, education, health care, transportation, saving for retirement and emergencies. Lamudi (2015) describes this situation by reporting that high housing costs also drain the family budget of expendable income that might

[1] suisam02@yahoo.com
[2] sarfmenghana@gmail.com

Sam, A. and Mensah, S. (2017) Identifying the factors influencing real estate pricing in Kumasi metropolis *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 803-813

otherwise be spent in the local economy, thus, reducing the expenditure linkages of a household.

Ghana, as a developing country, is facing a lot of rapid urbanization issues in its major cities. The rate of urbanisation is directly related to the demand for houses. Rapid population growth and increasing urbanization have made lack of shelter one of the most critical problems currently facing the country. Increasing overcrowding, declining quality and access to services characterize much of the housing stock in Ghana. (UN-Habitat, 2009). Rural–urban migration and population growth has undoubtedly increased the demand for housing and put severe pressure on existing infrastructure in most cities. Subsequently, most residents in cities in Ghana encounter serious accommodation problems as they desperately look for decent and reasonably priced houses to rent (Ministry of Works and Housing, 2000).

It is argued by Bank of Ghana (BoG, 2007) that improved housing markets will provide a number of positive externalities, as well as direct consumption benefits. GREDA was established to promote the development of residential estate, to increase the stock of housing units thereby ensuring adequate provision of affordable housing for all classes of the population (GREDA, 1999). However, only five to eight percent of Ghanaians can afford a house from their own resources due to relatively unaffordable prices of real estate houses. About 60 percent of the people in Ghana need some form of financial assistance, while up to 35 percent will not be capable of owning or building a house in their lifetime (Adinyira, 2016). Moreover, Ghana has a housing deficit of about 1,000,000 units as at the year 2010 in view of 2.4% population growth rate per annum (Ghana Statistical Service, 2012). It is therefore estimated that 500,000 houses are needed annually in order make up for the housing deficit (ibid).

Without taking a second look at optimizing the pricing of real estate houses in order to improve affordability, it is highly possible for the housing deficit to remain at its current level or worsen. Therefore, the aim of this paper is to identify the factors that influence real estate pricing in Ghana, a developing country, in order to facilitate strategies for improving housing affordability for especially, the low-income urban dwellers. Kumasi Metropolis is selected as the urban area in Ghana for this study.

CHARACTERISTICS OF STUDY AREA IN RELATION TO HOUSING

Kumasi is the second largest city in Ghana and the capital city of Ashanti Region. It is located between latitudes 6.350 N to 6.400 N and longitudes 1.300 W to 1.350 W and covers a total land area of approximately 245 km2 (Wireko-Gyebi and Ametepeh, 2016). The city was considered appropriate for this research in view of the fact that, according to the Ghana Tourism Authority, (GTA, 2015), Kumasi has all categories of accommodation units with the exception of a five-star hotel. The city is also uniquely positioned, making it a traversing point from all parts of the country. This has caused the city to experience frequent rural-urban migration leading to increasing

rate of urban population and associated proliferated untidy urban accommodation (usually slum areas) for mostly low-income earners and some transit travelers.

Population distribution largely reflects housing distribution in Ghana. The 2010 Population and Housing Census placed Ghana's population at about 25.9 million. According to Prudential Bank Ghana Ltd (2012), prices of land in Kumasi ranged from as low as US$4,136.50 to as high as US$966,494.00 per acre. In the neighborhood of '*Asokwa'*, a light industrial area, a standard 30m x 30m plot of land sold for $31,023.80 in 2003. By 2006 the same parcel of land was priced between $103,413.00 and $155,119.00. In '*Apire'*, a low-density residential area in Kumasi, a standard building plot was sold for $1,551.19 in 2003 and in 2006, the same parcel of land increased in price by about 12.4% to $3,619.44. In 2012, the highest cost of land in Kumasi was recorded as $966,494.00 for an acre of land at *'Adum',* which is the Central Business District in Kumasi. On the other hand, land in the *'Zongo'* Extension, a comparatively low-income earners residential area, sold for about $4,136.50 (Prudential Bank Ghana Ltd, 2012). On average, a low-cost three-bedroom house cost US$32,143.00 in the informal housing market and sells for $50,000.00 in the formal housing market. A semi-detached house costs between US$30,000 and US$90,000 and detached self-contained house cost between US$50,000 and US$110,000 in the formal housing markets (BoG, 2007). Noticeably, the land prices are highly instable and could account for instability in prices of housing in Kumasi.

INFLUENCES ON PRICING OF URBAN HOUSES

Wilhelmson (2009) recognises that housing pricing are impacted by several factors. (Bowen *et al.*, 2001) also argue that there are independent determining factors of pricing, which are limited to structural characteristics of housing unit, accessibility and location in terms of quality of neighbourhood. GREDA (2007) found that, cost of construction materials and land acquisition are the major forces influencing the continuous increase in housing prices. GREDA also noted that remittances play an important role in financing the housing market in Ghana. This study identifies and examines specific factors in literature that could affect the pricing of real estate houses in the Kumasi Metropolis.

The Location factor

There is an adage in real estate housing discipline that states that the three most important factors, which determine property values are (i) location, (ii) location and (iii) location. Spatially, no two properties are the same and indeed, there is a consensus among Valuers, that location is the most important factor in property value determination (McCluskey et al., 2000). The importance of location in pricing of real estate houses is evident in the fact that location defines the distance of a given accommodation from features such as commercial, transportation and leisure activities. Again, in cases where houses within a particular sub-market or neighbourhood are homogeneous, most of the amenities that are common to those properties

are best represented by location (Gelfand et al., 1998). Location is an inherent attribute of a house which directly determines the quality and hence the market value of the house. The theory of housing immobility is premised on location. The locational influences on the value of residential property may arise from a number of sources. These are grouped under neighbourhood quality and accessibility (McClauskey et al., 2000).

The neighbourhood quality factors that influence residential property values include (a) exposure to adverse environmental factors (b) neighbourhood amenities (c) perceived levels of neighbourhood security etc. Depending on the presence or absence of these amenities, residential properties may reduce or increase in value (Gallimore et al., 1996). Neighbourhood amenities are the necessary services and attractions within the neighbourhood that makes life easy and comfortable for the inhabitants. The more there are good and high level of amenities like schools, hospitals, shopping facilities, leisure facilities, road and other transportation networks in a place, the more it would be pleasant to live in that place. Thus, it would not be unexpected that such a place would sell or be hired out at comparatively higher prices. As Atati (2014) noted, the level of amenity in a neighbourhood is obviously a qualitative factor. It can therefore be determined subjectively by different individuals. Even though it cannot be measured directly, its value can be assessed by consumers. Similarly, the perceived levels of security in a neighbourhood, determined by the absence or presence of factors such as crime, drug peddlers and users has the tendency of affecting the pricing of houses in such areas (Gallimore et al., 1996).

Furthermore, easy and convenient accessibility within a neighbourhood are location factors that have ability to affect the pricing of facilities. Such accessibility measures relate to ease and cost of transportation. Relatively, locations that allow easier access to various necessary or desirable activities such as marketing, have higher property values, all other things being equal. Accessibility also relates to convenience of moving people and goods from one site to the other by overcoming the use of time and cost. Transportation ease affects cost. Therefore, how easy and convenient it would be for people to have access to and from place of work, recreational and social services is critical to the determination of price to pay for a particular property in a given location (Owusu-Ansah 2012). Other factors influencing housing prices are discussed below.

The accommodation/building size factor

The level of accommodation and size of a house could influence the value or price to pay for the house. As the property level of accommodation increases, it is possible for a willing buyer to pay higher price (Bog 2007). The number of rooms (bathrooms, public rooms and bedrooms) dominantly affects price in the positive direction (Sirmans *et al.* 2005). Thus, as the number of rooms increase, the price of the property could also increase.

The age and structural condition of houses and associated facilities

The materials that go into the construction of a property and the structural improvement made to the property affect the price to pay for the property. Usually, the availability of facilities like swimming pool, garages and gardens in a property would make rational buyers pay higher price for such a property (BoG, 2007). In a typical developing country city like Kumasi, it is necessary to investigate into the effect of a building's age and condition on its pricing. This would help in identifying appropriate ways to improve affordability.

The age and condition of a property could also influence the price to be paid for the property. In examining the factors that are mostly included in hedonic models to determine house prices, Sirmans *et al.* (2005) found that the age of property influences the value of the property mostly in the negative direction. Apart from the age, the structural condition of the property could also affect the price to pay for the property. If a property is old but has gone through substantial refurbishment, it will demand higher price than a similar property that has not been refurbished.

Complexity and cost of land acquisition

Land in Ghana is either owned by the government, an individual or group of individuals or a family. Residential lands delivered in the private/traditional sector are usually without infrastructure (Opoku-Boateng, 2011). According to Bank of Ghana (2007), the cost of inputs and land acquisition are the main driving force behind the persistent increases in house prices. The complexities associated with Ghana's land tenure system also influence pricing of houses. The immediate results of such a problem are lack of transparency and the ease of transfer, which perpetuates multiple sales of property (BoG 2007). It was ascertained that some of these problems are being tackled by the Land Administration Project (LAP), yet a lot still needs to be done. Demand for land has been more than supply, which is fixed. When supply is severely constrained, and demand is very high, land prices become inflationary, ultimately leading to high project cost. Escalating land prices constituted 10.8% of the problems.

Influence of building materials cost

The provision of infrastructure and affordable housing for citizens is constrained by high cost of building materials, especially Portland cement (Asibuo, 1994). Adding to the land problem is the high cost of building materials both local and imported (Ahadzie and Badu, 2010). This has resulted in increased cost of buildings within the past decade, making it difficult for the average Ghanaian to acquire a house before retirement (Edusei, 2003; Opoku-Boateng, 2011). The rising cost of buildings in most developing countries is also due to over reliance on imported building materials. This state of affairs to a large extent is as a result of the low production at the local level, lack of adequate mechanization, and lack of finance (Decardi-Nelson and Solomon-Ayeh 2011). Building materials account for 50 percent of the total cost of construction in Ghana (Asibuo, 1994). Generally, according to Aliyu *et al.* (2012), the problems in developing

countries' housing industry include that of scarcity and high cost of imported building materials. Aliyu *et al.* further explained that high cost of materials is detrimental to the affordability of the low and moderate income groups. Thus, high cost of building materials is identified as one of the major problems militating against the construction industry in most developing countries.

High interest rates on loans

A more stable currency coupled with low interest rates is likely to lead to lower housing prices. Most estate developers and individuals resort to bank loans to construct properties. High interest rates would raise the cost of construction and this is ultimately passed down to a prospective home owner. Conversely, lower interest rates would culminate in stability in housing price (Lamudi, 2015). In Ghana, high inflation rates and liquidity risks for lenders have stemmed from high interest rates (Boamah, 2010). Surprisingly, according to the BoG (2007), about 95 percent of developers do not identify the level of domestic interest rates as a major problem. Thus, further investigation is needed to ascertain the significance of interest rates to the pricing of real estate houses.

Foreign exchange volatility

For developing countries like Ghana, foreign exchange is a crucial factor that affects the price of commodities. This situation exists in view of the country's imports outstripping its exports, subsequently leading to an over reliance on foreign currencies such as the US Dollar. The instability of the Ghana Cedi has led many property developers to fall on the strategy of pricing houses in terms of US Dollar as a way of hedging against value depreciation. This means home prices move up when the Cedi depreciates and conversely drops when the local currency outperforms the US Dollar (Lamudi, 2015). The extent of importance of foreign exchange rate to the pricing of houses in the urban areas needs to be ascertained.

Land Tenure /access to land

The land tenure in Ghana plays a crucial role in housing delivery. The different types of lands, such as public and customary lands, as well as the roles of the indigenous, public and private sectors do not only determine the housing delivery system in the country, but also the rate at which houses are supplied. Insecure tenure is a major problem in Ghana, where many land transactions are not covered by proper documentation (Abdulai and Owusu-Ansah, 2010). Individuals or group of individuals who occupy land face the risks of illegal removal, eviction or harassment by government or individuals, corporations or other legal persons (UN-HABITAT, 2009). Customary land tenure, operated through chiefs and long leases, run as if they were freehold. However, such lands are not secure enough to attract bank lending. Thus, developers' efforts made in securing land for putting up real estate houses for sale are not without challenges such as incurring high cost of lease processing. The effect of these land tenure issues on pricing of houses in the urban areas requires ascertainment.

RESEARCH METHODS

To achieve the aim of identifying factors that influence real estate pricing in Kumasi Metropolis, a questionnaire survey approach was adopted. From the website of GREDA, the total number of members of is 123 (GREDA, 2014). The information available on the website did not indicate the locational addresses of the members. Thus, snowball sampling and purposive sampling methods were adopted leading to identification of 30 members in the Kumasi Metropolis. Out of the 30, 29 responded. Data obtained were analysed using descriptive statistics techniques. Respondents were asked to rank the level of importance of the factors on a 4-point Likert scale. This 4-point scale was chosen to prevent respondents from providing neutral answers. The ranking facilitated the determination of severity indices (SI) for the various variables identified. The SI obtained served as a measure of the level of influence of the variables on pricing of real estate houses. On the basis of the study of Elhag and Boussabaine (2002), a variable scoring a severity index of 70% or more was found to be relevant and thus adjudged significant.

RESULTS AND DISCUSSIONS

All the 29 respondents had been working in the real estate industry for more than 7 years with the corresponding companies being in existence for more than 10 years. From the results shown in Figure 1, most of the respondents normally find themselves in managerial positions, where major decisions on pricing are taken. This gives an indication of the reliability of data collected.

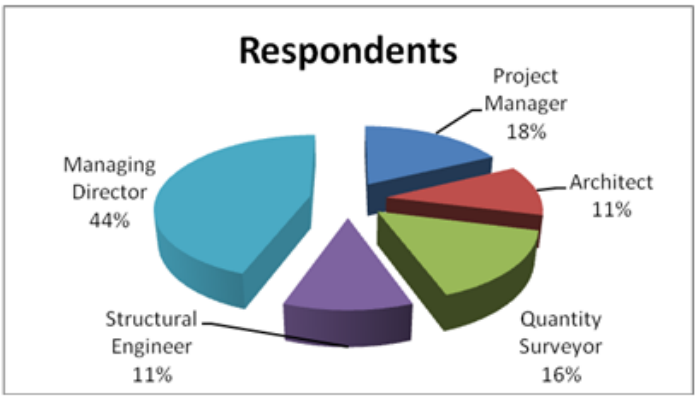


Figure 1 Respondents Professions

From the analysis results in Table 1, the most significant factor influencing pricing of estate houses in Kumasi is foreign exchange rate. This gives an indication that most of the materials used for the construction are imported. Importation of materials require using foreign currencies, which normally result in relatively higher prices of the materials. The frequent rate of the cedi depreciation would largely account for this phenomenon. Prices of buildings would normally be quoted in the local currency, the currency for trading in a particular country. However, lately, most developers in Ghana have resorted to quoting prices of houses in terms of US Dollars. The fact

that foreign exchange rate plays a major role in determining the prices of real estate houses could account for the trend of developers quoting prices in US Dollars in the local housing market.

Building materials account for 50 percent of the total cost of construction in Ghana (Asibuo, 1994). Asibuo further reported that the high cost of building materials in many developing countries, including Ghana, has resulted in the overall high-cost of construction placing satisfactory shelter beyond the reach of larger section of the population. The cost of materials also emerged as the second most significant factor influencing pricing of housing. Moreover, according to Ahadzie and Badu (2011), building materials, both locally-produced and imported, have resulted in the increased cost of buildings in most developing countries including Ghana. Therefore, it is not surprising to find in this study, that high cost of building materials is one of the major influencers of prices of real estate houses in Kumasi.

Table 1 Factors influencing the pricing of real estate houses in Kumasi

S/Nr	Factors affecting the pricing of real estate housing	Percentages	Index	Rank
1	Foreign exchange rate	62	96.7	1
2	Cost of materials	60	93.5	2
3	Interest rates on loans obtained by estate developers	49	80.6	3
4	Location	49	80.6	3
5	Home types built	42	74.4	4
6	Access to land	42	72.5	5
7	Inflation rates	27	61.7	6
8	Cost of labour	18	56.9	7
9	Fluctuation of material prices	18	55.8	8
10	Tax implication	18	55.8	8
11	Access to Credit	16	52.7	9
12	Mode of debt payment by the public	11	51.8	10
13	Security services	13	50.9	11
14	Access to services	11	49.2	12
15	Inefficient Technology on site	4	47.5	13
16	Duration of contract period	11	43.3	13
17	Inadequate skilled personnel	11	42.6	14
18	Land Litigation	18	41.4	15
19	Cost of purchasing/hiring equipment	9	40.3	16
20	Cost of maintenance	11	39.7	17
21	Insurance cost	4	39.7	17
22	Change in minimum wage	7	39.2	18
23	Transportation cost of materials and labour	7	38.7	19
24	Inadequate skilled personnel	9	38.7	19
25	Dispute on site	7	38.2	20
26	Lack of co-ordination between consultants and contractor	7	37.2	21
27	Cost of processing building permit	4	37.2	21
28	Poor financial control on site	7	36.7	22
29	Inadequate planning	2	35.4	23
30	Poor supervision on site	4	34.5	24

Interest rates charged as cost of financing real estate houses development, by both commercial banks and non-banking financial institutions, was found as a significant pricing influencer. Interest rate can easily be linked with foreign exchange rates in Ghana. Boamah (2010) reinforced this idea that high inflation rates have increased the credit, interest rate and liquidity risks for lenders in Ghana. Interest rates in Ghana are comparatively higher than other countries and this represents a major contribution to increasing prices of real estate houses in Kumasi. Furthermore, the importance of location in influencing the price of estate houses is evident in the results obtained in Table 1. The results buttress the fact that location is one of the most important factors that determines the price of a house in developing country's urban area like Kumasi. However, in the light of the popular adage that the three most important factors, which determine property values are (i) location, (ii) location and (iii) location, it is surprising that location did not emerge as the most significant among the factors identified.

It is worthy to also mention that inadequate supervision, poor planning and poor financial control on site were found to be inconsequential to determining the prices of house in the real estate market in Kumasi. Such issues are found to be related to coordination and other managerial functions of consultants and contractors during construction activities. It is difficult for developers to perceive the relationship between theses managerial functions and the pricing of houses. Thus, it is likely for managerial decisions that go into determining pricing of real estate houses to be devoid of managerial functions that occur during construction of the houses.

CONCLUSIONS AND RECOMMENDATIONS

This study provides preliminary results and insights into the pricing of real estate houses as a contemporary phenomenon in an urban area like Kumasi in a developing country. The findings provide an understanding into the extent of the housing problem in an urban area, as well as the factors that contribute to the pricing of estate houses within a given socio-economic context.

Foreign exchange rate, cost of building materials and location have been identified as the main factors influencing pricing of houses in the Kumasi Metropolis. In order to ensure or improve affordability of real estate houses in Kumasi and other urban areas of similar socio-economic characteristics, governmental policies that would stabilize or strengthen local currency are critical. Developers' ability to depend more on improved indigenous building materials would also contribute to houses price reduction. Real estate housing providers need to consider reducing the frequency of use of imported products in housing delivery. Significant shift to the use of local construction materials, after adding value to them, would play an important role in reducing the demand of foreign currencies, which has been found to be a major contributor to non-affordability of real estate

houses in the study area. This will also enhance the ability of developers to deliver sustainable affordable real estate housing to the poor and middle-income earners in developing countries. Additionally, governmental policy interventions that would stabilize the local currency need to be put in place in order to minimize the effect that the foreign exchange factor has on real estate housing pricing, as found in this study.

REFERENCES

Abdulai and Owusu-Ansah, (2010), House price determinants in Liverpool, United Kingdom, current politics and economics of Europe, 22(1), pp 1-26

Adinyira, E. (2016) Mortgage financing: Rising risk push informal sector out of the bracket, *Real Estate Journal GREDA* Vol. 3 pp 8-10

Ahadzie, D. K., and Badu, E. (2010), Success indicators for self-build houses in two Ghanaian cities, *Journal of Science and Technology,* Vol.31 (3, pp 86-96

Aliyu. A. A., Kasim, R. B., and Martin, D., (2012), Impact of violent ethno-religious conflict on residential property value determinants in the Jos Metropolis of Northern Nigeria: *OIDA International Journal of Sustainable Development.* 4(9), pp 35-49

Asibuo, S. K. (1994), Effect of structural adjustment programme on housing. Paper prepared for the Friedrich-Ebert Foundation at a workshop in Accra-Ghana.

Atati, F. O., (2014). An investigation into the factors that influence housing in developing countries, (Research Project Work)

Bank of Ghana (2007). The housing market in Ghana. Accra: Research Department Bank of Ghana

Boamah, N. A., (2010). Housing Affordability in Ghana: A focus on Kumasi and Tamale. *Ethiopian Journal of Environmental Studies and Management.*Vol.3 No.3, pp 1-11

Bowen, W., Mikelbank, M. and Prestegaard, D. (2001), Theoretical and Empirical Considerations Regarding Space in Hedonic Housing Price Models. *Growth and Change.* 32, pp 466-90

Decardi-Nelson, I. and Solomon-Ayeh, B., (2011). Towards sustainable housing finance: Is housing mortgage an option for Ghanaians? *Journal of Building and Road Research Institute (CSIR).*

Edusei, J., (2003). Mass housing development by public estate developers – the experiences of state housing company limited. *Journal of Building and Road Research Institute (CSIR).* Vol. 8, pp 17-26

Gallimore, P., Fletcher, M. and Carter, M., (1996). Modelling the influence of location on value. *Journal of Property Valuation and Investment,* 14(1), pp. 6-19

Gelfand, A. E., Ghosh, S. K., Knight, J. R. and Sirmans, C. F. (1998). Spatio-Tempora Modeling of Residential Sales Data, *Business and Economics Statistics 16, pp. 312-321*

Ghana Real Estate Developers Association GREDA (2007). GREDA General Information. Retrieved from: www.gredaghana.org/greda/aboutgreda.asp)

Ghana Statistical Service (2012), 2010 Population and Housing Census final result. Accra: Ghana Statistical Service

Ghana Tourism Authority (2015). Summary of accommodation plant 2009, Ghana Tourism Authority, Accra, Ghana.

GREDA (2014) Members list, available at http://www.gredaghana.org/members.htm accessed on 22nd June 2017.

Lamudi C. (2015), Six Major Factors Affecting Housing Price in Ghana https://www.modernghana.com/lifestyle/8035/six-major-factors-affecting-housing-price-in-ghanahousing.html. access 30th January 2017

McCluskey, W. J., Deddis, W. G. Mannis, A., Lamont, I. G. and Borst, R. A. (2000). The application of surface generated interpolation models for the prediction of residential property values. *Property Investment ad Finance,* 2, pp. 162-179

Ministry of Works and Housing, (2000). National Shelter Strategy Part 2 – Background Report Policy Planning, Evaluation and Monitoring Unit. Accra: Ministry of Works and Housing.

Opoku-Boateng, E., (2011), Plan to improve housing delivery and access in Ghana. *Emerald (online). www.emrald journal.com*.

Owusu-Ansah, A., (2012), Examination of determinants of housing values in urban Ghana and implication for policy makers, Foundation for African Real Estate Research.

Prudential Bank Ghana Ltd. (2012). Research by the Estate Officer of the Kumasi branch on pricing land in Kumasi.

Sirmans, G. S., Macpherson, D. A. and Zietz, E. N. (2005). The composition of hedonic pricing model. *Journal of Estate Literature,* 13(1), pp 3-43

United Nations Human Settlement Programme (UN-HABITAT). (2009). Ghana: Accra Urban Profile. (Brochure) Kuria F.

UN-HABITAT, (2011) United Nations Human Settlements Programme. Accessed on: 12/02/2017 http://www.unhabitat.org

Wilhelmson, M., (2009), Construction and updating of property index series: The case of segmented markets in Stockholm, *Property Management,* 27(2), pp119-137

Wireko-Gyebi, S. and Ametepeh, R. S. (2016). Influence of socio-demographic characteristics and occupational attributes on work-related stress among frontline hotel employees in the Kumasi metropolis, *African Journal of Hospitality, Tourism and Leisure Volume* 5 (2) - (2016) ISSN: 2223-814X

IFC SCHEMA EXTENSIONS FOR CONSTRUCTION CASH FLOW MANAGEMENT: A PROPOSED METHODOLOGY

M. Abdullahi[1], Y.M. Ibrahim[2], A.D. Ibrahim[3], and P.G. Chindo[4]
[1,2,3,4]*Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria*

Previous studies have explored the automation of construction cash flow analysis and management process and have developed several software applications that eliminate the manual exercises attributed to previous methods through automated spreadsheet solutions, cost-integration methods, Artificial intelligence techniques and more recently using 5D Building Information Models. However, these diverse CFM software applications which are based on different data formats do not directly or automatically exchange information heterogeneously due to interoperability challenges. This is fundamentally due to lack of standardization, and while the BuildingSMART Industry Foundation Classes (IFC) data model is currently the widely adopted data standard for information sharing and exchange in the AEC/FM industry, it's scope does not capture data specifications that support cash flow management, hence the lack of interoperability among this CFM applications. This study reports the methodology for a proposed PhD research underway to develop Industry Foundation Classes Data Schema for Construction Cash Flow Management (CFM). The study will adopt the BuildingSMART IFC development methodologies for the schema extensions and development. Information requirement identification and analysis for CFM will first be conducted and subsequently, process and information requirement models would be developed and finally schema extensions are developed and tested. The proposed data schema extensions will cover the entire CFM process; planning, forecasting, monitoring and controlling of construction cash flows.

Keywords: BuildingSMART, cash flow management, IFC

INTRODUCTION

The Architectural, Engineering, Construction and Facilities management (AEC/FM) industry is widely regarded as a highly fragmented industry that hugely relies on traditional means of communications based on paper documents and 2D CAD. This approach is mostly associated with errors,

[1] bnabdallah02@gmail.com
[2] makarfi@gmail.com
[3] adibrahim2@yahoo.com
[4] pcgangas@yahoo.com

Abdullahi, M., Ibrahim, Y. M. Ibrahim, A. D. and Chindo, P.G. (2017) IFC schema extensions for construction cash flow management: a proposed methodology *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 814-826

omissions, and duplication of efforts which often cause unanticipated field costs, delays, and eventual lawsuits between the various parties on a project (Eastman, Teicholz, & Sacks, 2011). Efforts to improve this traditional approach to information management and exchange includes the development of alternative organizational structures such as the design-build method; the use of real-time technology such as project Web sites for sharing plans and documents; and the implementation of 3D CAD tools. Even though these methods have gone a long way in improving the management and timely exchange of information, they have done little to reduce the severity and frequency of conflicts caused by paper documents or their electronic equivalents. Recently, the emergence of Building Information Modeling (BIM) have greatly addressed most of the deficiencies of the information management approaches and is seen as a promising innovation capable of addressing the inefficiencies in information management which affects the overall productivity of the industry.

Despite all the attendant benefits associated to BIM adoption, studies have reported interoperability challenge as the major bottleneck to BIM adoption worldwide (Gallaher, O'Connor, Dettbarn, & Gilday, 2004). Interoperability is the ability of two or more systems to seamlessly exchange information among each other without any data loss. To address the problem of interoperability, a number of CAD vendors have supported BIM using their own proprietary solutions. However, because these solutions are based on diverse, proprietary non-compatible standards, data sharing and exchange continue to be the major bottleneck affecting the rate of BIM implementation by construction professionals. This challenge necessitated the need for an open and neutral data format that ensures data interoperability across the different applications. Extensive research efforts have been invested into the development of standard data models to facilitate data sharing and exchange amongst heterogeneous software applications. The Initial Graphic Exchange Specification (IGES) and PDDI efforts in the United States, the VDA-FS effort in Germany, and Standard for the Exchange of Product Model Data's (STEP) Building Elements Using Explicit Shape Representation (Part 225 of STEP), and the Plant Spatial Configuration (Part 227 of STEP) are classic examples of the earliest solutions proposed by researchers. Similarly, in the construction industry, various standard data model in addition to STEP have been developed. These include early models such as; General AEC Reference Model (GARM) (Gielingh, 1988), the RATAS building data model (Bjork, 1989), and the CIMSteel model (Watson & Crowley, 1994), developed for structural works. However, the most significant international data modeling standardization effort in the construction industry is the BuildingSMART International (BSI) industry foundation classes (IFCs). BSI is a subdivision of ISO and have made tremendous progress since its inception in the year 1999 with several chapters and more than 600 member organizations around the globe (BSI, 2016).

On the other hand, the construction industry has been reported to have recorded the highest number of insolvencies than any other sector of the

economy. For example, 17.5% cases of bankruptcies were reported in the UK alone in 1989 (Kaka, 1999). These insolvencies were mostly attributed to poor financial management practices resulting from the inadequate attention given to cash flow issues at project and corporate levels. Therefore, as a way of tackling these problems, researchers have employed various approaches (deterministic and stochastic) to develop tools that facilitate the effective and efficient management of construction cash flows in the last decades. Previous studies have explored the automation of construction cash flow analysis and management process and have developed several software applications that eliminate the manual exercises attributed to previous methods through spreadsheet solutions (Hegazy & Ersahin, 2001), automated cost-integration methods (Abudayyeh & Rasdorf, 1993; Navon, 1995, 1996), Artificial intelligence techniques (Boussabaine & Elhag, 1999; Boussabaine & Kaka, 1998; Chen, Tsai, Tseng, Wang, & Chung, 2002; Cheng & Roy, 2011; Odeyinka, Lowe, & Kaka, 2013) and more recently Building Information Modeling (Kim & Grobler, 2013; Lu, Won, & Cheng, 2016). However, these diverse CFM software applications which are based on different data formats do not directly or automatically exchange information heterogeneously due to interoperability challenges. This is fundamentally due to lack of standardization, and while the BuildingSMART Industry Foundation Classes (IFC) data model is currently the widely adopted data standard for information sharing and exchange in the AEC/FM industry, it's scope does not capture data specifications that support cash flow management, hence the lack of interoperability among this CFM application.

The overall aim of the ongoing PhD work is to develop IFC data schema extensions that support construction cash flow management. However, this paper is aimed at describing the methodology proposed for the schema development. The succeeding parts the paper is organized in the following sections; industry foundation classes schema; CFM approaches in the construction industry; CFM information requirement; the research process and conclusions.

LITERATURE REVIEW

Industry foundation classes data schema

The IFC data model is a top-bottom hierarchical data schema made up of four (4) layers. Each layer comprises of number of modules which further contain various entities, types, enumerations, rules and functions (Ma, Zhenhua, Wu, & Zhe, 2011). The entity represents the abstraction of objects which have the same properties, and is the information agent that describes the information of building and surrounding components when the IFC standard is used. The current IFC Model -IFC4- covers nine domains of building construction controls; architecture; electrical; structural elements; structural analysis; heating, ventilation, and air conditioning (HVAC); facilities management; plumbing and fire controls; and Construction Management (BSI, 2016). Using entities, attributes and relationships, IFCs provide set of object oriented specifications that describe construction

products (such as walls, doors, roof, etc.) and processes (such as quantity takeoff, estimating). These specifications enable the development of a common language that allows project models to be shared at the same time allowing each profession to define its own view of the objects contained in that model. The IFCs enable interoperability among various AEC/FM software applications, allowing software developers to use IFCs to create applications that use universal objects that are based on the IFC specification.

Although the BuildingSMART international IFCs have made tremendous achievements in addressing interoperability challenges, their extent of coverage of the complex construction products and processes is still limited and inadequate (Aouad, Wu, & Lee, 2006; Ma, Zhenhua, et al., 2011). Hence, several researches have been carried out to extend the schema across various dimensions ranging from product descriptions to process definitions (Froese, Fischer, Grobler, Ritzenthaler, & Yu, 1999; Gokce, Gokce, & Katranuschkov, 2013; Hassanain, Froese, & Vanier, 2001; Kim & Seo, 2008; Lee & Kim, 2011; Ma, Lu, & Wu, 2011; Ma, Zhenhua, et al., 2011; Motamedi, Soltani, Setayeshgar, & Hammad, 2016; Froese & Yu, 1999; Vanlande, Nicolle, & Cruz, 2008; Wan, Chen, & Tiong, 2004; Weise, Katranuschkov, Liebich, & Scherer, 2003). IFC extensions proposed to cover other domains, products and processes include cost estimating and scheduling (Faraj, Alshawi, & Aouad, 2000; Froese et al., 1999; Ma, Lu, et al., 2011; Ma, Zhenhua, et al., 2011; Staub-French, Fischer, & Kunz, 2003; Tanyer & Aouad, 2005); facilities management (Hassanain et al., 2001); precast concrete structures (Rönneblad & Olofsson, 2003); structural analysis (Lee & Kim, 2011; Weise et al., 2003); and lifecycle cost assessment (Fu, Aouad, Lee, Mashall-Ponting, & Wu, 2006; Gokce et al., 2013; Lee & Kim, 2011; Motamedi et al., 2016). Despite the complexity of the IFC standard Weise et al. (2003) reported the IFC standard to be inadequate and has not captured several construction use cases.

THE RESEARCH PROCESS

To achieve the objectives set for this study, a combination of research techniques will be used. The first stage of the study will involve review of literature, basically to put the research into context and to identify the variables required to extend the IFC data schema. The second stage would involve the evaluation of the CFM information requirements identified and lastly the final stage will focus on the development, implementation and validation of the IFC model. The overall picture of the research process is depicted in the IDEF0 process diagram on Figure 1.

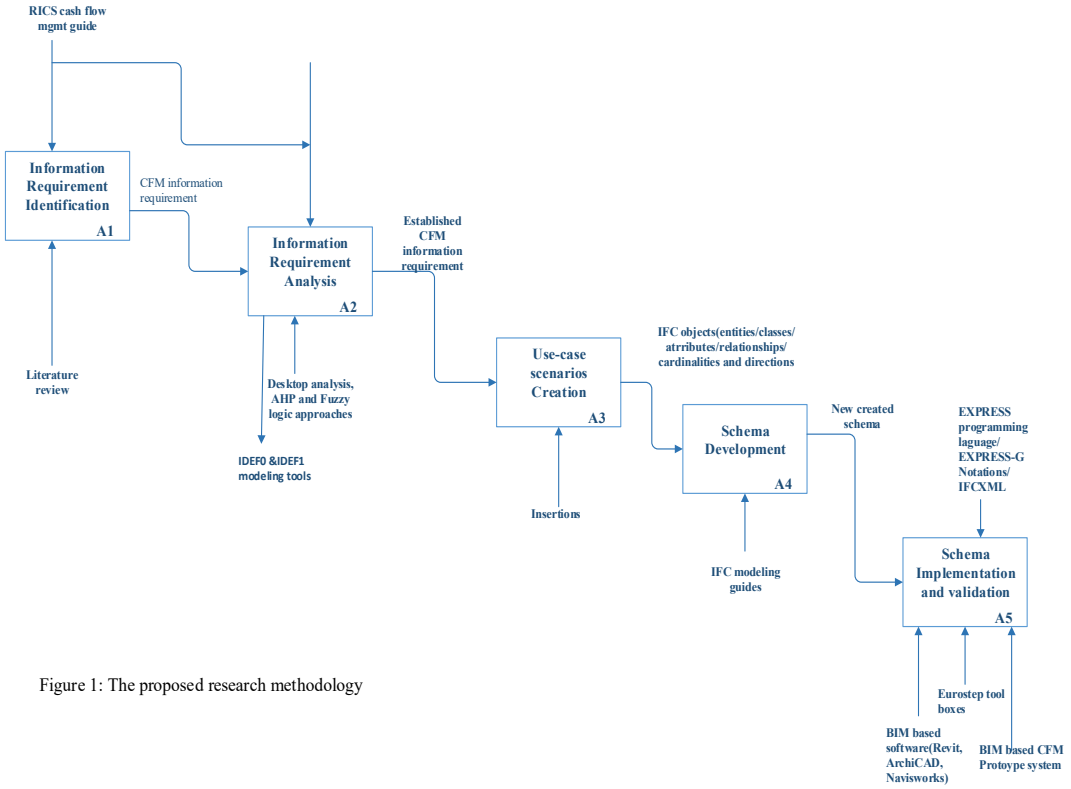


Figure 1: The proposed research methodology

Information Requirement identification and Analysis

Information requirement identification

This research adopts the quantitative methodological approach. This is fundamentally due to the nature of the research problem seeking to answer 'how much?' and 'how many?' questions, and also the philosophical stand of the positivist epistemological position adopted. Quantitative approach would be employed to both data collection and analysis. The information requirements for CFM would be identified and evaluated using the quantitative approach. Similarly, using the same approach, a fuzzy decision support system whose key inputs are made up of quantitative parameters (risk factors, cost, value, etc) will be developed as one of the components of the prototype system that will be developed for testing the IFC data schema extensions.

The information requirement would be identified via the following two approaches below.

LITERATURE REVIEW

A comprehensive review of literature on relevant topics such as Building information modeling; cash flow analysis and management; estimating and scheduling; fuzzy set theory, IFC data modeling will be carried out throughout the research process. The review would essentially identify the various components of the cash flow management (planning/analysis/monitoring and control) and the information

requirement for each component. Furthermore, to facilitate the development of the CFM decision system, risk factors impacting on construction cash flows would also be identified and subsequently evaluated. The impact of the risk factors will be used to determine the membership functions that define the linguistic variables to be incorporated in the fuzzy decision support system.

Various online databases, electronic journals and other internet search engines will be used for literature search. Key journals on construction information technology (IT) such as' Automation in construction, Computing in Civil Engineering(ASCE), Information Technology in Construction(ITCON), Advance Engineering Informatics, Construction Engineering and Management(ASCE), etc. will be considered as key literature sources for the study.

QUESTIONNAIRE SURVEY

A structured questionnaire survey will be conducted to evaluate CFM information requirement and risk factors identified in literature. The main aim of the survey is to establish the information entities relevant to CFM and to determine the potential risk factors capable of influencing the successful CFM of construction projects. The risk factors will be captured in the IFC extension and then incorporated into the fuzzy decision support system to be developed for the validation of the data model. The survey will involve construction professionals largely responsible for the management of cash flows in construction firms.

This study will consider construction firms as its population. Although the Corporate Affairs Commission (CAC) of Nigeria keeps the record of all duly registered construction firms in the country, the list is usually not well updated and therefore contains both extant and extinct firms (Abdulrazaq, 2015) with no real addresses to be located. Therefore, based on that, a list of active registered construction firms that duly remit their taxes to Federal Inland Revenue Services (FIRS) obtained by Abdulrazaq (2015) is adopted in this study. The list shows that there are Ten thousand, two hundred and thirteen (10,213) active contractors across the country, and using Cochran (1977) table and correction formula (as shown in equation 1), a sample size of 370 construction firms was computed and will be used as the study sample. Purposive sampling method will be used to select the firms to be involved in the survey. This is on the basis that not all firms practice cash flow management as reported in the literature (Abdullahi, Ibrahim, & Ibrahim, 2014; Abdulrazaq, 2015; Abdulrazaq, Ibrahim, & Ibrahim, 2012).

$$\mathbf{n_1} = \frac{\mathbf{n_o}}{(\mathbf{1} + \mathbf{n_o}/\mathbf{Population}))} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{1})$$

Where;

Population= Population size obtained from FIRS (10,213)

n_o= required return sample size according to Cochran's Table

n_1 = required return sample size because sample is > 5% of population

METHOD OF DATA ANALYSIS

Information requirement analysis

A combination of both descriptive and inferential statistical tools will be employed to analyse the data set collected. The information requirement identified will be evaluated using relative importance index (RII). Analysis of Variance (ANOVA) will be used to investigate difference in mean responses of the various categories of firms considered in the study. This is to further confirm the statement made by Odeyinka et al. (2003) and Abdullahi et al. (2014) that size of firm significantly affects their CFM practices.

The risk index (R) model developed by Zayed and Liu (2014) would be used to assess the effect of the risk factors identified on construction project cash flows. The R-index is made up of two components: weights of risks and their effect score. Weights of risk areas will be determined using Artificial Hierarchy Process (AHP) while the effect score will be assessed using fuzzy logic approaches. The R-Index is represented in the equation 1 below (Zayed and Lui, 2014).

$$R_k = \sum_{i=1}^{n} W_i * E_i(x_i) \quad \text{.....1}$$

Where,

R_k : Risk index for construction cash flows using k levels (Probability of failure).

W_i: Weight for each risk area i using Eigen value method.

$E_i(X_i)$: Effect score for each risk area (X_i).

X_i: Different risk areas i.

i: 1, 2, 3,.. . .. ., n.

The risk factors and other established information requirement would be used to develop a fuzzy cash flow management prototype system which will be used to validate the IFC extensions developed.

Reliability and construct validity tests will be conducted to determine the appropriateness of the survey instrument used in the study. While Cronbach's alpha (α) model, which measures the internal consistency will be employed for the reliability analysis, content and face validities will be used to validate the questionnaire through pilot survey.

Information requirement modelling and use-case scenarios

Process and Information Requirement Models Development

Augmented Integrated Definition of Process Models (IDEF) data modelling technique would be used to develop the process and information requirement model for the schema extension. The main purpose of developing the process models is to define the requirements for information sharing amongst the various CFM components. The augmented IDEF1-based process oriented modelling methodology is an integration of process and information (Chen et al., 2004). IDEF0 data modelling technique would be used to develop the process models while the information requirements will be abstracted and modelled directly in IDEF1 information model which will be used for the IFC object modelling. The IDEF0 and DEF1 techniques will be adopted because of their user-friendliness and top-down hierarchical structure advantages (Chen et al., 2004), and extensive software support (BSI, 2016).

Identifying classes, entities, attributes and relationships

As a requirement for developing IFC, information requirements are represented in such a manner that it relates together the scope definition, the process model and the object specification (IFC SDG, 2000). Therefore, use cases created would be analysed by setting assertions. The main purpose of developing the assertions is to identify classes, attributes, relationships, cardinality of relationships, direction of relationships, and rules (uniqueness, derived values, and constraints).

Development of the IFC Model Extension

To achieve the aim of developing Industry Foundation Classes data specifications for cash flow management, IFC2x (2000) data modeling guides would be used as the guide and mechanisms for the extensions. The model development will follow process-oriented methodology similar to that adopted by the BuildingSMART international. Also, the proposed IFC extension will take full advantage of reusing the available entities, relationships, and property sets in the most current IFC data schema. Only the necessary and unavailable entities would be defined and proposed to be added in the next IFC release. Therefore, IFC4 data schema will be examined to identify existing IFC entities, types, attributes, properties and relationships that support CFM process, and the CFM information not captured by the schema. New IFC entities, types, attributes, properties and relationships will then be developed and expressed/represented in EXPRESS-G data notations. The logical steps for the data extension are shown in the process model below.



Figure 2: The proposed IFC extension process

Data schema implementation and validation

Model implementation

To implement the proposed schema extension, 3D and 5D BIM of a simple building will be created in Autodesk Revit and Navisworks Manage respectively. NavisWorks Manage is a BIM tool that can produce 4D and 5D

BIM and have IFC import/export capabilities (Autodesk, 2016). The 5D model would be imported into an IFC viewer where the new entities, types, attributes and properties will be added. IFC tool box known as Eurostep classic tool box IFC 4.0 will be adopted as the viewer interface for the coding. Eurostep IFC viewer is selected basically for its advantage of reducing the programming work needed for the extension and its ability to verify the consistency of the BIM (BSI, 2016). EXPRESS Data Language will be used to add the new entities, properties and relationships created in the IFC data file of the case study building.

Model validation

Developing the CFM prototype system

To validate the proposed IFC extensions, a CFM prototype system will be developed to verify the feasibility of the model. The prototype system will be based on the BIM-based cash flow analysis and financing framework developed by Lu et al. (2016) with some slight modifications to capture the cash flow monitoring component and the risks/uncertainties likely to impact on project cash flows. This is necessary because probabilistic/stochastic CFM approaches produce more accurate and reliable cash flow estimates (Chen et al., 2002).

The prototype system would consist of five main modules namely:

1. Cost Estimation Module:
2. Cash Flow Analysis module,
3. Cash flow monitoring,
4. Fuzzy decision support system, and
5. Project financing

The prototype system will be based on IFCXML(*.ifcxml) file format that combines the advantages of the Industry Foundation Classes (IFC) and Extensible Markup Language (XML) (Kim and Grobler, 2013). XML is a schema created by the World Wide Web Consortium (W3C), meant for structuring, storing, and transporting information in a machine-readable file type (Kim and Grobler, 2013). Fuzzy set theory would be used to develop a decision support system that supports the stochastic cash flow management framework for the prototype system.

Testing the application of the data schema

The newly created entities, types, attributes, preoperties and relationships added would be tested by confirming that the cash flow parametres are correctly transferred and exchanged across heterogeneous applications. The validation will be done based on the two situations below:

1. Interoperability among domain specific applications: This would test the interactions between similar CFM management applications and other domain specificic applications such as quantity take-off, scheduling and estimating software. Autodesk Quantity Take-off and NavisWorks would be used for this purpose.

2. Interoperability among non-domain applications: Data exchange between CFM application and other non domian specific applications such as design authoring tools like Revit and ArchiCAD would also be tested. Autodesk Revit 2016 would be used because of its multi-domain capabilities.

CONCLUSIONS

Construction industry professionals exchange cash flow information among each other using different software applications developed by the various software vendors in the industry. These applications are based on proprietary data model requiring data translators to enable exchange among heterogeneous systems, thus serving as huge barrier to effective interoperation. To eliminate this barrier, neutral data formats that facilitate seamless data exchange and sharing with no loss or distortion of information becomes very necessary, especially when considering the economic loss likely to result due to poor interoperability. In the year 2004 alone, Gallaher et al. (2004) reported the loss of $1.58 billion in the US capital projects. Therefore, the development of these standards would immensely benefit cash flow managers in facilitating information exchange and collaboration among the diverse CFM applications and other related software such as quantity take-off, scheduling and estimating. The proposed schema extensions would have similar goal of the BuildingSMART IFC in terms of allowing multiple applications to share and exchange cash flow management related information. The schema would facilitate interactions between 3D, 4D and 5D BIM thereby supporting the management of cash flows in a collaborative manner. Also, construction management software vendors would be provided with approaches for improving the interoperability capabilities of their applications.

REFERENCES

Abdullahi, M., Ibrahim, Y. M., & Ibrahim, A. D. (2014). Assessing Contractors' Cash Flow Forecasting Process Capabilities Paper presented at the 3rd NMMU Construction Management conference, Port Elizabeth, South Africa.

Abdulrazaq, M. (2015). Developing Models for Predicting the Impact of Risk Factors on Construction Contractors' Cash Flow Forecasts in Nigeria. (Doctor of Philosophy), Ahmadu Bello University, Zaria, Nigeria.

Abdulrazaq, M., Ibrahim, Y. M., & Ibrahim, A. D. (2012). Investigating the Practice of Cash flow forecasting by Contractors in Nigeria. Paper presented at the 4th West Africa Built Environment Research (WABER) Conference, Abuja, Nigeria.

Abudayyeh, O. Y., & Rasdorf, W. J. (1993). Prototype integrated cost and schedule control system. Journal of Computing in Civil Engineering, 7(2), 181-198.

Aouad, G., Wu, S., & Lee, A. (2006). nDimensional Modeling Technology: Past, Present, and Future. Journal of Computing in Civil Engineering, 20, 151-153.

Autodesk. (2016). Retrieved 5th January, 2016, from www.autodesk.com

Bjork, B. C. (1989). Basic structure of a proposed building product model Computer Aided Design, 12(2), 71-78.

Boussabaine, A. H., & Elhag, T. (1999). Applying fuzzy techniques to cash flow analysis. Construction Management and Economics, 17, 745-755.

Boussabaine, A. H., & Kaka, A. P. (1998). A neural networks approach for cost-flow forecasting. Construction Management and Economics, 16(4), 471-479.

Boussabaine, A. H., Thomas, R., & Elhag, M. S. (1999). Modeling cost-flow forecasting for water pipeline projects using neural networks. Engineering, Construction and Architectural Management, 6(3), 213-224.

BSI. (2016). BuildingSMART International: IFC 4. Retrieved 24th, November, 2014, from www.buildingsmart.org

BuildingSMART. (2016). Industry Foundation Classess (IFC) 4. Retrieved 9th, June 2016, 2016

Cabinet-Office. (2011). Efficiency and Reform Group of the Cabinet Office and the Construction Sector Unit of BIS. UK.

Chen, C. W., Tsai, C. H., Tseng, C. P., Wang, M. H. L., & Chung, P. Y. (2002). A novel fuzzy regression approach on managing target cash balance for construction firms. Paper presented at the 17th IASTED International Conference on Modeling and Simulation, Montreal, Canada.

Chen, H. L., O'Brien, W. J., & Herbsman, Z. J. (2005). Assessing the accuracy of cash flow models: the significance of payment conditions. Journal of Construction Engineering and Management, 131(6), 669-676.

Cheng, M., & Roy, F. V. (2011). Evolutionary Fuzzy Decision Model for Cash Flow Prediction Using Time-Dependent Support Vector Machines International Journal of Project Management, 19, 56-65.

Cui, Q., Hastalk, M., & Halpin, D. (2010). System analysis of project cash flow management strategies. Construction Management and Economics, 28(1), 361-376.

Eastman, C., Teicholz, P., & Sacks, R. (2011). BIM Handbook; A Guide to Building Information Modeling to Owners, Designers, Engineers and Contractors (2nd ed.). Canada: Wiley & Sons Inc.

Evans, R. C., & Kaka, A. P. (1998). Analysis of the accuracy of standard/average value curves using food retail building projects as case studies. Engineering Construction and Architectural Management, 5(1), 56-68.

Faraj, I., Alshawi, M., & Aouad, G. (2000). An Industry Foundation Classes Web-based Collaborative Construction Computer Environment: WISPER. Automation in Construction, 10(1), 79-99.

Froese, T., Fischer, M., Grobler, F., Ritzenthaler, J., & Yu, K. (1999). Industry Foundation Classes For Project Management- A Trial Implementation. Journal of Information in Construction, 4, 17-36.

Fu, C., Aouad, G., Lee, A., Mashall-Ponting, A., & Wu, S. (2006). IFC model viewer to support nD model application. Automation in Construction, 15, 178-185.

Gallaher, M. P., O'Connor, A. C., Dettbarn, J. L., & Gilday, L. T. (2004). Cost analysis of inadequate interoperability in the US capital facilities industry. Rep. No. NIST GCR 04-867, . National Institute of Standards and Technology (NIST), Gaithersburg, MD.

Gielingh, W. F. (1988). General AEC reference model, ISO TC 184/SC4/WG1 doc 3.2.2.1. Delft, the Netherlands.

Gokce, K. U., Gokce, H. U., & Katranuschkov, P. (2013). IFC-Based Product Catalog Formalization for Software Interoperability in the Construction Management Domain. Computing in Civil Engineering, ASCE, 27(1), 36-50.

Hassanain, M. A., Froese, T. M., & Vanier, D. J. (2001). Development of a Maintenance Management Model Based on IAI Standards. Artificial Intelligence in Engineering, 15, 177-193.

Hegazy, T., & Ersahin, T. (2001). Simplified SpreadsheetbSolutions II: Overall Schedule Optimization. Journal of Construction Engineering and Management, 127(6), 469-475.

Hudson, K. W. (1978). DHSS expenditure forecasting method. Chartered Surveyor—Building and Quantity Surveying Quarterly, 5, 42-45.

Kaka, A. P. (1999). The development of a benchmark model that uses historical data for monitoring the progress of current construction projects Engineering Construction and Architectural Management, 6(3), 256-266. .

Kaka, A. P., & Lewis, J. (2003). Development of a Company Level Dynamic Cash Flow Forecasting Model (DYCAFF). Construction Management and Economics, 2(17), 693-705.

Kaka, A. P., & Price, A. D. (1991). 'Net Cash Flow Models: Are they reliable'? . Construction Management and Economics, 9, 291-308.

Kenley, R., & Wilson, O. D. (1986). A construction project cash flow model—an idiographic approach. Construction Management and Economics, 4, 213-232.

Khosrowshahi, F. (1991). Simulation of expenditure patterns of construction projects. Construction Management and Economics, 9(2), 113-132.

Khosrowshahi, F. (2000). A Radical Approach to Risk in Project Management. Paper presented at the 16th ARCOM Conference, Glasgow Caledonian University.

Kim, H., & Grobler, F. (2013). Preparing a Construction Cash Flow Analysis Using Building Information Modeling (BIM) Technology. Journal of Construction Engineering and Project Management, 3(1), 1-9.

Kim, I., & Seo, J. (2008). Development of IFC Modeling Extension for Supporting Drawing Information Exchange in the Model-based Constructiion Environment. Computing in Civil Engineering, ASCE, 22(3), 159-169.

Lee, S. H., & Kim, B. G. (2011). IFC Extension for Road Structures and Digital Modeling. Procedia Engineering, 14, 1037-1042.

Lu, Q., Won, J., & Cheng, J. C. P. (2016). A Financial Decision Making Framework for Construction Projects Based on 5D Building Information Modeling (BIM). International Journal of Project Management, 34, 2-21.

Ma, Z., Lu, N., & Wu, S. (2011). Identification and Representation of Information Resources for Construction Firms. Advanced Engineering Informatics, 25, 612-624.

Ma, Z., Zhenhua, W., Wu, S., & Zhe, L. (2011). Application and Extension of the IFC Standard in Construction Cost EStimating for Tendering in China. Automation in Construction, 20, 196-204.

Motamedi, A., Soltani, M. M., Setayeshgar, S., & Hammad, A. (2016). Extending IFC to Incorporate Information of RFID Tags attached to Building Elements. Advanced Engineering Informatics, 30, 39-53.

Navon, R. (1995). Resource-based model for automatic cash-flow forecasting. Construction Management and Economics, 13(6).

NBIMS. (2007). National building information model standard project committee Retrieved 5th March, 2013, from http://www.buildingsmartalliance.org/index.php/nbims/faq/ .

Odeyinka, H. A., Lowe, J., & Kaka, A. P. (2013). Artificial neural network cost flow risk assessment model. Construction Management and Economics, 32(15), 423-439.

Rönneblad, A., & Olofsson, T. (2003). Application of IFC in Design and Production of Precast Concrete Constructions. Journal of Information Technology in Construction, 0, 167-180.

Staub-French, S., Fischer, M., & Kunz, J. (2003). A Generic Feature-driven Activity-based Cost Estimation Process. Advanced Engineering Informatics, 17(1), 23-39.

Tanyer, A. M., & Aouad, G. (2005). Moving Beyond the fourth dimension with an IFC-based single project database. Automation in Construction, 14(1), 15-32.

Thomas Froese, & Yu, K. (1999). Industry Foundation Class Modeling for Estimating and Scheduling. Paper presented at the Durability Of Building Materials And Components 8. , National Research Council of Canada: Ottawa.

Vanlande, R., Nicolle, C., & Cruz, C. (2008). IFC and building lifecycle management. Automation in Construction, 18, 70–78.

Wan, C., Chen, P.-H., & Tiong, R. L. K. (2004). ASSESSMENT OF IFCS FOR STRUCTURAL ANALYSIS DOMAIN. Journal of Information Technology in Construction, 4, 75-95.

Watson, A., & Crowley, A. (1994). CIMSteel Integration Standards. Paper presented at the The First European Conf. on Product and Process Modeling in the Building Industry, Dresden, Germany.

Weise, M., Katranuschkov, P., Liebich, T., & Scherer, R. J. (2003). Structural Analysis Extension of the IFC Modelling Framework. Journal of Information Technology in Construction, 8, 181-199.

Zayed, T., & Liu, Y. (2014). Cash Flow Modeling for Construction Projects. Engineering, Construction and Architectural Management, 221(2), 170-189.

IMPACT OF RATING SYSTEMS ON THE CONSTRUCTION OF GREEN BUILDINGS IN SOUTH AFRICA

Masego Leburu[1] and Christopher Allen[2]

[1] SIP Project Managers, Johannesburg, South Africa

[2]Department of Construction Management, School of the Built Environment, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

The built environment is a major contributor to global carbon emissions and the substantial negative environmental impacts of buildings has led to the concept of green building. Amongst the challenges that the industry is faced with is that green building techniques are voluntary and can be highly variable. In South Africa, the Green Building Council of South Africa has created the Green Star SA rating system in order to standardise green building practices, allowing for the objective assessment of just how green a building is. The tools serve as a mechanism to drive the adoption and uptake of green buildings, however, the process involved in achieving a rating is perceived to be negatively impacting the wider uptake. The aim of the research was thus to determine how the use of a rating system influences the mind-set of a project team and the overall process of certification. Furthermore, the research investigated the added advantages that certified projects may have whilst exploring alternative rating systems that could be used in the local industry. A quantitative research method has been employed, using questionnaires sent to a random selection of eighty-five accredited professionals across South Africa registered with the Green Building Council. Twenty-six responses were included in the results that indicated aspects of the rating process, including additional documents, commissioning and document review, contribute negatively due to the lengthy nature required to comply. Furthermore, project teams are resistant to adopt the additional tasks associated with procurement of green materials which affect the procurement strategy and contribute to its complexity. Purchasing these materials is hindered by the lack of available, reliable knowledge about them, limited availability from suppliers and a lack of certification provided. The shift away from conventional design and construction exposes project teams to new risks and a lack of knowledge and training with green building means that project teams face unfamiliarity regarding green practices. Conclusions include a great need for increased education and training of project teams with respect to the rating system and an increased exposure of them to green projects, specifically involving the procurement and certification process for materials.

[1] masego@sippm.co.za

[2] Chris.Allen@nmmu.ac.za

Leburu, M. and Allen, C. (2017) Impact of rating systems on the construction of green buildings in South Africa *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 827-842

Keywords: assessment, certification, green building, green materials, green star rating

INTRODUCTION

The built environment is a major contributor to global carbon emissions and has a large impact on the natural environment and on human health. A report by the Department of Environmental Affairs and Tourism (2009), states that the substantial negative environmental impacts of buildings has led to the concept of green building which is designed to be energy and water efficient, use non-hazardous materials and provide healthy, productive environments. The report further states that the use of green building techniques are voluntary and can be highly variable, so in order to standardise green building practices and provide a measure of efficiency of the techniques, different certification and assessment systems have been developed.

Bodart and Evrard (2011), state that is difficult to evaluate the design and management of a building as a green building in consideration of investment feasibility and return on investment. It is for this reason that the Green Building Council of South Africa (GBCSA) has set agreed standards and benchmarks for green buildings (2008) in order to allow the construction industry to objectively assess just how green a building is. The Federal Transit Administration (2009) reports that green building rating systems now in use provides a systematic approach to evaluating green building practices. These systems establish criteria and methods by which buildings planned for construction and existing buildings scheduled for renovation are measured and evaluated. Some systems require registration and independent assessment of documentation by qualified reviewers, while others are self-administered. Rating systems therefore provide a menu of green measures that can be used in the design, construction and management of a building to make it more sustainable, in order to fit the criteria for green buildings, as well as the promoted reduction of environmental problems and global warming.

The South African Green Building Council has developed the Green Star SA rating tools based on the tools from the Green Building Council of Australia (GBCA). Yudelson and Meyer (2013) discuss in detail the development of Green Star by the GBCA beginning in 2004. Green Star is a comprehensive and voluntary rating system developed by the GBCA for the property industry in Australia with the aim of establishing a common language and standard as well as assessing green buildings' life-cycle impacts in addition to recognising and rewarding environmental leadership. The Green Star system uses existing green building rating systems such as Building Research Establishment Environmental Assessment Method (BREEAM)

and Leadership in Energy and Environmental Design (LEED) as a base from which to establish a unique rating system.

Green Star SA evaluates the environmental initiatives of designs, projects and/or buildings based on a number of criteria, with each rating tool reflecting a different market segment, including office, retail, and multi-unit residential. The Green Star SA rating system has continued to gain recognition, which according to Sabnis (2011) is the result of economic incentives as owners and renters increasingly demand facilities with improved efficiency ratings. According to McGraw-Hill Construction (2013), green building in South Africa has been growing at a faster rate than in any other part of the world. In 2012, 16% of South African firms reported heavy levels of green activity which they expected to more than triple in the next three years, but only twelve buildings, mostly corporate office structures, had achieved Green Star SA certification at that time (Schnehage, 2012). This number had risen to 200 in 2016 (Wilkinson, 2016), although this is still only a very small percentage of the green buildings being created, with the World Green Building Trends 2016 report stating respondents in South Africa indicated '41 percent of their work is already green.' (Dodge Data and Analytics, 2016). Ultimately, having a green building rated and certified can give developers an edge or added advantage in attracting tenants (Reeder, 2010), but the question that arises is, why, if a Green Star SA rating provides these benefits for project owners, developers, tenants and professionals, is there still a reluctance in the construction industry to pursue certification?

Green building rating tools are seen as a mechanism to drive the adoption and uptake of green buildings. The aim of the research was thus to determine whether the use of a rating system and the overall process of certification influence the project team in the decision making for a green building, impacting the construction process chosen to deliver the project, including the choice of materials. The objective was to identify what contributes to reluctance within the industry to pursue a rating as well as the factors that may hinder the use of these systems in order to inform government policy on materials certification as well as amendments to the building regulations enabling greater adoption of principles defined within current rating tools.

THE CASE FOR RATING A BUILDING

The use of rating systems and their implications

There are already building regulations in place that have been improved upon over time and focus on the reduction of energy consumption as well as on the reduction of toxic emissions from building materials. Kubba (2010) highlights that since the first Green Star SA tool was developed in 2008, South Africa has incorporated the SANS 10400-XA energy efficiency standard into its building regulations, which aims to enforce energy efficient building practices as a basic standard to all new projects. So why the need to create an additional layer of complexity for green buildings?

There are numerous environmental benefits that arise from the use of rating systems. According to Parr and Zaretsky (2011), certified buildings use a lower percentage of materials with high level of toxicity, make use of less water and energy, and also have less negative impact on the physical landscape as compared to typical building construction. Ideally, the aim is to create a standardised set of criteria for environmental performance and credits that will provide a project team with a specific system that will allow them to claim their building to be green. Woolley et al. (1997) state that guidelines are required, in order that well-informed designers and clients, through a process in which they are made accountable for the implications thereof, can then make decisions. Ainger and Fenner (2014) define building rating systems as: "holistic, multi-dimensional, criteria-based assessment tools, often third-party verified, and tied to a green building certification scheme." Most of these tools are based on some form of life-cycle assessment, either being quantitative performance indicators for design alternatives, or rating tools to determine the performance level of a building. The World Green Building Council (WGBC) (2009) discusses the many benefits of green rating systems including 'providing a compelling incentive to order parties, owners, architects, and users of buildings to promote development and diffusion of sustainable construction practices'.

Ainger and Fenner (2014) state that the use of these systems has altered the way in which green buildings are viewed, encouraged building owners and the construction industry at large to aim to achieve higher levels of sustainability, as well as enabled the adoption of green building requirements into existing regulations. According to The Green Building Handbook (2013), investors are demanding greater disclosure, accountability and responsibility from companies, and more responsible investment standards are being introduced. Therefore, successful certification means that investors can be assured that a company has been measured with independent criteria, by an independent body, and that the property in question has met certain environmental requirements. Building rating systems thus provide verification of having met an accepted market standard as well as act as an assessment guide for the design team.

The process of obtaining a Green Star SA rating

According to Bose (2010), although Green Star is based on the internationally accepted and widely used BREEAM and LEED tools, there is a perception that it is impractical in some circumstances. The Green Star rating process is considered time consuming in that gathering the supporting information required to substantiate sufficient points to earn a rating can be extremely onerous to the project participants. Kibert (2013) states that projects seeking certification will have additional procurement and commissioning documentation requirements, as well as requirements for registration and certification review, which make undertaking a Green Star rating both an integrated and lengthy process. Green Star assesses the sustainability of projects and community against nine categories (see Figure 1) including Indoor Environment Quality (IEQ) and Innovation.

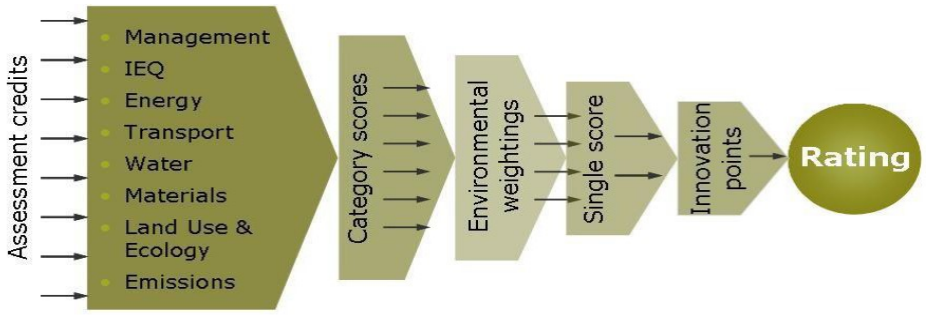


Figure 1. Structure of the Green Star SA rating system (GBCSA, 2008)

Wang *et al.* (2013) explain that these categories are divided into credits, each of which address a specific aspect of sustainable performance, with points awarded to these credits based on the relative environmental impact of the credit. Once a project has been registered for certification, a Green Design Facilitator must be appointed to begin an internal assessment (Kibert, 2013) in order to obtain a preliminary self-assessment of a building, however, a building cannot be promoted as Green Star certified until the final assessment verification report has been completed. Wang *et al.* (2013) further describe how during the certification process, the project team applies the Green Star rating tool to guide the design or construction process, and the documents are submitted as proof that this has been done. The GBCSA then commissions a panel of third-party certified assessors to evaluate the documentation and establish whether all the claimed credits meet the requirements outlined in the Technical Manual of each rating tool.

Materials procurement process

According to Kibert (2013), selecting building materials and products for a high-performance green building project is known to be the most difficult and challenging task facing the project team. According to Mokhlesian (2014) green purchasing is hindered by the lack of available, reliable knowledge about green products, materials, systems, design, correct green specifications, as well as assessing green requirements and the availability of green suppliers. Hence the project team must rely on their own best judgement in deciding which materials would best fit the criteria for a specific project.

Procurement methods have a significant influence on the success of construction project delivery, and choosing the right procurement method is one of the factors that can reduce overruns in green projects. Ainger and Fenner (2014) point out that although the procurement strategy for a green project may not always differ greatly from a traditional one, many material choices will still be dictated by the choice of design life, design for reuse, as well as having to integrate roles. Green materials requirements are important since they affect the schedule of procurement, construction and commissioning and therefore in order to solve unforeseen problems in green projects, establishing cooperative innovation with suppliers may be beneficial to the project team. Keeler and Burke (2009) discuss the importance of assessing the footprint left by materials, products or systems used for a particular project in order for a team to gain a better

understanding of their implications. An additional task that a project team will thus have to perform is the investigation into the following factors when selecting green materials: Resource effectiveness and conservation; Energy efficiency and conservation, and; Indoor air and environmental quality. According to Turk and Scherer (2002), the involvement of so many participants makes it crucial that there is coordination amongst teams, as a holistic view of supply chain interactions allows for the evaluation of overall performance of material handling, distribution, and information flow through every link of the chain beginning with initial raw materials. It is therefore important to involve the supply chain at an early stage in order to help develop a suitable procurement strategy.

Risks involved for a project team in green building

According to Cottrell (2011), green building risks can generally be considered under three broad umbrellas, these include regulatory and policy risks, financial risks, and performance risks. Furr (2009) states that while green building has many benefits, the shift away from conventional design, construction and project delivery practices exposes owners, designers, contractors, and other project team members to new risks that may not be accounted for by conventional risk management strategies. The structure of green building standards further increases the potential impact of these risks. As distinguished from conventional projects, green projects are designed and constructed to achieve certain green objectives, certification being an example, and achieving these objectives may require additional integration of the designers, contractors, subcontractors, installers, and other project team members. Hwang (2013) highlights the challenges faced in managing green construction projects: Risk from different contract forms of project delivery as well as unfamiliarity with the technology installed; Lengthy approval process for new green technologies and recycled materials, and; Higher costs for green construction practices and materials. Furr (2009) discusses how strategies for drafting and negotiating a contract for the construction of a green building may not generally differ from formulating and allocating the risks on any other project. However, a few additional risks may arise between various parties due to uncertainty in the responsibility for various services or work described in the scope, which could create potential liabilities.

Shen et al. (2015) state that tendering commonly takes on a hard-bid method, whereby the lowest tender will be awarded the contract, however, the hard-bid method is adversarial in nature and is therefore exceptionally difficult to employ for a green building project (Kibert, 2013). It is likely that a project will take on an open-book tendering process where all information describing how the tender amount was achieved must be disclosed. This would also require that a project team be assembled and involved in the early pre-design stages of the project to give advice on constructability and scheduling issues and roles may be interlinked, effectively requiring an increased level of communication amongst the project team. The more complicated nature of green buildings requires more detailed documentation and involves a higher level of communication in order to

ensure all ideas are shared between the project team participants in order to achieve the requirements set out by the various accreditation systems. The unique aspects of green projects should therefore guide the selection of the various members of the project team. According to Cottrell (2011), selecting the right team members for a green project could be the difference between achieving certification or not.

RESEARCH DESIGN AND METHOD

Although green building is not new to the South African construction industry, the use of the Green Star certification system is relatively new. Therefore, the primary aim of the study focused on receiving quantitative feedback from various stakeholders in order to provide an answer to the research problem statement: Does the process involved in achieving a green building rating negatively impact the uptake of green projects in the South African industry.

A total of 85 questionnaires were distributed to architects, engineers, contractors and clients, all of whom were accredited professionals registered with the GBCSA. Questionnaires were deemed to be the most appropriate method to gather the data mainly due to the extensive geographical spread of the sample throughout South Africa as well as the limited time most professionals in this sector have available to respond due to increased workloads. The accredited professionals contact details were randomly selected by the GBCSA from their companies' register (Companies rather than individuals register with the Council).

The questionnaire consisted of four sections, with a total of nineteen questions, based on the sub-problems and their hypotheses, in order to quantitatively test each. Section 1 contained demographic questions, whilst Section 2 contained the bulk of the questions linked to the hypotheses. Section 3 was used to enable respondents to provide additional opinion on the challenges experienced in relation to the certification process whilst Section 4 was for respondents to provide contact details should they wish to receive feedback. The questionnaire made use of a six point "Likert" scale with all questions containing an unsure response. Twenty-six responses were received from across the spectrum of professionals targeted, a 30.59% response for the limited sample. The largest response rate was from sustainable/green consultants at 35% of the total, with the Construction Project Managers/Construction Managers zero returns the only other notable result.

RESULTS AND FINDINGS

Aside from the response rate discussed under Research Design and Method the other notable statistic from the demographic information was that 25 of the 26 respondents had tertiary qualifications, 12 of whom had post-graduate education. In addition, more than half had more than 15 years' experience in the industry, so the respondents could be deemed to have the

necessary skill, competence and expertise to have completed the questionnaire accurately.

The study found that 21/26 (81%) of the respondents had previous work experience with green buildings. It further indicated that the majority of those respondents (15/21) had experience with projects specifically seeking certification. Both these results are higher than that contained in the literature with the percentage who had experience seeking certification substantially higher, although this could be linked to the choice of sample i.e. that as they are registered with the GBCSA, they are more involved in gaining certification for projects.

Table 1 indicates the extent to which respondents rate the level of difficulty in meeting the criteria that would allow a project to be eligible for a Green Star SA assessment. It is notable that none of the respondents believed meeting any of the criteria was a major difficulty. Conditional requirements ranked the highest with a mean score of 2.17, indicating a minor to near minor challenge of meeting the Man-1 credit, submission must be by a Green Star SA - Accredited Professional within the rating tool being applied for in order to achieve certification.

Table 1. The extent to which respondents consider the difficulty in meeting the Green Star SA criteria for assessment.

Response (%)									
Criteria		Unsure	Minor ..... Major					Mean Score	Rank
			1	2	3	4	5		
1.1	Conditional requirements	12	27	31	19	12	0	2.17	1
1.2	Timing of certificatio	23	31	27	8	12	0	2.00	2
1.3	Spatial differentiation	12	42	27	12	8	0	1.83	3
1.4	Space use	19	23	54	4	0	0	1.76	4

Table 2 indicates to what degree the respondents consider the process of certification to impact the overall duration of green construction. Commissioning ranked the highest with a mean score of 3.15 indicating a near minor extent to some extent that it would, with respondents stating that this process alone may take up to 18 months. However, the unsure response rate was quite substantive with no definitive grouping of responses, providing little indication that certification impacts on the development of green buildings. What it does indicate is that the certification process may require a larger project team than is currently the case (unsure responses may indicate those respondents don't deal with this) and that the duration of construction on green buildings (18 months for commissioning) is going to extend the time frame for completion.

Table 2. Extent to which respondents consider that the process of certification affects the overall duration of green construction

Response (%)									
Process		Unsure	Minor ..... Major					Mean Score	Rank
			1	2	3	4	5		
2.1	Commissioning	23	4	8	46	12	8	3.15	1
2.2	Document submissions	23	23	19	12	23	0	2.45	2
2.3	Credit assessments	23	35	19	0	23	0	2.15	3
2.4	Project registration	27	46	12	8	8	0	1.68	4

Respondents were then asked, based on their personal experience, to what degree project teams may be resistant to adopt the additional tasks associated with the certification process. Respondents consider that project teams are to a near minor extent to some extent resistant to adopt the additional tasks associated with the certification process, a mean score of 2.83 being achieved. What is notable is that nearly two-thirds (65%) of respondents chose a neutral response believing that project teams would neither be always willing nor never willing to adopt the additional tasks associated with the certification process.

In order to identify what project teams see as the greatest risk in the construction of green buildings when compared with non-green building construction, four areas of project risk were referenced. Table 3 indicates that financial risk is still considered the greatest risk concerning the construction of green buildings as compared to traditional construction with a mean score of 3.46 indicating some extent to a near major extent, while performance is considered to only have a near minor extent to some extent risk, with a mean score of 3.33.

Table 3. Risks faced by a project team regarding the construction of green buildings as compared to traditional construction

Response (%)									
Associated Risks		Unsure	Minor ..... Major					Mean Score	Rank
			1	2	3	4	5		
3.1	Financial	8	12	12	8	46	15	3.46	1
3.2	Performance	8	12	12	23	27	19	3.33	2
3.3	Regulatory	4	23	19	23	23	8	2.72	3
3.4	Legal	4	23	42	19	8	4	2.24	4

Specific risks associated with green construction for a project team were then ranked in terms of their likelihood of occurrence, on a scale of 1 (low)

to 5 (high). Table 4 indicates that failure to meet certification requirements is the most common risk faced by a project team in green building with a mean score of 3.00 indicating near minor to some extent. It is notable that all associated risks fall within this range and that no one risk scored highly.

Table 4. Likelihood of occurrence of the risks associated with green construction for a project team

Response (%)									
Associated Risks		Unsure	Low ..... High					Mean Score	Rank
			1	2	3	4	5		
4.1	Failure to meet certification requirements	0	12	19	27	42	0	3.00	1
4.2	Establishing conflicting standards and potentially unachievable project requirements	8	12	23	23	35	0	2.88	2
4.3	Schedule impacts associated with delivering sustainable building	4	19	23	19	35	0	2.83	3
4.4	Higher than anticipated operating expenses	8	27	12	19	23	12	2.79	4
4.5	Employing materials and products with immediate performance failures	4	27	19	42	0	8	2.40	5

When asked whether the respondents' organisation planned to become involved in green building in the future, specifically with projects seeking certification, almost all of the 26 respondents confirmed they will continue to venture into green projects, with only 2 indicating they were not interested in being involved in the future. The study found that the nature of the certification process alone affects the interest to venture into green projects only between a near minor to some extent, the mean score being 2.70.

Table 5 indicates the extent to which a project team may be faced with challenges in the selection of green materials. It is notable that all factors indicate a near minor to some extent with availability of green materials and products raking the highest with a mean score of 3.09. This somewhat contradicts the literature, although, the following comment received in Section 3 may partly explain the outcome: 'Before a green star project would begin, a consultant would get buy in from the team on the strategy to be pursued and explain where sustainable materials may be obtained and what benefits or pitfalls may exist with using a particular product.' As the majority of respondents stated in the demographic information that they had already participated in a green certified project, it may be that they have already had to identify suppliers and therefore no longer see it as a challenge to achieve this.

Table 5. Extent to which project teams are faced with challenges in selecting green materials.

Response (%)									
Factors		Unsure	Minor ..... Major					Mean Score	Rank
			1	2	3	4	5		
5.1	Availability of green materials and products	12	8	19	27	27	8	3.09	1
5.2	Certainty of the required green materials and products	12	19	0	46	23	0	2.83	2
5.3	Consensus about standards of materials and products	12	19	12	27	31	0	2.78	3

Table 6 indicates to what degree the respondents consider that material choices are affected by project team influences. Past project experience ranked the highest with an MS of 3.88 indicating it falls within the to some extent to a near major extent range, while personal knowledge was also considered to have some extent to a near major extent influence over the material choices with an MS of 3.79. This is therefore an indication that project teams rely greatly on their personal knowledge in deciding the criteria that materials and products should meet to characterise them as environmentally preferable or green.

Table 6: Extent to which certain factors affect material choices with regard to project team influences

Response (%)									
Factors		Unsure	Minor ..... Major					Mean Score	Rank
			1	2	3	4	5		
3.1	Past project experience	4	0	0	27	54	15	3.88	1
3.2	Personal knowledge	8	0	0	27	57	8	3.79	2
3.3	Knowledge and information resources	4	0	8	23	65	0	3.60	3
3.4	Team opinion	4	8	19	46	23	0	2.88	4
3.5	External opinions	19	12	27	23	19	0	2.61	5
3.6	Company ethos	19	12	35	27	8	0	2.19	6

Table 7 below indicates challenges a project team with little or no experience with green construction will face in successfully achieving certification. Management of green-related information was rated the greatest challenge by respondents, an MS of 3.68 indicating this to be to a near major extent

the greatest challenge faced. Awareness of the responsibilities needed to achieve certification also ranked highly, also just within some extent to a near major extent range, whilst ability to conform to specifications, which could be deemed to relate to awareness of responsibilities, came in just under this at 3.38. All six factors registered above 3 indicating that those with little or no experience would experience many challenges in successfully achieving certification.

Table 7. Challenges faced by a project team with little or no experience with green construction in successfully achieving certification

Response (%)									
Factors		Unsure	Minor……. Major					Mean Score	Rank
			1	2	3	4	5		
4.1	Management of green-related information	4	0	12	19	54	12	3.68	1
4.2	Awareness of green building responsibilities	4	0	19	27	42	8	3.40	2
4.3	Ability to conform to specifications	8	4	15	27	35	12	3.38	3
4.4	Use of new technologies due to green building	4	0	19	35	42	0	3.24	4
4.5	Management and supervision of tasks	8	8	4	46	35	0	3.17	5
4.6	Non-standard workflows in communication	12	0	23	38	19	8	3.13	6

When asked how they would rate the need for increased education and/or training of the project team, specifically with regard to green construction, more than half of the respondents consider that there is to some extent to a near major extent a need for increased education and / or training, with a mean score of 3.61 being recorded.

DISCUSSION

The study indicated that certain aspects of the hypotheses were confirmed through a combination of the Primary and Secondary data collected. With respect to the certification process requiring many assessments and submissions to be made in order to check and validate the project's self-rating, the data only partially supports this. Failure to meet certification requirements was seen as the most likely risk associated with green

construction for a project team in terms of likelihood of occurrence, however, it only had a mean score of 3.0, so indicating only a near minor to some extent it being considered a risk. Commissioning as a process appears to be the most onerous, with respondents indicating it to be between a near minor extent to some extent likely to impact on the delivery of a green project. It was stated by a respondent that this process alone may take up to 18 months which would indicate that the process to validate the self-rate is onerous. This is supported by the literature with Bose (2010) stating that the Green Star rating process is considered time consuming in that gathering the supporting information required to substantiate sufficient points can be quite an undertaking whilst Kibert (2013) highlights that projects seeking certification will have additional documentation requirements including for commissioning, as well as requirements for registration and certification review which make the undertaking a lengthy process.

With respect to the 2nd hypothesis, there is consensus that concerning the standards or criteria that materials and products should meet to characterise them as environmentally preferable or green needs more work to be done. This is an indication that project teams rely greatly on their personal knowledge in deciding the criteria that materials and products should meet to characterise them as environmentally preferable or green. Past project experience ranked the highest with a mean score of 3.88 indicating to some extent to a near major extent that this was the preferred process whilst personal knowledge was not far behind with a mean score of 3.79.

Table 5 indicates to what extent a project team may be faced with challenges in the selection of green materials. All listed factors indicated a near minor to some extent with availability of green materials and products raking the highest with a mean score of 3.09. Therefore, it can be concluded that project teams are faced with some level of difficulty in selecting materials and products specifically for green building. This hypothesis is further supported by the following literature: Kibert (2013) states that selecting building materials and products for a high-performance green building project has been known to be the most difficult and challenging task facing the project team. He notes that this is due to the fact that what is and is not considered environmentally preferable is still being established and is still open to debate. Project teams must thus rely on their own best judgement in deciding which materials would best fit the criteria for a specific project. Mokhlesian (2014) also notes that green purchasing is hindered by the lack of available, reliable knowledge about green products, materials, systems, design, correct green specifications, as well as assessing green requirements and the availability of green suppliers.

The third hypothesis which looks at the need for a minimum exposure and training with regard to green building otherwise project teams are not fully aware of the methods and protocols necessary in green construction. Respondents consider that there is to some extent to a near major extent a need for increased education and/or training of the project team specifically with regard to green construction with a mean score of 3.61. Table 7

indicates that a project team with little or no experience with green construction will face more challenges in green building and in ultimately successfully achieving certification. Management of green-related information was rated the greatest challenge by respondents with a mean score of 3.68 indicating this to be of some extent to a near major extent. This being the opinion of respondents who could be deemed to have the necessary skill, competence and expertise to have completed the questionnaire accurately due to the majority having at least 15 years' experience in addition to having worked on projects seeking certification.

CONCLUSION

Ultimately, having a green building rated and certified can give developers an edge or added advantage in attracting tenants (Reeder, 2010), so why, if a Green Star SA rating provides these benefits is there still a reluctance in the construction industry to pursue certification?

It appears that a number of factors may impact on the uptake of a Green Star rating for a project, although no single 'smoking gun' reason could be identified in the research. The greatest challenge a project team faces regarding green material selection and procurement is the availability of the materials and products. Project teams have to rely greatly on their personal knowledge and past experience regarding green material choices as there is no clear system in place to provide the necessary information a rating system requires. As a result, project teams with little or no experience of green building are potentially placing themselves at increased risk of failure, as failure to meet certification requirements is the most common risk associated with green building. As this is linked to financial risk, which is still considered the greatest risk concerning the construction of green buildings as compared to traditional construction, project teams may be dissuaded by a lack of reliable data on the added benefit the certification may bring when viewed against this additional financial risk.

However, there is no clear indication that the overall process of certification impacts on the development of green building, with only the commissioning process deemed, to a near minor extent to some extent, impact on the delivery process, prolonging the duration of green projects 'by sometimes as much as 18 months'. This delay, may also be aligned to the financial risk with the expected return delayed by this extended process.

Agreed standards and benchmarks for green building therefore allows for the objective assessment of just how green a building is. Green building rating tools therefore serve as a mechanism to drive the adoption and uptake of green building. However, some recommendations that can be drawn from the study include the need for increased education and training of project teams with regard to certified green building and aligned to that, a need for increased exposure to green projects specifically those involving certification.

Although building regulations are in place that focus on aspects addressed by certification, governments should incorporate Green Star style

certification into planning requirements to increase compliance and knowledge (legislative rather than voluntary). Aligned to this, a single reference standard for materials needs to be developed with simple yet practical check measures to overcome the challenges of project teams having to rely on their own best judgement based on personal knowledge.

REFERENCES

Ainger, C. and Fenner, R. (2014). *Sustainable Infrastructure: Principles into Practice*. London: ICE Publishing.

Bodart, M. and Evrard, A. (2011). *Architecture and Sustainable Development (vol. 1): 27th International Conference on Passive and Low Energy*. Belgium: Presses univ. de Louvain.Bose, R.K. (2010). *Energy Efficient Cities: Assessment Tools and Benchmarking Practices*. Washington: World Bank Publications.

Cottrell, M. (2011). *Guide to LEED Certification Process: LEED for New Construction, LEED for Core and Shell and LEED for Commercial Interiors*. New Jersey: John Wiley & Sons.

Department of Environmental Affairs and Tourism. (2009). *Green Building in South Africa: Emerging Trends*.

Dodge Data and Analytics (2016). *World Green Building Trends 2016 SmartMarket Report*. Massachuchutes: Dodge Data and Analytics.

Federal Transit Administration. (2009). *Transit Green Building Action Plan: Report to Congress*. Pennsylvania: DIANE Publishing.

Furr, J.E. (2009). *Green Building and Sustainable Development: The Practical Legal Guide*. Chicago: American Bar Association.

Green Building Council of South Africa. (2008). *Technical Manual Green Star SA – Office v1*. Cape Town: Green Building Council of South Africa.

Hwang, B. (2013). *Are Project Managers Ready for Green Construction? – Challenges, Knowledge Areas, and Skills*. Australia: CIB World Building Congress.

Keeler, M. and Burke, B. (2009). *Fundamentals of Integrated Design for Sustainable Building*. New Jersey: John Wiley & Sons.

Kibert, C.J. (2013). *Sustainable Construction: Green Building Design and Delivery*. New Jersey: John Wiley & Sons.

Kubba, S. (2010). *Green Construction Project Management and Cost Oversight*. Oxford: Butterworth-Heinemann.

McGraw-Hill Construction (2013). *World Green Building Trends*. McGraw-Hill Publishing

Mokhlesian, S. (2014). How Do Contractors Select Suppliers for Greener Construction Projects? The Case of Three Swedish Companies. *Sustainability*, 2014 (6), 4133-4151.

Parr, A. and Zaretsky, M. (eds.) (2011). *New directions in Sustainable Design*. Routledge

Reeder, L. (2010). *Guide to Green Rating Systems: Understanding LEED, Green Globes, Energy Star, the National Green Building Standard, and More*. New Jersey: John Wiley & Sons.

Sabnis, M. (2011). *Green Building with Concrete: Sustainable design and Construction*. CRC Press.

Schnehage, M. (2012) *SA's 12 green buildings: Small business lagging behind corporates in taking the plunge*. Moneyweb, 30 January 2012

Shen, L., Ye, K. and Mao, C. (2015). *Proceedings on the 19th International Symposium on Advancement of Construction Management and Real Estate*. Springer Science & Business Media.

The Green Building Handbook. (2013). CSIR

The World Green Building Council. (2009). *How Green Building is Shaping the Global Shift to a Low Carbon Economy*. November 2009.

Turk, Z. and Scherer, R. (2002). *eWork and eBusiness in Architecture, Engineering and Construction*. CRC Press.

Woolley, T., Kimmins, S., Harrison, P. and Harrison, R. (1997). *The Green Building Handbook*. London: Spon Press.

Yudelson, M. and Meyer, U. (2013). *The World's Greenest Buildings: Promise Versus Performance in Sustainable Design*. London: Routledge.

Wang, J., Ding, Z., Zou, L. and Zou, J. (2013). *Proceedings on the 17th International Symposium on Advancement of Construction Management and Real Estate*. Springer Science & Business Media.

Wilkinson, B. (2016). *2016: another great year for the GBCSA*. Green Building Council News, December 6, 2016.

IMPACT OF SOIL EROSION ON FARMERS LIVELIHOODS IN IWARO OKA AKOKO, ONDO STATE, NIGERIA

Olorunlana, Folasade Aderonke[1]

[1]*Department of Geography and Planning Sciences, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria*

This study was carried out in Iwaro Oka Akoko,Ondo State, Nigeria. The general objective of the study was to assess the causes of soil erosion and to determine how these affect the livelihoods of farmers in Iwaro Oka Akoko. The specific objectives of the study were to determine the major causes of soil erosion and its effect on agricultural productivity and livelihoods as well as identify the methods used to control soil erosion in the study area. The study used both primary source of data collection and secondary sources. Primary sources included use of interviews, field observations and questionnaires, whereas secondary sources included literature materials from various journals and publications. The sample population was 151 households which were selected using simple random sampling techniques. Key findings of the study indicated that soil erosion is a major problem which negatively affect agricultural productivity and also affect the livelihoods of farmers. It also reduced the goods and services that the community had access to and thereby negatively affecting their standard of living. From the findings of the study, there is need to create awareness at all level on the negative effects of soil erosion which affect the livelihoods of farmers and also to educate farmers on better methods of soil conservation and farming technologies so as to reduce problem of soil erosion.

Keywords: farmers, land degradation, livelihoods, soil erosion

INTRODUCTION

Soil erosion is a critical global land degradation phenomenon affecting human beings since humanity's basic sources of livelihood is from the land. However, changes in land use worldwide have been recognized as capable of accelerating soil erosion (Chappell et al., 2010). Degraded soil is unproductive, which is also determined by the degree of severity to land damage. Soil worldwide is being degraded at a phenomenal rate. On a global scale, the Food and Agriculture Organization (FAO) estimates that the loss of productive land through soil erosion globally is about 5-7 million ha/year (Kumar and Ramachandra, 2003). Many

[1] Tise80097@yahoo.com

Olorunlana, F. A. (2017) Impact of soil erosion on farmers livelihoods in Iwaro Oka Akoko, Ondo State, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 843-852

scholars projected that unless there is an adoption of better land management practices, about 140 million hectares of high quality soil, in Africa and Asia, would have been degraded as a result of soil erosion by 2010 (FAO, cited in Kumar & Ramachandra, 2003). This unveils the danger of soil erosion activities and the need for appropriate soil management practices, as well as a concerted effort in the fight against its effects.

According to Ojo and Johnson (2010) soil erosion is a dynamic geomorphic event operating on the landscape. Further, Jones (2007) defined soil erosion as "the wearing away of the land surface by physical forces such as rainfall, runoff water, wind, ice, temperature change, gravity or other natural or anthropogenic agents that abrade, detach and remove soil or geological material from one point on the earth's surface to be deposited elsewhere". About 40-75% of the world's agricultural land's productivity is reduced due to soil erosion (Baylis et al., 2012; UNCCD, 2013). Soil erosion has negative consequences on agriculture (Olsson et al., 2005).

This study therefore seeks to identify the main impacts of soil erosion on livelihoods of the study are. The following are the research questions of the study:

i. What are the major causes of soil erosion in the study area?
ii. What is the impact of soil erosion on rural livelihoods?
iii. What effective adaptive mechanisms have the farmers developed to sustain their livelihoods?

STATEMENT OF THE PROBLEM

Change in livelihoods is one of the consequences of soil erosion upon people (Sah, 2002; Lestrelin and Giordano, 2007). The deterioration in land qualities affects the way in which smallholder farmers make a living (R&AWE, 2004). When faced with soil erosion, some farmers may decide to intensify and/or extensify their agricultural production while others will migrate or diversify their activities. However, farmers' decisions depend on both ecological and socio-economic conditions which enhance the potential of available resources in the creation of viable livelihoods strategy. Unfortunately, many of the activities carried out by farmers to create livelihoods also tend to accelerate soil erosion (Sajad, 2007).

Agricultural activities and the livelihoods of people of Iwaro-Oka have been affected by land degradation. The major drive is soil erosion. Soil erosion depletes soil fertility and reduces land productivity which in turn reduces the farm level of income of households. Pressure on arable land is growing forcing people to convert more marginal lands to arable land and this leads to further soil erosion. Farmers have traditionally cleared land, grown crops for a few seasons and then moved on to clear more land. This practice left the abandoned soil fallow, allowing it to regain its fertility. But constant population growth now forces farmers to continually plant crops on the same land, 'mining' the soil while giving no nutrients back. Consequently, severe erosion continues to affect the farmers' livelihoods. The rich top soils have

been washed off by runoff and the remaining sub-soils are exposed and generally deficient in available minerals. This study, therefore, attempted to assess the impacts of soil erosion on rural livelihoods.

JUSTIFICATION OF THE STUDY

Knowledge of the potential impacts of soil erosion on the livelihoods of rural communities is prerequisite to designing programmes and project to implement suitable land management systems nationally, to reduce the degradation of land, to ensure sustainable agriculture and to improve food security among communities. This study would significantly shed light on how farmers could increase their income, ensure food security and environmental sustainability. This understanding has an advantage of finding the best path way to follow in different localities. This would provide entry points on how to support different categories of farmers. In addition, understanding of the impact of soil erosion on the livelihoods of the people will enable policy makers and development partners of the government to plan and implement programmes and projects to alleviate the problem thereby increasing livelihoods. Level of knowledge of the community on soil erosion and the associated negative impacts on their livelihoods is essential in the development and implementation of national resource management programmes.

LITERATURE REVIEW

As the problem of soil erosion on the livelihoods of rural communities presents a global challenge, it is receiving concerted attention from the scientific community and governments. In developing countries, where agriculture is a main source of livelihoods and a significant contributor to economy, soil erosion poses a common threat (Abegunde et al, 2003). This problem is crucial in Iwaro-Oka since it limits agricultural production through decreased soil fertility negatively affecting the livelihoods of the farmers.

Soil erosion is a physical process of soil degradation and the most widespread form of land degradation (Argaw, 2005). According to Montgomery (2007), the recognition of the detrimental influences of accelerated soil erosion on agrarian societies dates back to Plato and Aristotle. Several classic studies have attributed the bare rocky slopes of the classic world to soil erosion in current times. Furthermore, Pimentel, et al. (1995) states that soil erosion is a major environmental and agricultural problem worldwide. Although erosion has occurred throughout the period of agricultural activity, it has intensified in recent years. Soil erosion therefore impacts agricultural production negatively by depleting nutrients needed for plant growth. The intense and increased pressure on land leads to its degradation resulting in a complete loss of its productive capacity (Bellayan, 2000). Furthermore, soil loss has ecological and economic consequences such as nutrient depletion, degraded soil structure and loss in organic matter that affects agricultural livelihoods. The economic and social

effects of soil erosion are more severe in the developing countries than in developed countries because of the direct dependence for livelihoods of the majority of the population on agriculture and land resources.

Erosion-induced loss in soil productivity is a major threat to global food and economic security especially among farmers. It not only diminishes the quality of soil resources but also makes earning a living from the land increasingly difficult. Reduced productivity of soil affects outputs such as crop yields derived from the renewable nutrient system of the biosphere (Boardman et al, 2009).

DESCRIPTION OF THE STUDY AREA

Iwaro-Oka Akoko is located North-East of Ondo State and South-West of Nigeria. The region lies within Latitude $7^{0}28'$N and longitude $5^{0}44'$E. The region covers an aerial extent of about 2465.6km2. The area is situated at an altitude between 270m and 2750m above sea level. Most parts of the region have undulating terrain, which in many cases are almost completely encircled by high rugged rock outcrops, rising to a height of over 2750m in some places.

Geologically, the area is a physiographic region characterized by two major crystalline basement rocks of the main African Precambrian shield. These are magmatite and granite gnesis, with quartz and pegmatite veins. These rocks belong to the migmatite gnesis sub-classification of the basement complex of Nigeria. Iwaro-Oka Akoko is located within the humid tropical climate of the forest region, which experiences two climatic seasons namely the rainy season (April-October) and the dry season (November-March).

RESEARCH METHODS

Questionnaire surveys were used in this research so that quantitative and qualitative data could be collected from a statistically significant number of households. The questionnaire combined open-ended questions that allowed respondents to express themselves in the fullest possible way and potentially provide a better representation of their viewpoints with closed questions that are simpler for respondents to answer and provide data that can be analysed more easily.

Iwaro-Oka Akoko was zone into six different zones which include Owake, Oka-odo, Okela,Owalusi, Ayepe and Ebo using stratified sampling technique. The sample size needed for level of credibility is a total of 151 copies of questionnaire administered. In each zone, 24 copies of questionnaire were administered except Ayepe where 31 questionnaires were administered using stratified random sampling techniques. The respondents were selected using simple random sampling techniques. The choice of this techniques is aimed at giving each element the choice of being selected (Marginson and Wende, 2007).

For the analysis of the collected data, descriptive statistics such as frequency, percentage and tabulation were employed using SPSS software package version 19.

RESULTS AND DISCUSSION

Demographic profile of farmers

Table 1: Demographic Profile of Farmers

Items	Frequency	Percentage
Gender		
Male	123	81.5
Female	28	18.5
Total	151	100
Age		
<35	9	6
36-45	39	25.8
46-55	65	43
56-65	31	20.5
66-75	7	4.6
Total	151	100
Educational Status		
No formal education	11	7.3
Primary	73	48.3
O'level	49	32.5
NCE	7	4.6
B.Sc.	11	7.3
Total	151	100
Sources of Income		
Farming	78	51.7
Trading	46	30.5
Artisan	7	4.6
Others	20	13.2
Total	151	100
Income Distribution	Frequency	Percentage
Below #5,000	15	10
#5,000-#15,000	20	13.2
#16,000-#25,000	39	25.8
#26,000-#35,000	44	29.1
#36,000-#45,000	22	14.6
Above #45,000	11	7.3
Total	151	100

Source: Field Survey, 2016

According to the findings of the study highlighted in Table 1, the study area consists of older people whose age group ranges from 45-55 and 56-65 years old, as compared to young people less than 35 years of age. The indication of this is that farming decisions are left in the hands of older people who are more conservative in thinking and tend to avoid more risk. The results also indicated that majority (81.5%) are male while female (18.5%) are of the minority. Similarly, majority (48.3%) of the farmers had primary school education while only 6% are graduate showing that education level of the farmers in the area is low. Inadequate education and poverty are two key characteristics which impact on farmers' poor farming decisions which result to soil erosion (Pender and Hazell, 2000). Result in Table 1 indicate that the 30% of the respondents had income less than #5,000. 13.2% had income ranging from #5,00-#15,000 per year, 25.8% had income between

#16,000-#25,000 per annum, 29.1% had income ranging from #26,000-#35,000 per year. 14.6% of the respondents had income ranging from #36,000-#45,000 per year while 7.3% had income above #45,000. This implies that most of the farmers in the study area were low income earners.

Causes of soil erosion in the study area

Identification of the causes of soil erosion is important for knowing the main factors contributing to the loss of the resource in return influencing the sustainability of the life and helps to take appropriate measurement to halt it. Table 2 indicates the main causes of soil erosion in Iwaro-Oka community. It was revealed that climate change, winds, heavy rain, deforestation, nature of the soil and slope/gradient of the land were the causes of soil erosion in the area which usually lead to the people inability to sustain their life, increase food crisis and poverty. Pimental (2006), suggested that soil erosion results from actions that expose the soil to rainfall or wind. As observed from the table, deforestation has created favourable condition for heavy rain fall to do its activity of removing soil particles from one locality to another.

Table 2: Causes of Soil Erosion

Causes of erosion	Frequency	Percentage
Climate Change	14	9.3
Wind	13	8.6
Heavy Rain	60	39.7
Deforestation	23	15.2
Nature of the soil	20	13.3
Slope/gradient of the land	21	13.9
Total	151	100

Source: Field Survey, 2016

Consequences of soil erosion

Table 3 below shows the response from farmers on the consequences of soil erosion. Loss of crop production was indicated by 49% of the respondents whereas 9.3% and 1.3% indicated that the gully formation and land dissection are also consequences of soil erosion. 39.7% and 0.7% responded that soil erosion led to loss of soil fertility and damage infrastructure. The overall impact of soil erosion means a loss of crop production with reduced income will directly affects the livelihoods of the rural population.

The level of crop loss in an area is a reflection of food security or insecurity especially for rural areas. Nutrient deficient soils which is one main impact of soil erosion, produce 15 to 30% lower crop yields than an un-eroded soil (Pimentel, 2006). According to the findings of this study indicated on Table 4, majority of the population of farmers confirmed that they lose well above 21% of crops every year due to erosion. This is a high reflection of food insecurity in the study area because the level of crop loses is positively related to food security of an area. In support of this, Odendo, et al. (2010) emphasize that soil fertility degradation on farmers is reported as the primary biophysical root cause of food insecurity and poverty in Iwaro-Oka

Akoko where most people living in the area obtain their livelihoods from farming.

Table 3: Consequences of Soil Erosion

Consequences of soil erosion	Frequency	Percentage
Loss of crop production	74	49
Land dissection	2	1.3
Gully formation	14	9.3
Loss of soil fertility	60	39.7
Damage of infrastructure	1	0.7
Total	151	100

Source: Field Survey, 2016.

Table 4: Percentage of Crop Loss due to Soil Erosion Impact

Percentage of crop loss due to soil erosion	Frequency	Percentage
0	27	17.9
1-20	18	11.9
21-40	31	20.5
41-60	32	21.2
61-80	21	13.9
>80	22	14.6
Total	151	100

Source: Field Survey, 2016

Effect of soil erosion on livelihoods

According to the farmers (Table 5), the impact of soil erosion on farmers' crops and livestock (26.5%) as well as farmers' household feeding (15.9%) which happens to be factors of farmers' livelihoods were the major livelihood factors impacted the most by soil erosion in the study area. The implication is that the main source of livelihoods is severely threatened and coping strategies such as reduced number of daily meals, reduced quantity of food per meal, withdrawal of children from school and marginal land cultivation has been adopted.

Table 5: Impacts of Soil Erosion on Livelihoods

Impact of Soil Erosion on Livelihoods	Frequency	Percentage
Household feeding	24	15.9
Impacts on crops and livestock	40	26.5
Destruction of infrastructure/properties	23	15.2
Other Impacts	27	17.9
No impacts at all	20	13.2
No response	17	11.3
Total	151	100

Source: Field Survey, 2016.

Impact of soil erosion on farmers' income

Table 6 shows that soil erosion affect the income of farmers which in turn have impact on their livelihoods with 88.1% of the respondents indicating that soil erosion has affected their livelihoods through reduction in their income, majority of whose source of livelihoods is mainly on land production while 11.9% responded that impact of soil has not been noticeable.

As indicated in Table 7 below, majority of the respondents reported that their livelihoods were seriously affected and coping strategies such as reduced number of daily meals, reduced quantity of food per meal, withdrawal of children from school and marginal land cultivation has been adopted.

Table 6: Impact of Soil Erosion on Farmers' Income

Responses	Frequency	Percentage
Yes	133	88.1
No	18	11.9
Total	151	100

Source: Field Survey, 2016

Table 7: Consequences of the Reduction in Farmers' Income

Consequences	Frequency	Percentage
Reduced number of meal	17	11.3
Reduced quantity per meal	24	15.9
Withdrawal of children from school	34	22.5
Poor health	4	2.6
Marginal land cultivation	18	11.9
All	53	35.1
Total	151	100

Source: Field Survey, 2016

Use of conservation techniques

Erosion control measures are land management practices that control run-off or run-on. Several indigenous methods were observed as measures used in the study area in controlling soil erosion. This include mulching, sand filling gullies, shifting cultivation, bush fallow, minimum tillage, zero tillage and ridging across slope. 47% of the farmers carried out mulching, 42% used sand to fill gullies while 9% engaged in shifting cultivation. 5% practiced bush fallow while 27% practiced minimum tillage (that is moderate soil loosening with hoe). 10% make ridges across slope to control soil erosion. This shows that farmers are aware of happenings in their environmental situation and make effort at controlling soil erosion.

Table 8: Erosion Control Measures

Erosion control measures	Frequency	Percentage
Mulching	47	31.1
Sand filling of gullies	42	27.8
Shifting cultivation	9	6
Bush fallow	5	3.3
Minimum tillage	27	17.9
Zero tillage	7.3	11
Ridging across slope	10	6.6
Total	151	100

Source: Field Survey, 2016.

CONCLUSION

Soil erosion poses great danger to rural livelihood anywhere in the world (Pimentel et al., 1995). According to the findings in this study, soil erosion is a serious problem that negatively affect livelihoods of farmers in Iwaro-Oka. The three most significant causes of erosion in the area are heavy rain, deforestation and slope/gradient of the land. Soil erosion is a major driver of land degradation and pose key problems to livelihoods of the community members in the study area. Sheet, rill and gully erosion are the main types of erosion within the study area and the latter form of erosion is the most alarming problem removing huge quantities of soil, dissecting land and damaging infrastructure. Deterioration in soil fertility as a result of severe soil erosion is a critical deterrent to crop production. The negative effects of soil erosion on the livelihoods of farmers are well understood by the households.

From a clear understanding of the problem of soil erosion, not only from the point of effects on livelihood, but also from the point of environmental sustainability and wellbeing of the ecosystem, a comprehensive program of land management interventions should be implemented to avoid further damage. This will entail mobilizing resources, experts and the community at large. Awareness should be created at all levels on the negative effects of land degradation on the livelihoods of rural community and alternative technologies in soil and water conservation measures should be explored by national research institutes, tested and disseminated taking into account the different agro-ecological zones of the country.

REFERENCES

Abegunde, A., Adeyinka, S. and Olawumi, P. (2003). An Assessment of Socioeconomic Impact of Soil Erosion in Eastern Nigeria. Research Paper, Munich, Germany.

Baylis, K., Jolejole, M. and Lipper, L. (2012). Land Degradation's Implications in Agricultural Value of Production in Ethiopia: A Look inside the Bowl. Presentation Papers at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguacu, Brazil, 18-24 August 2012.

Boardman, J., Shepheread, M., Walker, E., and Foster, L. (2009). Soil Erosion and Risk-Assessment for on-and off-farm impacts: A test case using the Midhurst area, West Sussex, Journal of Environmental Management, 1(18): 1-11.

Chapell, A. Longhran, R. Rossel, R.V. and Hancock, G. (2010). Time to establish a 137Cs-derived net soil redistribution baseline for Australia? 19th World Congress of Soil Science, Soil Solutions for a changing world. 1-6 August 2010, (DVD), Brisbane, Australia.

Jones, B. (2007). Soil Erosion. Paper presented at the Thematic strategy for soil protection, common criteria for risk area identification in the soil framework directive (pp.1-27), 25th April 2007, BGR, Hannover.

Kumar,R. and Ramachandra, T.V. (2003). Water Soil and Sediment Investigation to explore status of aquatic Ecosystem. Bangalore: Centre for Ecological Sciences, India Institute of Science.

Lestrelin, G. and Giordano, M. (2007). Upland Development Policy, Livelihood Change and Land Degradation: Interactions from a Laotin Village; Land Degradation and Development, Vol. 18(1): 55-76.

Montgomery, D. (2007). Soil Erosion and Agricultural Sustainability. Journal of Natural Academy of Sciences, 104 (33): 13268-13272.

Odendo, M.O., Obare, G. and Salasya, B. (2010). Determinants of the speed of adoption on soil fertility enhancing technologies in Western Kenya, Cape Town. African Association of Agricultural Economists (AAAE) 3rd Conference/AEASA 48th Conference. September 19-23, 2010.

Ojo, A.D., and Johnson, O. (2010). Erosion problems in a Nigerian Rural Community. Journal of Sustainable Development in Africa, 12(1).

Olsson, C., Eklundh, L. and Ardo, J. (2005). A recent greening of the Sahel- trends, patterns and potential causes. Journal of Arid Environments 63(3): 556-566.

Pender, J. and Hazell, P. (2000). Promoting Sustainable Development in less-favoured areas overview. Washington D.C.: International Food Policy Research Institute (IFPRI).

Pimentel, D., Harvey, C., Rasosudarmo, P., Sinclair, K., Kurz, D., Macnair, M., Crist, S., Shpritz, L., Fitton, L., Saffouri, R. and Blair, R. (1995). Environmental and Economic costs of Soil Erosion and Conservation Benefits. Journal of Science, 267: 1117-1121, 83.

Pimentel, D. (2006). Soil Erosion: A food and environmental threat. Environmental Development and Sustainability, 8,119-137. http://dx.doi.org/10.1007/s10668-005-1262-8.

R&AWG – Research and Analysis Working Group (2004). Vulnerability and Resilience to Poverty in Tanzania: Causes, Consequences and Policy Implications. Mkuki and Nyota Publishers, Dar es Salaam. 150pp.

Sah, R.P. (2002). Improving Food Security and Livelihopod of Mountain People through Development of Agriculture (http://www.mtnforum.org/oldocs/360.doc.) Site visited on 20/02/2008.

United Nations Convection to Combat Desertification (UNCCD) (2013). Economic Assessment of desertification, Sustainable Land Management and Resilience of Arid, Semi-arid and Dry Sub-humid Area. In Westerberg, V., Olsen, N., Stoeckli, V., Jaquet, S., Roth, A., David, E., Baker, C. Castillo, V. and Shim, K. (Eds), 2nd Scientif Conference of United Nations Convection to Combat Desertification and Global Risk Forum, Davos, ISBN 978-92-95043-65-7, Bonn, Germany.

IMPACT OF TENDERING PROCEDURE ON PRICE FORMATION IN CONSTRUCTION CONTRACTS: CASE STUDY OF THE COMPETITIVE NEGOTIATION PROCEDURE

Samuel Laryea[1]

[1]*School of Construction Economics and Management, Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, South Africa*

There are different types of tendering methods used to secure tender offers from contractors. This paper will argue and demonstrate that the type of tendering procedure used by a client is one of the significant determinants of the pricing levels of contractors particularly the risk component. A competitive negotiation tendering procedure was shadowed in South Africa for six months using participant observation. Six contractors submitted tenders based on bill of quantities in the first round of the tender process and three were selected to submit final tender offers in the second round based on acvtivity schedule. The average of tender prices in the first round was R58,646,712 compared to R57,151,509 in the second round which translates to 2.5% reduction in the overall pricing levels of contractors. Despite minor additions in the tender addenda and the fixed price nature of the final tenders, the winning contractor's final tender was 0.25% lower than their price in the first round, although the average of the final three tender prices was 0.69% higher than their first round tender prices. The monetary value of the tender addenda could not be quantified mainly because of access. This would have enabled a more direct comparison of pricing levels in the first and second rounds. Clearly, a number of variables influence pricing levels and not all of them have been controlled for in this study. However, two preliminary conclusions are presented. The first one is that the type of tendering procedure is a significant determinant of pricing levels. The main variable dictating the influence of the tendering procedure on pricing levels seems to be the extent to which the tendering procedure enables tenderers to clarify their uncertainty about the proposed work. Tendering procedures that enable greater interaction between contractors and the client's professional team will generally lead to more accurate risk pricing. The second observation relates specifically to impact of the competitive negotiation tendering procedure on price formation. The stages and activities of this tendering procedure promoted clarity for the contractors and thus reduced their risk of pricing. The winning contractor's tender price was 0.25% less than the first round tender offer despite minor additions to the original project information and its fixed price nature. Their fee percentage of 6.65% remained unchanged. Hence, the reduction in pricing levels should be linked with the cost estimate. Assuming resources is a fixed cost, risk contingencies would be the variable cost element that came down.

[1] Samuel.Laryea@wits.ac.za

Laryea, S. (2017) Impact of tendering procedure on price formation in construction contracts: case study of the competitive negotiation procedure *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 853-869

Keywords: competitive negotiation procedure, participant observation, price formation, risk pricing, tendering

INTRODUCTION

In construction, there are different types of tendering procedures for inviting tenders and selecting a suitable contractor. Price formation in construction contracts often occurs by the process of tender (Hughes et al., 2015) – and different tendering procedure can have different impacts on pricing levels of contractors. However, little research has been done to examine the way that different tendering methods impact on the price formation process. This paper reports on a participant observation study carried out in South Africa from June to November 2012. The aim was to examine the impact of one particular type of tendering procedure, that is, the competitive negotiation procedure on pricing levels of contractors and the price formation process in construction contracts. The case observed and examined is a public sector infrastructure project.

The International Organisation for Standardisation (ISO) (2014) Building and Civil Engineering – Vocabulary – Part 2: Contract terms (ISO 6707-2: 2014, 7.12) defines "tendering" as the process of obtaining tenders, with the intention of forming a contract with one or more of the tenderers. Based on experiential knowledge of a group of architects and quantity surveyors, Hackett et al. (2007) described tendering as a procedure that helps clients to obtain an acceptable tender from contractors, at an appropriate time and circumstances.

A “tendering procedure”, according to ISO 10845-1, is ‘the selected procedure used to solicit tender offers for a specific procurement’. ISO 10845-1 provides for eleven standard tendering procedures associated with procurements other than those relating to disposals by auction and framework agreements (see Table 1).

This paper will demonstrate to some extent that the type of tendering procedure used to secure tender offers from contractors impacts on the price formation process. In other words, the way you obtain your tender offers has a significant influence on the pricing levels of contractors. The specific tendering method examined in this paper is the competitive negotiation procedure which was shadowed from start to finish to ascertain the way that the tendering procedure impacts on the pricing levels of contractors.

ISO 10845 describes a competitive negotiation procedure as a tendering procedure which reduces the number of tenderers competing for the contract through a series of negotiations until the remaining tenderers are invited to submit final offers. There are two variants of the competitive negotiation procedure (see Table 1). The specific tendering method applied in the case examined was the Restricted competitive negotiations which is described by ISO as a tendering procedure where a call for expressions of interest is first

advertised and thereafter only tenderers who have expressed interest, satisfy objective criteria and who are selected to to submit tender offers, are invited to do so. The employer evaluates the offers and determines who may enter into competitive negotiations

LITERATURE REVIEW

The way that clients and their contractors negotiate and agree on price is complex, and not well explained in most of the literature. This literature review covers some of the salient issues around the way that price formation occurs in construction contracts including the different types of tendering methods used for contractor selection.

Relationships between Procurement, Tendering and Contracts

The text-book approach to describing the way that the price of a construction project is established reveals a complex process (for example, Hughes et al., 2015). This introduces three inter-related concepts: procurement strategies, contractual arrangements, and tendering procedures. The relationship between these concepts is not always articulated clearly in the construction management literature although it is clear that contractual arrangements are often dictated by the procurement strategy.

In broad terms, procurement can simply be understood as a method of buying goods and services (Hackett *et al*., 2007). Procurement methods in construction may be broadly classified as 'traditional and competitive' and 'innovative and collaborative' (Hughes *et al*., 2006). Risk allocation often forms the basis of most procurement methods (Hackett *et al*., 2007). Thus, most people who procure goods and services may wish to record such transactions using formal, written contracts just in case things go wrong. The main distinguishing feature of the different types of contractual arrangement in construction is often the extent to which the price is based on a fixed estimate provided by the contractor/supplier or cost reimbursement.

Most contracts in construction are made by tender. Thus, the contract price formation occurs through a competitive tendering framework that clients often use to obtain the lowest price from the winning contractor. Therefore, the main distinguishing feature of tendering procedures is often the extent of competition. However, a comprehensive review of literature on the origins and practice of tendering theory in construction by Runeson and Skitmore (1999) showed that this mechanism does not always help clients to achieve value for money on projects. Indeed, Smith and Bohn (1999) for example, observed that for clients, periods of high competition would yield bid prices that would appear on the face of it to be exceptional value. However, ultimately, the lowest bids may not prove to be such bargains, especially in cases that lead to claims and insolvencies.

Given that the three concepts of procurement, contracts, and tendering form the basis of the organizational strategy adopted for many infrastructure projects (Hughes et al., 2015), these factors can influence the extent to which contractors assume and apportion risk in their bids for construction work.

Tendering Procedures in Construction

Generally in the construction management literature there are basically three mechanisms used by clients for obtaining tenders and awarding work to a contractor. These are open tendering, selective tendering, and negotiation (Brook, 2004). However, ISO 10845-1 provides for eleven standard tendering procedures associated with procurements other than those relating to disposals by auction and framework agreements (see Table 1).

Competitive Negotiation Procedure

ISO 10845 (2010) defines the "competitive negotiation procedure" as a "procurement procedure which, through a series of negotiations, reduces the number of tenderers competing for the contract until the remaining tenderers are invited to submit final offers". There are two alternatives within competitive negotiation procedure (see Table 1). The first one is "restricted competitive negotiations" and the second one is "open competitive negotiations".

In the "Restricted competitive negotiations" system, a call for expressions of interest is advertised and thereafter only those tenderers who have expressed interest, satisfied objective criteria and been selected to submit tender offers, are invited to do so. The employer evaluates the offers and determines who may enter into competitive negotiations. In the "Open Competitive negotiations" system, tenderers may submit tender offers in response to an advertisement by the organization to do so. The employer evaluates the offers and determines who may enter into competitive negotiations.

In some parts of the literature, the competitive negotiation procedure is seen as a best value tendering method (see, for example, Scott, 1995). However, an examination of descriptions of the different tendering methods in Table 1 suggests that a significant time period will be required to implement a competitive negotiation procedure. Tendering costs in this tendering procedure can be significant and hence the method should only be used where it can be demonstrated that its application will yield best value for money. The costs of time and resources required to implement a competitive negotiation procedure would need to be taken into account and balanced against the potential benefits when it comes to choice and implementation of this method of tendering.

China's legal framework for procurement also provides for a competitive negotiation method. In China, competitive negotiation is used where tendering has failed (no qualified bidders, no bids, etc.), where it is not feasible to specify the technical requirements, or under emergency circumstances.

Table 1: Standard tendering procedures (ISO 10845)

Procedure			Description
TP1	Negotiation procedure		A tender offer is solicited from a single tenderer.
TP2	Competitive selection procedure		Any procurement procedure in which the contract is normally awarded to the contractor who submits the lowest financial offer or obtains the highest number of tender evaluation points.
	TP2A	Nominated procedure	Tenderers that satisfy prescribed criteria are admitted to an electronic database. Tenderers are invited to submit tender offers based on search criteria and their position on the database. Tenderers are repositioned on the database upon appointment or upon the submission of a tender offer.
	TP2B	Open procedure	Tenderers may submit tender offers in response to an advertisement by the organization to do so.
	TP2C	Qualified procedure	A call for expressions of interest is advertised and thereafter only those tenderers who have expressed interest, satisfy objective criteria and who are selected to submit tender offers, are invited to do so.
	TP2D	Quotation procedure	Tender offers are solicited from not less than three tenders in any manner the organization chooses, subject to the procedures being fair, equitable, transparent, competitive and cost-effective.
	TP2E	Proposal procedure using the two-envelope system	Tenderers submit technical and financial proposals in two envelopes. The financial proposal is only opened should the technical proposal be found to be acceptable.
	TP2F	Proposal procedure using the two-stage system	Non-financial proposal are called for Tender offers are then invited from those tenderers that submit acceptable proposals based on revised procurement documents. Alternatively, a contract is negotiated with the tenderer scoring the highest number of evaluation points.
	TP2G	Shopping procedure	Written or verbal offers are solicited in respect of readily available goods obtained from three sources. The goods are purchased from the source providing the lowest price once it is confirmed in writing.
TP3	Competitive negotiation procedure		A procurement procedure which reduces the number of tenderers competing for the contract through a series of negotiations until the remaining tenderers are invited to submit final offers.
	TP3A	Restricted competitive negotiations	A call for expressions of interest is advertised and thereafter only those tenderers who have expressed interest, satisfy objective criteria and who are selected to submit tender offers, are invited to do so. The employer evaluates the offers and determines who may enter into competitive negotiations.
	TP3B	Open competitive negotiations	Tenderers may submit tender offers in response to an advertisement by the organization to do so. The employer evaluates the offers and determines who may enter into competitive negotiations.
TP4		Electronic auction procedure	Tender submissions are initially evaluated using stated methods and criteria. All tenderers who submit responsive tenders are invited simultaneously by electronic means to submit new evaluation parameters and have their evaluation scored, without having their identity made known to other tenderers. Tenderers may amend their offers up until such time as the auction is closed

Source: ISO 10845-1:2010 (International standard for construction procurement)

Technical specifications and price are negotiated with a specified number of firms according to predetermined procedures and criteria. Critics of China's legal framework or procurement have expressed concern about the procedure. They believe it lacks the transparency and competitive features envisaged in the WTO-GPA (Government Procurement Agreement) (see paper on China's legal framework by Rothery, 2003).

There is no comprehensive literature on how widely the competitive negotiation procedure is used in practice. However, there have been studies such as Liu and Wilkinson (2011) which reported how a competitive negotiation procedure was adopted to select the private sector partner for the Beijing Metro Line 4 project. One respondent in the study by Liu and Wilkinson (2011) said that the competitive negotiation method provided" a trade-off between gaining efficiency and maintaining the required level of competition".

Kovács (2004) indicates that the competitive negotiation procedure can create opportunity for participants (contractors) to be involved in a remarkable part of the design work. Kovács (2004) states that a typical competitive negotiation starts with the issuance of the solicitation documents that are almost sufficiently spelled out but there are lack of details either because the procuring entity does not intend to choose from the available solutions; or does not have the right key to certain problems. In order to speed up the evaluation and clarification, participants may be invited separately to give an oral overview of their proposed solutions.

PROBLEM STATEMENT

Tendering is a common method used internationally by clients to secure tender offers from contractors and award the contract for an infrastructure project. There are different methods of tendering used in the construction industry to select a suitable contractor and establish an appropriate price for a construction contract (see Table 1). However, the way that different tendering methods impact on the price formation process is not clearly illuminated in the construction management literature. This study is the starting point for a comprehensive investigation into the impact of different tendering methods on price formation in construction contracts. The particular tendering method observed to kickstart the research is the competitive negotiation procedure explained in the international standard for construction procurement (ISO 10845: 2010). The research findings will illuminate the relationship between tendering method and price formation, guide clients in the price implication(s) of different tendering procedures, and help them control for factors that specifically influence pricing levels in the context of different tendering procedures.

AIM AND SPECIFIC OBJECTIVES

The research aim was to examine how the competitive negotiation tendering method impacts on the price formation process.

The specific objectives were to:

- Examine how the competitive negotiation procedure is applied in practice including the timelines associated with the various stages
- Evaluate the relationship between the competitive negotiation procedure and the price formation process, that is, evaluate the

impact of the competitive negotiation procedure on price formation in construction contracts.

RESEARCH DESIGN AND METHODS

Given the research aim and specific objectives, it was necessary to design a comprehensive research and obtain access to a competitive negotiation tendering procedure in order to shadow the process and investigate the following variables of interest in the study:

- Tendering activities and their timelines;
- Pricing levels of contractors in the various stages of the tendering process; and
- Reasons for changes in pricing levels of contractors as the tender process progressed.

Access to the Campus Planning and Development Division at Wits University was arranged and the application of the competitive negotiation procedure in the capital projects programme became the setting for the study.

The competitive negotiation procedure was used for the selection of a framework contractor who will enter into a framework contract with the client for a period of three years.

A case study research strategy was chosen for the study. One advantage of the case study research strategy is that it enables multiple methods to be used for an investigation (Gill and Johnson, 2010). Yin (2013) also identified one hallmark of the case study approach as the collection of data from different sources using different methods. Consequent to the choice of a case study research strategy, the data collection methods employed were participant-observation, documentary analysis and exploratory interviews with some participants in the competitive negotiation tendering procedure. A field notebook was used to write down observations in a systematic way. The observations recorded were then coded and analysed qualitatively using content analysis followed by interpretation by the researcher.

A participant observation method provided two main advantages here. The first advantage was ecological validity as it provided real-life insight into the phenomenon being investigated (see Gill and Johnson, 2010). The second advantage was that it allowed for access to the project documents and the entire procurement team comprising of client and contractor representatives so that a comprehensive understanding could be obtained from the interactions with project team members and the documents.

The documentary analysis of project documents provided data on the project information, tender documents, addenda to tender documents, tender queries from contractors and the bid prices submitted by contractors.

DATA PRESENTATION AND RESULTS

The purpose of the tender was to appoint a Framework Contractor for Construction and Refurbishment of Buildings over a 3-year period. The timelines and activities involved in the application and implementation of the competitive negotiation procedure is summarized in Table 2.

The contracting strategy was design by employer with a target price based on an activity schedule. The form of contract was NEC3 Engineering and Construction Contract (Option C). The targeting strategy was preferences for B-BEEE, contracting with enterprises that are black or women owned and providing bursaries from the share gain. As demonstrated in Table 2, a call for expressions of interest was advertised in June and ten contractors submitted expressions of interest. Following a prequalification process, seven contractors were considered eligible and invited to tender. This commenced the first round of the competitive negotiation procedure.

Table 2: Summary of the competitive negotiation procedure

Timelines	Tendering activities	Actions by contractors	Actions by employer
10-25 June	Call for expression of interest	Ten contractors submit expression of interest	Seven contractors were selected into framework agreement
18 Sept	Invitation to tender	All seven framework contractors invited	Tender documents were issued to all seven contractors
27 Sept	Compulsory clarification meeting (2 hours)	Reps from all seven framework contractors attend	Employer briefs all contractors on the mechanism of target cost contracts and the project
05 Oct	Tender submission closing date for 1st round	First round tendering Six contractors submitted bids. One failed to submit	Tenders are evaluated and three contractors are selected and invited into second round
21 Oct	Invitation of final three tenderers	Second round of tendering	Three contractors were selected from first round and invited into second round of tendering
9 Nov	Clarification meeting with contractors (1.5 hours for each bidder	Contractors attended clarification meetings separately	Employer and consultants engage with contractors to discuss project and how they can add value
20 Nov	Closing date for 2nd round tender submissions	Three contractors submit final bids	Receipt of submissions
06 Dec	Selection and award	Contractor selected	Award to successful tenderer

The contractors were given a bill of quantities to price in the first round. Afterwards three contractors were selected to submit final tender offers in a second round where they were given the full set of drawings and required to do their own measurements and confirm the quantities inserted in the bill of quantities. The final tender offer was to be submitted based on a priced activity schedule which is essentially a lump sum contract.

Tender clarification meeting

A compulsory clarification meeting was organised for the eligible contractors to provide an opportunity for them to meet with the professional team and obtain a briefing on the procurement arrangements, scope of work services and employer's requirements.

Six out of the seven eligible contractors participated in the clarification meeting; one contractor withdrew from the process. The clarification meeting lasted for two hours, and seemed to serve two main purposes in this particular instance. First, it afforded the bidders an opportunity to clarify their understanding of the client's framework contract and target cost contract approach. Second, the clarification meeting provided an opportunity for the client's professional team to clarify areas of uncertainty for contractors.

Following the clarification meeting, the six contractors proceeded with their tender preparation and all six submitted tender offers. The tender submission comprised of a priced bill of quantities, approach paper, and key people who will be executing the contract.

First round of tender submission

Table 3 shows the summary of the prices submitted by the contractors in the first round of the competitive negotiation procedure. The six contractors who submitted tenders are designated as Alpha, Gamma, Epsilon, Zeta, Delta and Beta.

Table 3: Tender prices in the first round of the competitive negotiation procedure

Name of Tenderer	Total of Price (In VAT)	Total of Price (ex VAT 14%)	Fee percentage
Alpha	57 108 345.78	50 095 046.16	6.65%
Gamma	65 353 728.79	57 327 832.27	6.65%
Epsilon	54 917 747.82	48 173 463.00	5.88%
Zeta	58 252 088.88	51 098 323-58	7.16%
Delta	57 999 826.00	50 877 041.00	8.56%
Beta	58 248 618-83	51 095 279.67	4.20%
Mean tender price	58 646 712.05	51 444 497.61	6.52%

The cost consultant's estimate was R 53,741,000.00, excluding VAT i.e. 4.4% above the average price but within the standard deviation of 5.5%. This amount included budgetary allowances totalling R 14 689 excluding VAT relating to specialist work which will be subcontracted after the award of the contract. Table 4 shows the pricing parameters tendered in the first round of the competitive negotiation procedure.

Table 4: Pricing parameters tendered in the first round

Tendered parameter	Lowest	Highest	Average	Standard deviation
Tendered total of the Prices excluding VAT	48 173 463	57 327 832	51 444 497	± 2 819 518.56
Percentage for Working Area overheads	3	12	7.33	± 2.85
Percentage for adjustment for Equipment in published lists	-10%	12.5%	2.42	± 7,61
Percentage for people overheads	4.5	12.5%	6.17	± 3.39
Subcontracted fee percentage	2.5	7.5	5.19	± 1.70
Direct fee percentage	5	7.5	6.16	± 1.10

Tender addenda and query responses

The tender addenda and tender query responses issued to contractors are summarised in Table 5. It is typical for clients to issue addenda to tender documents during the tender process. Such documents may clarify information or provide additional information that contractors require to price their tenders (see paper by Laryea, 2011 on quality of tender documents).

Table 5: Tender addenda and tender query responses

Reference No	Date	Description of Amendment
01	01 Oct 2012	Addendum no 1
02	03 Oct 2012	Addendum no 2
03	01 Nov 2012	Ceiling and partition details
04	02 Nov 2012	Clarification structural changes
05	02 Nov 2012	Responses tender queries
06	05 Nov 2012	Addendum no 3
07	07 Nov 2012	Additional clarifications
08	13 Nov 2012	Additional clarifications
09	15 Nov 2012	Addendum no 4
10	16 Nov 2012	Returnable documents clarification

Addendum No 3 amended the Department of Higher Education and Training's Standard for developing skills that result in nationally accredited outcomes through infrastructure, provided pricing assumptions for quantities of reinforcement, revised the list of drawings and replaced the finishing schedule with a separately issued schedule.

Addendum No 4 transformed the PC allowances for certain wall and floor tiles contained in the Bill of Quantities into budgetary items, created budgetary items for mosaics, made some minor adjustments to the specified finishes and reduced the retention held for the defects liability period for the electrical and mechanical systems.

Second tender clarification meeting

Each of the three tenderers invited into the second round attended another clarification meeting conducted on 9th November 2012 - this took place 12 days to the final tender submission date. The professional team participants who met with the three contractors separately were three client's

representatives (Infrastructure department director, Infrastructure programme director, and procurement consultant), representatives of the architects, structural engineer and cost consultants attended.

The purpose was to afford contractors another opportunity to clarify their uncertainties and understanding of the project requirements in order to finalise their tender offer.

Three final submissions were received and subsequently evaluated using a point scoring system of financial offer, preferences and quality. Tenderers were ranked in accordance with the number of points received to enable a recommendation to be made regarding the award of the contract.

Second round of tender submission

Table 6 shows a summary of the tender prices submitted in the second round of the competitive negotiation procedure.

Table 6: Tender prices in the second round of the competitive negotiation procedure

Pricing parameters	Alpha	Epsilon	Beta
Budgetary items	14 698 000.00	14 698 000-00	14 698 000.00
Activities	26 758 534.55	24 907 259.07	26 758 122.39
General items	5 399 734.00	6 695 816-65	7 931 170.00
Subtotal	46 856 268.55	46 301 075.72	49 387 292.39
Direct fee	(6.65%) 3 115 940.53	(5%) 2 315 053.79	(5.29%) 1 835 639-65
Subcontract fee			(4.0%) 587 560-00
Total	49 972 189.08	48 616 129-51	51 810 391.65
VAT (14%)	6 996 106.47	6 806 258.13	7 253 454.83
Total incl. VAT	56 968 295.55	55 422 387.64	59 063 846.48

Interestingly, Table 6 shows that contractor Alpha (who was the winning tenderer) came down on their tender offer in the first round by R140,050.23 (0.25%) but their direct fee percentage of 6.65% remained unchanged in the second round of tendering. This notwithstanding, its fee value stood at R3115940.53, which was the highest of the three contractors (see Table 6). Epsilon's tender price increased by R504 639.82 (0.92%) but the direct fee percentage reduced by 0.88%, while Beta increased their tender price from 58, 248, 618.83 to R59,063,846.50 (see Table 3 and Table 5). Beta's initial direct fee percentage was 4.20% but this was increased to 5.29% in the second round which represents a 1.1% increase in the direct fee percentage initially tendered.

DISCUSSION OF RESULTS

Based on the research aim and objectives, four issues are brought forward for discussion.

- The first discussion point relates to the way that the competitive negotiation procedure was implemented in practice.
- The second discussion point relates to the impact of market competition on pricing levels of contractors.
- The third discussion point relates to comparison of tender prices in the first round with tender prices in the second round of the competitive negotiation procedure.
- The fourth discussion point relates to the impact of the competitive negotiation procedure on the process of price formation in construction contracts.

<table>
<tr><td colspan="6">Six month long tender process (June – November)</td></tr>
<tr><td>Submission of expressions of interest</td><td>First tender clarification meeting</td><td>Submission of tenders in the first round based on bill of quantities</td><td>Second tender clarification meeting – contractors meet with whole of client's professional team</td><td>Response to tender queries

Provision of tender addenda</td><td>Final submission of tenders in the second round based on activity schedule</td></tr>
<tr><td colspan="6">Uncertainty and risk pricing of contractors reduces as a result of more information and clarification meetings</td></tr>
</table>

Fig 1: Illustration of the relationship between the competitive negotiation tendering procedure and clarification / risk reduction as the process evolves

The discussion of results is based on the evidence presented in Tables 2-7 and Figure 1 which attempts to illustrate a relationship between the competitive negotiation procedure and specific activities or interventions in the process that enabled a reduction in risk and uncertainty for contractors and hence risk pricing in their tenders.

Application of the competitive negotiation procedure in practice

ISO 10845 (2010) describes the competitive negotiation procedure as a tendering procedure which reduces the number of tenderers competing for the contract through a series of negotiations until the remaining tenderers are invited to submit final offers. However, there is no indication of timelines for implementing various stages of this tendering procedure in practice. The timelines and activities associated with the use of the competitive negotiation method examined is presented in Table 2.

The tendering process lasted for six (6) months in this case due to the series of complex activities involved in this tendering procedure. Therefore, clients intending to adopt the tendering procedure should do a value for money assessment to ensure appropriate use as tendering costs can be very significant (see Hughes et al., 2006) and it is important to avoid wasteful tendering practices (see UK Government Construction Strategy, 2011).

The other point relates to finding a way to keep competing contractors from contact with each other. This is mentioned by Kovács (2004). In the tendering process examined, the three contractors in the final round met

with the client representatives (as indicated in Table 2). Sufficient time of 30 minutes was allowed between the slots so that contractors arrived and left without contact with each other and knowing the identify of their competitors. The face-to-face engagement between contractors and the whole professional team provided an opportunity for contractors to clarify their understanding of the project requirements and propose their solutions to some of challenges identified in the project. On the underhand, the engagement also provided an opportunity for the client's team to identify and assess the level each contractor's understanding of the project requirements and their proposed methodology.

The competitive negotiation tendering procedure in ISO 10845 (2010) may be similar to the competitive dialogue (CD) introduced by the European Parliament and the Council in 2004. According to a paper by Hoezen and Doree (2008) on the first competitive dialogue projects in Netherlands, it was presented as a public sector procurement procedure for particularly complex contracts. The purpose of CD is to provide public clients with a flexible procedure to enable a discussion concerning all aspects of the contract with several contenders - to identify and define the means best suited to meeting its objectives - in an intervening stage between the tender announcement and the submission of final tenders.

Competitive dialogue allows for bidders to develop alternative proposals in response to a client's outline requirements. Only when their proposals are developed to sufficient detail are tenderers invited to submit competitive bids. The aims are to increase value by encouraging innovation and to maintain competitive pressure in bidding for complex contracts. Hoezen and Dorée (2008) did an evaluation study on 15 CD projects where they found that the parties are often concerned about the high transaction costs. They also found that the parties in CD balance between the wish to cooperate and the need of keeping information to themselves due to competition. Hoezen and Dorée (2008) described competitive dialogue as a procurement route caught between competition and collaboration.

Comparison of first and second round tender prices

A comparative analysis of the prices submitted by the three final tenderers can be broken down as follows (see Table 7). See Table 3 and Table 6 for details of the tender prices in the first and second rounds.

Table 7: Comparison of first and second round tender prices

Number	Name of Tenderer	Total of Price (first round)	Total of prices second round	Difference
1	Alpha	57 108 345.78	968 295-55	-140 050.23 (-0.25%)
2	Epsilon	54 917 747-82	55 422 387-64	+ 504 639.00 (+0.92%)
3	Beta	58 248 618-83	59 063 846-48	+ 815 227.65 (+1.4%)

The average of all six tenders received in the first round was R58 646 712.05 (see Table 3) compared to R57 151 509.89 in the second round (seeTable 6) which translates to 2.5% reduction in the overall pricing levels of

contractors. This evidence may confirm the impact of market competition on pricing levels of contractors. However, when only the tenders of the final three contractors are considered, then there was an overall average increase of 0.65% which is expanded upon in the next paragraph.

As mentioned earlier, contractors were given a bill of quantities to price in the first round. After evaluation of the first round tender submissions, three contractors were selected to submit final tender offers in a second round where they were given the full set of drawings and required to do their own measurements and confirm the quantities inserted in the bill of quantities. The final tender offer was to be submitted based on a priced activity schedule which is essentially a lump sum contract. Two factors introduced in the second round could potentially increase pricing levels – (1) additions in tender addenda; and (2) risk for fixed price tenders in the second round. If these two variables impacted quite significantly on pricing and the winning contractor's price was still 0.25% less than the first round price, the factors that influenced reduction in pricing levels need to be systematically identified.

As can be seen from Table 5, minor additions to the original project information given in the first round were contained in tender addenda and query responses summarized in Table 5. The precise monetary value of these additions could not be directly quantified. However, the average increase in pricing levels of the final three contractors was 0.65% (see Table 7). This figure may be taken as a rough estimate of the value of additions contained in the tender addenda and query responses summarized in Table 5. However, this estimate should probably be seen as the maximum amount as the impact of factors such as competition and clarification of contractors' uncertainty is likely to have brought down the first round tender prices if no minor additions had been introduced in the second round.

Impact of market competition on pricing levels of contractors

The tender evaluation process in the first round revealed that the cost consultant's estimate was R 53,741,000.00, excluding VAT i.e. 4.4% above the average price but within the standard deviation of 5.5%. To some extent, the deviation between the consultant's estimate and the data in Table 3 provides evidence of the impact of market competition on pricing levels of contractors. In the competitive tendering process, five out of six contractors priced significantly lower than the cost consultants for the project who are a credible and leading QS and cost consultancy firm based in Johannesburg. Studies involving contractors in the USA by Smith and Bohn (1999) and de Neufville and King (1991) presented ample evidence to indicate that pricing levels of contractors are significantly influenced by market competition especially in times when they have a high need for work.

Impact of the competitive negotiation procedure on the price formation process

The average of tenders received in the first round was R58 646 712.05 (see Table 3) compared to R57 151 509.89 in the second round (seeTable 6) which translates to 2.5% reduction in the pricing levels of contractors. Despite

some additions to the project information (tender addenda) and fixed price nature of tender offers in the second round, the winning contractor's final tender (Alpha) was 0.25% lower than their price in the first round, although the average of the final three tender prices was 0.69% higher than their first round tender prices.

The monetary value of additions to the original project information (tender addenda) could not be estimated to enable a relatively more direct comparison between pricing levels in the first and second rounds. However, two preliminary observations from the research data are presented as follows. First, the reduction in pricing levels from first to second round may confirm the impact of factors such as market competition on pricing levels of contractors. Second, the competitive negotiation procedure stages and activities promoted a reduction in contractor uncertainty around the project requirements and the client's professional team. This may be said to have reduced risk pricing in contractors' tenders. The clarity gained through the stages of the competitive negotiation procedure clearly influenced a reduction in their risk pricing.

CONCLUSION AND RECOMMENDATIONS

The research aim was to examine and analyse the application of the competitive negotiation tendering method in practice and examine how it impacts on the price formation process in construction contracts.

Using participant observation, a competitive negotiation tendering procedure for a construction project in South Africa was shadowed six months (June – November 2012).

The findings relating to the first objective on how the competitive negotiation procedure is applied in practice including the timelines associated with the various stages was summarized in Table 2. The second objective relating to impact of the competitive negotiation procedure on the price formation process was summarized in Table 7 and Figure 1.

The competitive negotiation procedure took a considerable period of six months to implement with eight key activities associated with the process (see Table 2). The process allowed contractors to make input into the design in the second round where the contractors met seperately with the client's professional team to clarify their understanding of the project requirements and present their proposed methodology for execution. The key conclusion from the results sunnmarised in Table 2 is that the competitive negotiation procedure is a lenghty tendering process which can be associated with significant tendering costs. It should only be used where the benefits outweigh its costs.

The research data shows that market competition impacts on pricing levels of contractors. The average of tenders received in the first round was R58 646 712.05 compared to R57 151 509.89 in the second round which translates to 2.5% reduction in the pricing levels of contractors. The research data further demonstrates that one reason it was possible for

contractors to offer a more competitive price was because of reduction in risk pricing. The clarification opportunities offered by the competitive negotiation procedure and discussion of their proposed methodology with the entire professional team offered a chance to know the client's response in advance and hence lesser need for risk price for uncertainty.

REFERENCES

British Standards Institution (2012) Construction Procurement Policies, Strategies and Procedures-Code of Practice BS 8534:2011, BSI Standards Publication, UK

Brook, M. (2004) Estimating and Tendering for Construction Work, 4ed, Routledge

Gill, J. and Johnson, P. (2010) Research methods for managers. 4ed, London: Sage

Hackett, M., Robison, I. and Statam, G. (2007). "Procurement, Tendering and Contract Administration, Blackwell, Oxford

Hoezen, M.E.L. and Dorée, A.G. (2008) First Dutch competitive dialogue projects: a procurement route caught between competition and collaboration, in 24th Annual ARCOM Conference, A. Dainty, Editor. 2008, Association of Researchers in Construction Management: Cardiff, UK. p. 535-543

Hughes W P, Hillebrandt P, Greenwood, D. G. and Kwawu W. E. K. (2006). Procurement in the Construction Industry: The Impact and Cost of Alternative Market and Supply Processes", London, Taylor and Francis.

Hughes, W., Champion, R. and Murdoch, J. (2015) Construction contracts: law and management. 5th edition. Routledge, London, pp435.

International Organisation for Standardisation (ISO) (2014) Building and Civil Engineering – Vocabulary – Part 2: Contract terms (ISO 6707-2: 2014, 7.12)

International Organization for Standard (ISO, 2011). "Construction Procurement-Part 1: Process, Methods and Procedures", ISO, Geneva, Switzerland

International Organisation for Standardisation (ISO) (2010) Construction procurement -- Part 1: Processes, methods and procedures, Geneva: ISOKovács, A. (2004) Contract negotiations, Enhancing Procurement Practices - Comprehensive approach to acquiring complex facilities and projects, 517-526, New York: Springer

Laryea, S. (2011) Quality of tender documents: case studies from the UK, Construction Management and Economics, 29(3), 275-286

Liu, T. and Wilkinson, S. (2013) "Can the pilot public-private partnerships project be applied in future urban rail development?: A case study of Beijing Metro Line 4 project", Built Environment Project and Asset Management, 3(2), 250-263

Neufville, R. and King, D. (1991) Risk and need-for-work premiums in contractor bidding, Journal of Construction Engineering and Management, 117(4), 659-673

Rothery, R. (2003) China's Legal Framework for Public Procurement, Journal Of Public Procurement, 3(3), 370-388

Runeson, G. and Skitmore, R.M. (1999). " Tendering Theory Revisited". Construction Management and Economics, 17 (3),285-96

Scott, S. (1995) Best value contracts: Lessons learned in paving the road to quality, National Contract Management Journal, 26(2), 1-11

Smith, G.R., and Bohn, M.C. (1999). "Small to Medium Contractor Contingency and Assumption of Risks". ASCE Journal of Construction Engineering and Management, 125 (2), 101-8

UK Government Construction Strategy, 2011

Yin, R.K. (2013) Case Study Research: Design and Methods (Applied Social Research Methods), 5ed, London: Sage

IMPLICATIONS OF SOCIAL PRACTICES AND LITERACY ON WAYFINDING DESIGN STRATEGIES IN NIGERIAN HOSPITALS

Joy Joshua Maina[1] and Abdulhamid Dauda[2]
[1,2]Department of Architecture, Ahmadu Bello University, Nigeria

This study set out to establish ways of improving wayfinding in Nigerian hospitals due to the rise of trauma cases resulting from insecurity and insurgency. This is important because such scenarios complicate wayfinding for local residents within hospital environments designed along western healthcare standards. Unique Adequacy approach was employed to generate responses to wayfinding needs in Northeast Nigeria, the most vulnerable region to terrorist attacks in the country. Two surveys were conducted in four large regional hospitals to explore existing features and wayfinding components of physical features, coded information and social practices obtained from literature. Results via visual observations and interviews reveal extensive incorporation of wayfinding features with little or no guidelines resulting to poor design, confusing signs and high dependency on social practices. Questionnaire responses from 364 respondents analysed for means (M), relative importance index (RII) and differences of means using ANOVA reveal physical features notably entrances and exits, staircases, ramps and courtyards recorded significantly higher ratings for wayfinding cues. These were followed by the social practices of verbal communication and lastly, coded information in form of signage, a common design solution to wayfinding. These results imply that users will find it tasking to find their way out of complex hospitals in the event of a security or fire emergency by relying on designed wayfinding strategies. Specifically, users rely on the social practice of verbal instructions to supplement physical building features during wayfinding in part due to low educational levels in the study area. The implication on practice is that architects and construction professionals need to differentiate finishes, structures and landscaping elements, project clear building entrances and sidewalks as well as design colour guides on walls and not floors to improve wayfinding. Urgent improvement, implementation and monitoring of basic education delivery are also required in the northeast to meet global best practices to aid wayfinding.

Keywords: education, hospitals, northeast Nigeria, social practices, wayfinding

[1] jjmaina@abu.edu.ng
[2]4dauda@gmail.com

Maina, J. J. and Dauda, A (2017) Implications of social practices and literacy on wayfinding design strategies in Nigerian hospitals *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 870-885

INTRODUCTION

Insurgency and insecurity has been a trending problem in Nigeria over the last five years. The northeast region has particularly been plagued by horrific activities of insurgents resulting in a huge humanitarian crisis, the emergence of internally displaced persons (IDPs), untold hardship, pressure on housing, education, security management and healthcare infrastructure as well as overwhelming trauma inflicted on victims (Aro, 2013; Ovaga, 2014; Iweze, 2014; Ajibola, 2015; Immasuen, 2015; Ager, et al., 2015; Omilusi, 2016). For the injured and their families, the first point of relief is usually the nearest healthcare facility or hospital, some of which have been the targets of bomb attacks (Omole, Welye, & Abimbola, 2015). In such scenarios, anxiety and frustration of victims and their relatives who throng medical facilities in a panicked state increases when faced with long and confusing corridor systems, bends, turns and confusing signs. Security and medical personnel add to this frantic scenario in the course of carrying out their duties in aid of traumatized patients. The consequences of poor wayfinding in complex healthcare facilities are enormous: loss of quality man-hours, appointments, less efficient use of resources and bad hospital reputation (Mollerup, 2016).

Wayfinding problems have been recorded in a wide variety of hospital settings worldwide (Rooke, 2012). This phenomenon has been attributed in part to the rapid expansion of healthcare facilities, sub-specialization in the medical field, user impairment in terms of perception, cognition and mobility as well as an increase in elderly patients (Mollerup, 2016). Solutions to wayfinding by designers has been the use of coded information and signage (Carpman & Grant, 2002). Problems arise when the population does not have an adequate education for understanding signage and coded information in a proper way (Yalon-Chamovitz, 2009). The northeast region of Nigeria is the most disadvantaged in terms of education and access to basic infrastructure, in part due to insurgency by a sect opposing western education (Abdulrasheed, Onuselogu, & Obioma, 2015; Winsor, 2015; Segun, 2016).

Christian missionaries introduced western education in Nigeria in the mid nineteenth century (US Embassy Nigeria, 2012) with a focus on training pupils for missionary work via reading, writing, arithmetic and religion (Thovoethin, 2012). This framework was established by British Colonial education after independence to train clerks for administrative and commercial duties (Okoro, 2011; Jaja, 2013). Today, Nigeria practices the Revised 9-3-4 educational system introduced from September 2014 (Igbokwe, 2015). This comprises nine years of primary and junior secondary schools, three years senior secondary education and four years of tertiary education. Basic education also includes other categories such as adult and non-formal education (Adesina, 2011). The main aim of primary education in the first six years is to provide a broad-based education with emphasis on effective communication skills in order to produce a literate and numerate population as a foundation for further education (Olaniyan & Obadara,

2008). "The revised curriculum pays particular attention to the teaching of reading" (Igbokwe, 2015 p. 34). The first nine years of basic education is mandatory. Unfortunately, it is estimated that less than one-third of basic educated children will proceed to senior secondary level (US Embassy Nigeria, 2012). Secondary education aims at preparing students for useful living and for tertiary education. Specifically, it provides sub-professional manpower in science, technology and commerce, technical knowledge and vocational skills as well as inspiring the desire for self-improvement and achievement (Okolocha & Onyeneke, 2013). Tertiary education is categorized as either university education or higher professional education (EP-Nuffic, 2015; Jaja, 2013). It is education provided after secondary school in Universities, Colleges of Education, Polytechnics, Monotechnics, including other institutions offering correspondence courses (Yusuf & Afolabi, 2014). The sole aim of tertiary education is to produce "the required skilled manpower for managerial and technocratic levels of the economic, social and political sectors of the nation" (ibid, p. 1). University education in Nigeria consists of three stages: Bachelor programmes, Master's and Doctorate degrees. Higher professional education aims at preparing candidates for direct entry into the labour market through practical skills via Diploma programmes. Entry qualifications into tertiary institutions are determined at the end of senior secondary school.

Nigeria's literacy rate is estimated at 61% (US Embassy Nigeria, 2012). School enrolment is highest in primary school at approximately 20 million pupils (US Embassy Nigeria, 2012; Olaniyan & Obadara, 2008). A large number of school children and young adults have limited literacy and numerical skills with little hope of productively joining the work force. Overall, education indicators are poor nationwide, the greatest need occurring in the north, particularly the northeast (US Embassy Nigeria, 2012). Prior to the Boko Haram insurgency, the region recorded the lowest school enrolment, lowest level of literacy and highest poverty rates in the country (Winsor, 2015). "Over half a million children in northeast Nigeria have had to flee to safety . . . bringing the total number of displaced children in the conflict-torn region to 1.4 million . . . More than 208,000 of them are not in school" (ibid). Consequently, many people in the religion may be educationally disadvantaged to adequately employ coded information and signage for wayfinding.

With calls by various stakeholders for the provision of better healthcare facilities to cater to victims (Omole, Welye, & Abimbola, 2015), it is imperative that information regarding how best to improve wayfinding and make medical facilities more efficient be conducted in the region as little research efforts have been made in that regard. Specifically, it is unclear what strategies users employ for wayfinding in hospitals across northeast Nigeria. It is also uncertain whether educational/literacy levels influence wayfinding in hospitals in the region. This paper aims to address these issues via the question: Which components of the built environment are employed by wayfinders who visit hospitals in the study area?

REVIEW OF RELATED LITERATURE

Wayfinding

Wayfinding is a spatial cognitive activity involving specific tasks such as choosing routes, establishing and maintaining orientation, judging distances and remembering turns, location of objects and events (Montello & Raubal, 2013). It is the "goal directed and planned movement of one's body around an environment in an efficient way. Wayfinding requires a place goal, a destination we wish to reach" (Montello, 2005, p. 259). Wayfinding is a complex problem solving behavior requiring multiple cognitive resources and activities which have been categorized into four major components: Decision making, Orientation, Path integration and Closure (Vanderberg, 2016).

Decision making involves the initial motivation to find somewhere with a specific purpose and destination. It is also active in the second and third components of orientation and path integration as wayfinders decide from given options which route to take. Orientation is activated in the environment after the decision has been made and involves knowing where a person is in space.

Closely related is path integration. This involves constantly updating one's position via tracking of movement in space (ibid). Closure is understanding the destination has been reached (Montello & Raubal, 2013; Svensson, 1998). People have also been known to approach wayfinding tasks via landmark, route and survey knowledge (Vanderberg, 2016; El Ali, Bachour, Heuten, & Boll, 2016).

Landmark knowledge or knowledge of reference points begins orientation (Vanderberg, 2016). Physical entities such as tall buidings, trees, walls, entrances or other reference points distinct to individuals are common landmarks employed in wayfinding. "After acquiring landmark knowledge, people begin to fill in their understanding of the spaces between the landmarks, linking them into sequences of paths from one landmark to another." (ibid, p. 21). This is route knowledge from an egocentric perspective, with reference to self. Survey knowledge is an understanding of the larger spatial configurations of the environment (ibid). It is a cognitive comprehension of how landmarks, paths and locations of interest are spatially related to each other in such a way that description is possible. Acquiring survey knowledge, also known as having a cognitive map, evolves from an allocetric or external perspective independent of self.

Literature on wayfinding in the last few decades has been extensive in environmental psychology, spatial cognition and more recently in Human Computer Interaction (HCI). However, there has been little conceptualization of variables to improve daily real world wayfinding and navigation tasks (Mollerup, 2016; Montello & Raubal, 2013). To improve conceptualization, Rooke (2012) proposed a framework which assigns primacy of physical features for wayfinding tasks, followed by coded information, then social practices (Figure 1).

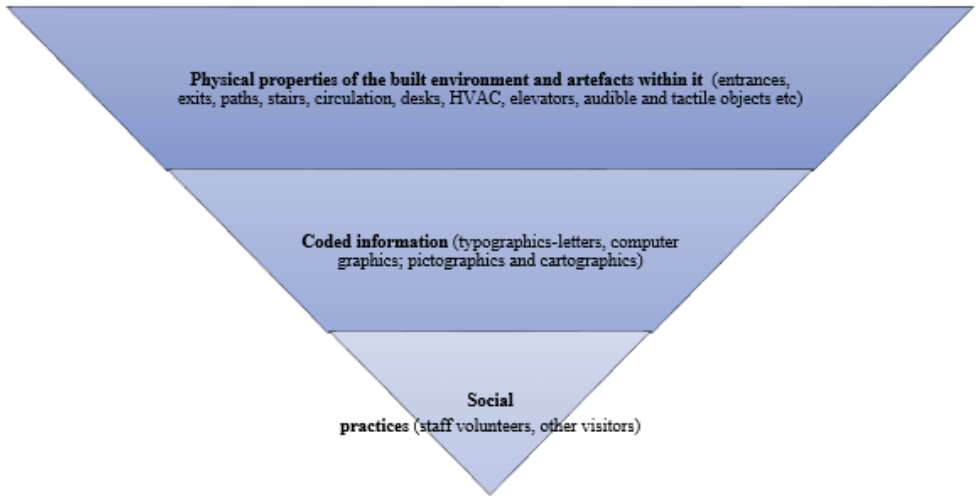


Figure 1: Prescriptive framework for addressing wayfinding problems. Adapted from Rooke (2012)

Several studies have shown that wayfinders in complex buidlings such as hospitals and dense urban areas employ descriptions of the environment through landmarks and notable physical entities (Vanderberg, 2016; Maina & Umar, 2015; Devlin, 2014; Rooke, 2012). In addition, wayfinders employ coded information in the form of directions and prompts to supplement what is already established or expected (Maina & Umar, 2015; Tenbrink & Wiener, 2007). These may involve pre-visit information provided by healthcare institutions (Mollerup, 2016). Accurately deciphering coded information is also a function of several factors such as the cultural milieu and literacy levels (El Ali, Bachour, Heuten, & Boll, 2016). When information from the physical built environment and coded data is insufficient to successfully navigate from one point to another, social practices are employed, usually verbal (or non-verbal) communication such as asking for directions or pointing in a direction (Khan, n.d.).

In reality, this sequence for wayfinding/navigation employing physical features, coded information and social practices may not always be feasible as people begin wayfinding prior to being within the environment (Mollerup, 2016). Reliance on social practices becomes glaring where the capacity to understand physical entities and coded information is low largely due to ageing, disability and low literacy related factors. Harris & Wolbers (2014) as well as Bates & Wolbers (2014) established the effect of ageing and disabilites on overall wayfinding and navigation in complex environments. Although wayfinding is a cognitive activity, research relating wayfinding to education is scarce despite the established link between cognition and education (Lenehan, Summers, Saunders, Summers, & Vickers, 2015; Rubinsten, 2015; Bangirana, Menk, John, Boivin, & Hodges, 2013). In addition, such research have been conducted in developed countries around literate populations with access to good physical and technology related infrastructure (El Ali et al., 2016). Developing countries have received comparatively little research efforts in this regard in part because current wayfinding research employs advanced technology and devices (Devlin 2014). These are not always available in developing countries (El Ali et al., 2016), Nigeria inclusive.

RESEARCH DESIGN AND METHODS/DATA COLLECTION

Methods and Materials

The research question posed by the study pertained to components of the built environment employed by wayfinders who visit hospitals in the study area. The most current research strategies involve mapping out user routes and behaviors with tracking devices during experiments or fire alarm checks. Implementing these strategies was not possible due to several reasons. First, routine or periodic fire alarm checks are uncommon in the study area. Secondly, any fire or security check in the form of an alert will be taken as real emergency due to the frequency of insurgent attacks in the study area (Maina and Umar, 2015). Consequently, permission for access into such facilities is highly restricted. Thirdly, training a large number of users in the use of tracking devices requires extensive time and financial resources beyond the scope of research for a master's degree in Architecture.

Thus, a mixed methods approach was adopted in two surveys conducted in December 2015. The framework employed for the study is based on the Unique Adequacy (UA) criteria from ethnomethodology consisting of a weak and strong form (Figure 2). The weak form demands that the researcher is competent in the research setting; the strong form reports only concepts originating from the research setting (Rooke & Kagioglou, 2007). This framework is especially beneficial for exploring phenomena in a research setting of the built environment (Maina, 2014)

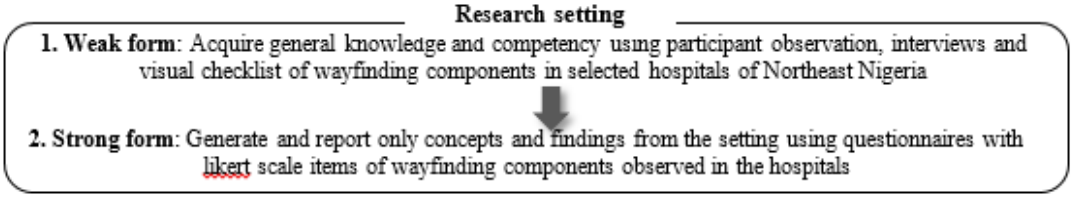


Figure 2: Research framework adapted from Maina (2014)

To fulfil the weak form of the UA criteria, an initial survey was employed to acquire general knowledge of hospitals in the study area and to determine how wayfinding features of physical entities, coded information and social practices have been incorporated in the research settings. This was achieved using visual surveys, observations and interviews in four large hospitals in northeast Nigeria not under direct constraints of insurgency and insecurity. The hospitals were Abubakar Tafawa Balewa University Teaching Hospital, Bauchi, Bauchi State (patient population, $N \approx 2000$); Federal Medical Centre Azare, Bauchi State ($N \approx 1500$); Specialist Hospital, Gombe ($N \approx 1500$) and Federal Teaching Hospital Gombe, Gombe State ($N \approx 1500$). Walking through the hospitals and noting the common categories of items constituted the visual survey of wayfinding features. This usually took an average of 4 hours per hospital. Observations of wayfinding activities commenced from the entrance of each hospital and were instrumental in identifying categories of activities and users such as visitors with limited

knowledge of the settings. Brief interviews were conducted with 10 staff from the Works and Maintenance department in the respective hospitals to understand the basis of the existing wayfinding features. The second set of surveys was conducted in the same hospitals in line with the second UA criteria employing questionnaires, which solicited data in two sections. Section A, demographics requested data for gender, user category, education level and tribe while section B consisted of 5-point likert scale responses for 21 items employed for wayfinding observed in the first survey (refer to table 3).

Data collection and analysis

Data collected from the first survey are presented as descriptions of activities, behaviour and attitudes observed walking through the hospitals. This was instrumental for generating an overall impression of wayfinding activities and features in the research setting. These were then quantitatively tested by responses from the questionnaires for descriptive and inferential statistics. The sample size was obtained from Yomens (2000) where sample size is calculated as the ratio of N (6500) and $1+ N (e^2)$, where e is 0.05 margin of error. This yielded a sample size of 377, which was rounded up to 400. The questionnaires were randomly distributed pro rata to patients, staff and visitors at various clinics, wards and departments in each of the hospitals after explanations about the survey and how to fill the questionnaire was made. A total of 374 questionnaires were retrieved, with 364 valid cases employed for analysis in SPSS v. 21.

In response to the research question regarding which components wayfinders employ in the hospitals, means (M) of items under each of the three components (physical entities, coded information and social practices) were computed via descriptive statistics and tested using one-way ANOVA and Tukey's HSD for differences as distributions of scores were not significantly different from normal distributions (z scores for skewness and kurtosis were all within $\pm$1 SD). ANOVA was employed in this case to establish if a statistically significant difference exists for means of the three wayfinding components in the study area based on education levels. Tukey's HSD is a post hoc test carried out after running the ANOVA to find out which of the group means differ in samples of equal size and similar variances (Field, 2013). Individual wayfinding items were also ranked using the relative importance index (RII) calculated as the ratio of actual agreement scores (AS_{ac}) and maximum possible agreement score (PAS_{max}) on the 5-point Likert scale for each item (Maina & Umar, 2015). A Likert scale is a psychometric response scale primarily employed in questionnaires to obtain preferences or the degree of agreement with a statement or set of statements (Betram, 2007). The scales assume the agreement of a wayfinder for any of the items is linear, thereby attaching a numerical value (Maina & Umar, 2015). Results from these procedures are presented in the next section.

RESULTS

Visual survey

Results from the visual survey reveal the predominant use of physical features specifically entrances, stairs and corridors for wayfinding. Entrances and exits were particularly effective when projected from the building. Oblique entrances pose a problem. The social practice of verbal descriptions using physical features as landmarks is highly prevalent and extensive. People in the study area rely heavily on a combination of these strategies when seeking information within the hospitals. Courtyards were sometimes confusing, as they often look alike with little differentiation, providing poor landmarks to orient users even when accompanied by verbal descriptions. Reception desks at the hospitals were sometimes empty as personnel leave the desks to offer help to wayfinders. To improve this trend, hospital administrators employ additional staff in form of security personnel. These are in two categories. The first help secure hospitals in the face of insurgent and insecurity threats. The second category, known as SERVICOM staff, monitor activities at specific service points. Some were observed reading and explaining prescriptions to patients as well as giving verbal directions to visitors. The predicament of coded information in the form of signboards, building directories and layout maps (forms of You-Are-Here signposts) were found to increase information overload. People rarely use them for wayfinding purposes. Most of these are labeled in English or phrased in medical terms. The latter are particularly difficult to decipher by the average user. Some hospitals however provide signs in Hausa, the local dialect prevalent within the region. Painting on the floors using different colors was popular and easily understood. These were unfortunately faint in many areas due to high traffic, frequent cleaning expected in hospitals and poor maintenance culture. Their location was also noted as a problem as floor line information did not often commence from entrances or vintage locations such as main reception areas to be maximally effective. Directions on walls were often ineffective due to incorrect placement in terms of height and direction.

Questionnaire responses

Demographic data reveals that most respondents are male visitors with basic literacy levels between primary and junior secondary school education in the form of adult literacy classes. About 28% of the sample has attained tertiary level of education (Table 1). This supports the assertion that diverse tribes and cultures in the northeast exposed to early missionary influences such as the Tangale, Tera, Waja, Karekare, Jarawa and Sayawa benefited from formal education within the region. 74% of respondents are adults between 26-45 years. This age bracket is unlikely to be affected by effects of ageing in relation to wayfinding.

Table 1: Demographic data of respondents

Variable	Category	N (364)	%
Respondent type	Visitor	184	51
	Staff	120	33
	Patient	60	16
Gender	Male	210	58
	Female	146	40
	Missing	8	2
Educational level	Others (Adult literacy classes etc)	145	40
	Tertiary	101	28
	Secondary	69	19
	Primary	38	10
	Missing	11	3
Age	18-25	68	19
	26-35	151	42
	36-45	118	32
	46+	15	4
	Missing	12	3
Tribe/Culture	Hausa	87	24
	Tangale	43	12
	Fulani	37	10
	Others	34	9
	Tera	33	9
	Waja	26	7
	Karekare	26	7
	Jarawa	24	7
	Sayawa	23	6
	Yoruba	16	4
	Missing	9	3
	Igbo	6	2

Results reveal that respondents employ physical features (M 3.32) and social practices (M 2.92) followed by coded information (M 2.55) for wayfinding in hospitals within the study area. A significant difference exists between these means based on educational levels, $F(3, 360) = 3.545$, $p<0.05$. Significant differences were also recorded between means of coded information at primary school level compared to the other categories of educational levels using Tukey's HSD post hoc tests (Table 2).

Table 2: Tukey's post hoc test for Coded information

Variable/component	Category	Level	Mean difference	Sig.
Coded info	Primary	Secondary	.23255*	.042
		Tertiary	.21619*	.046
		Others	.21325*	.037

Results from the individual ranking of items support the predominance of physical features employed for wayfinding in the study area. Specifically, entrances, stairs, corridors and balconies are the most preferred features of the built environment employed for wayfinding (Table 3). The social practices of relying on hospital security and SERVICOM staff are ranked fourth and fifth. These are closely followed by the first set of coded

information, which are painting on floors and route from memory. Features which demand extensive reading, and by implication literacy, in the form of letters, bold words, captions and notices on boards are ranked lowest on the table. These findings support wayfinding activities observed within the hospitals.

Table 3: Ranking of individual wayfinding items in the hospitals

Item	Mean	Sum	RII	Rank	Category
Entrances	3.97	1445	0.79	1	Physical features
Stairs	3.76	1370	0.75	2	Physical features
Corridors/balconies	3.69	1342	0.74	3	Physical features
Follow hospital Security	3.58	1302	0.72	4	Social practices
Follow SERVICOM Staff	3.51	1277	0.70	5	Social practices
Painting on floors	3.44	1252	0.69	6	Coded information
Route from Memory	3.37	1225	0.67	7	Coded information
Courtyards	2.84	1034	0.57	8	Physical features
Follow fire fighters	2.84	1033	0.57	8	Social practices
Windows/Openings	2.82	1027	0.56	10	Physical features
Follow volunteers	2.82	1026	0.56	10	Social practices
Ramps	2.81	1023	0.56	10	Physical features
Loudspeakers, PA systems	2.66	970	0.53	13	Physical features
Signage/visuals	2.62	955	0.52	14	Coded information
Follow others	2.6	948	0.52	14	Social practices
Graphics/pictures	2.38	868	0.48	16	Coded information
Posters	2.25	819	0.45	17	Coded information
Look for Information desk	2.71	791	0.43	18	Social practices
Follow visitors	2.02	736	0.40	19	Social practices
Letters, bold words, captions	1.93	704	0.39	20	Coded information
Notices on boards	1.75	636	0.35	21	Coded information

DISCUSSION OF RESULTS

Modified wayfinding framework in low literate areas

Results from the study reveal that while physical features of the built environment are predominantly employed for wayfinding purposes, these are supplemented by social practices. Coded information was averagely the last option for many respondents. This suggests that the framework proposed by Rooke (2012) and verified by Maina and Umar (2015) holds true for a very literate populace. In areas where literacy is not high, the framework takes the form presented below where social practices rank second after physical features followed by coded information. The

implication on design professionals is that architects and construction professionals need to adequately incorporate wayfinding cues relevant to the characteristics of the recipient population. The viewpoint is inadequately reflected in current wayfinding literature.

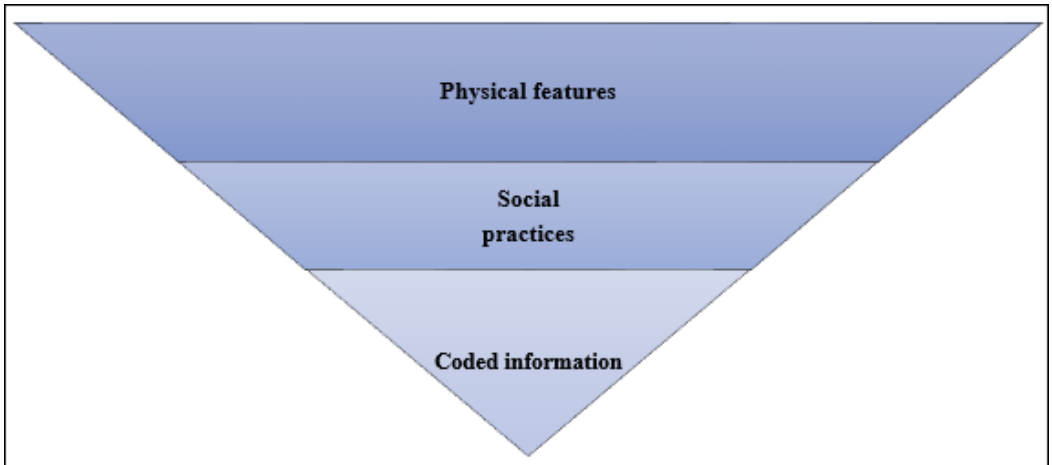


Figure 3: Modified framework for addressing wayfinding problems for hospitals in the study area

Design of physical features is critical for wayfinding

Studies in wayfinding highlight the predominant use of physical features such as tall structures, colourful facades, distinctive entrances/exits, staircases, corridors, columns and sculptures. These often serve as landmarks for navigation and orientation within the built environment (Vanderberg, 2016). El Ali, Bachour, Heuten and Boll (2016, p. 10) note that for the task of finding an unfamiliar point of interest, "people draw on mutilfaceted strategies . . . but also importantly seeking out the nearest well known landmark". This underscores the importance of designing physical features of the built environment with wayfinding in mind (Maina & Umar, 2015). It reiterates the issue of architectural differentiation expoused by Carpman & Grant (2002). This is especially true for courtyards often designed to modulate hot tropical climatic conditions in Nigeria. Although studies have noted the poor placement and design of staircases with regards wayfinding (Maina and Umar, 2015; Holscher, Brosamle, & Vrachliotis, 2006), staircases were ranked second as wayfinding features by respondents in part because most hospitals in the study area are single storey. Stairs are only employed for administrative blocks that are two storey high. The use of colors on physical features is an area in need of further research as this was found to be a beneficial wayfinding strategy in the study area.

Influence of education and literacy on wayfinding

Findings from the study reveal the modulating influence of education especially at primary school/basic level on wayfinding. This is a stage where reading is introduced, not advanced (Igbokwe, 2015; Olaniyan & Obadara, 2008). The implication on wayfinding is an overload when deciphering coded information. Averagely, people understand the basics in terms of colours and physical features and fall back on the socio-cultural practice of verbal instructions to supplement wayfinding information. This suggests that

basic education in the study area may not be providing the requisite literacy knowledge to cater to world standards as most hospitals are modelled after the western style of healthcare delivery. These results furnish further proof for urgent improvement in primary and adult education systems as this maybe the only formal education received by the average person within the region.

CONCLUSIONS AND RECOMMENDATIONS

This study set out to establish wayfinding strategies and features users within northeast Nigeria employ in hospitals. Results reveal the predominant use of physical features notably entrances/exits, staircases as well as corridors and balconies. A modification of Rooke's (2012) framework is proposed where social practices precede coded information for low literate communities such as found in the study area. The study also established a statistically significant difference at primary school level compared to other levels of education with regards wayfinding. Consequently, the study recommends that:

i. Incorporating different surface finishes and various landscaping elements such as different trees and scultures in similar looking spaces and courtyards will aid differentiation and by implication, wayfinding.

ii. Entrances should project from the building and not be flushed with sidewalks as this produces oblique and indirect entrances especially in courtyards.

iii. Color guides should be painted on walls not on floors. These should start from main entrances and lobbies.

iv. Sidewalks designed as corridors should be adequately offset from buildings to provide clear visible entrances and exits.

v. More research be conducted on culturally understood graphical signs, color coding and words in hospital and other complex environments.

vi. Urgent improvement, implementation and monitoring of basic education delivery in the northeast region is essential to meet global best practices.

Study limitations and area for further studies

Further studies on the effect of other demographic factors such as gender, age and ethinicity on wayfinding in other regions of the country is necessary to provide a holistic framework for wayfinding in socio-economically disadvantaged areas in Nigeria. This is important as results from the present study limits generalization of findings across the entire country.

REFERENCES

Abdulrasheed, O., Onuselogu, A., & Obioma, U. G. (2015). Effects of Insurgency on Universal Basic Education in Borno State of Nigeria. *American Journal of Educational Research, 3* (4), 490-494.

Adesina, O. B. (2011). Organizational and Management Problems Confronting Redesigning Teaching and Learning in Nigerian Schools in the Globalization Era. *Journal of Management and Strategy, 2* (2), 78-86.

Ager, A. K., Lembani, M., Mohammed, A., Ashir, G. M., Abdulwahab, A., de Pinho, H., et al. (2015). Health service resilience in Yobe State, Nigeria in the context of the Boko Haram insurgency: a systems dynamics analysis using group model building. *Conflict and Health, 9* (30), 1-14.

Ajibola, O. O. (2015). Terrorism and Insurgency in Northern Nigeria: A Study of the Origins and Nature of Boko Haram. *Research on Humanities and Social Sciences, 5* (12), 6-15.

Aro, O. I. (2013). Boko Haram Insurgency in Nigeria: Its Implications and Way Forward toward Avoidance of Future Insurgency. *International Journal of Scientific Research Publications, 3* (11), 178-187.

Arthur, P. & Passini, R. (1992). Wayfinding: People, Signs, and Architecture. New York: McGraw-Hill.

Bangirana, P., Menk, J., John, C. C., Boivin, M. J., & Hodges, J. S. (2013). The Association between Cognition and Academic Performance in Ugandan Children Surviving Malaria with Neurological involvement. *PLoS ONE , 8* (2), e55653:1-7.

Bates, S. L., & Wolbers, T. (2014). How Cognitive Aging Affects Multisensory Integration of Navigational Cues. *Neurology of Aging, 35*, 2761-2769.

Betram, D. (2007). Likert Scales [Online article]. Retrieved September 20, 2014 from http://pointcare.matf.bg.ac.rs/-kristina/topic-dane-likert.pdf

Carpman, J., & Grant, M. (2002). Wayfinding: A Braod View. In B. &. Churchman, *Handbook of Environmental Psychology*, 427-442. York: John Wiley & Sons.

Chen, C.-H., Lin, T.-J., & Chen, C.-Y. (2016). From Isovist to Spatial Perception: Wayfinding in Historical Quarter. *Environment-Behaviour Proceedings Journal, 1* (3), 300-310.

Chou, C., Wu, C.-J., & Lay, J.-G. (n.d.). *Way-finding test using Google Street View: A Pilot Study on Spatial Cognition.* Retrieved January 17, 2017, from http://www/a-a-r-s.org/acrs/administrator/components/com_jresearch/files/publications/WE3-6-3.pdf

Devlin, A. S. (2014). Wayfinding in Healthcare Facilities: Contributions from Environmental Psychology. *Behav. Sci. 4,* 423-436. DOI: 10.3390/bs4040423

El Ali, A., Bachour, K., Heuten, W., & Boll, S. (2016). Technology Literacy in Poor Infrastructure Environments: Characterizing Wayfinding Strategies in Lebanon. *Procs MoboleHCI '16, September 06-09*, 1-12. Florence, Italy: ACM.

EP-Nuffic. (2015). *The Nigerian Education System described and compared with the Dutch System*. Nuffic.

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics (4th Ed).* Sage: London.

Harris, M. A., & Wolbers, T. (2014). How Age-Related Strategy Switching Deficits Affect Wayfinding in Complex Environments. *Neurobiology of Aging, 35* (5), 1095-1102.

Holscher, C., Brosamle, M., & Vrachliotis, G. (2006). Challenges in Multi-level Wayfinding: A Case study with Space Syntax Technique. In C. Holscher, R. C. Dalton, & A. Turner (Eds.), *Space Syntax and Spatial Cognition, Proceedings of the Workshop held in Bremen, 24th September 2006*, 143-162. Spatial Cognition.

Huelat, B. J. (2007). *Wayfinding: Design for Understanding*. Accessed 04/08/2014 from: http://www.healthdesign.org/sites/default/files/WayfindingPositionPaper.pdf

Igbokwe, C. O. (2015). Recent Curriculum Reforms at the Basic Education Level in Nigeria Aimed at Catching them Young to Create Change. *American Journal of Educational Research, 3* (1), 31-37.

Immasuen, E. (2015). Insurgency and Humanitarian Crisis in Nigeria: the case of Boko Haram. *African Journal of Political Science and International Relations*, 284-296.

Iweze, D. O. (2014). *Insurgency in the North-East of Nigeria and its Implications on Inter-State and Trans-Border Mobility*. Retrieved February 9, 2017, from http://www.t2m.org/wp-content/uploads/2014/09/Daniel%20Olisa%20Iweze_Insurgency%20and%20Risks%20of%20Travels%20andMobility.pdf

Jaja, J. M. (2013). Higher Education in Nigeria: Its Gain, its Burden. *Global Journal of Human Social Science, Linguistics and Education, 13* (14).

Khan, N. (n.d.). *Ecology of Patients' Experience in Wayfinding Situation in the Hospitals of Bangladesh*. Retrieved February 2, 2017 from http://www.clevelandclinic.org/collective/postproceedings/Mon_230pm_Khan.%20Nyma.pdf

Lenehan, M. E., Summers, M. J., Saunders, N. L., Summers, J. J., & Vickers, J. C. (2015). Relationship Between Education and Age-related Cognitive Decline: A Review of Recent Research. *Psychogeriatrics, 15* (2), 154-162.

Maina, J. J. (2014). Housing, Architectural Theory and Practice: Exploring the Unique Adequacy approach in housing research for communities in Nigeria. In A. Tadeu, O. Ural, D. Ural, & V. Abrantes (Eds.), *Procs. 40th IAHS World Congress on Housing, December 16th -19th, 2014, Portugal*, 263:1-10. Funchal: IAHS.

Maina, J. J. and Umar, B. O. (2015). Wayfinding in multi-level buildings: A case study of the Senate Building, Ahmadu Bello University. In S. Laryea & R. Leiringer (Eds.). *Procs 6th West Africa Built Environment Research Conference, 10-12th August 2015, Accra, Ghana, 2*, 1227-1241.

Mollerup, P. (2016). The Challenge of Wayfinding in Health Care Environments Chp 6. In R. H. Hunter, L. A. Anderson, & B. L. Belza (Eds.), *Community Wayfinding: Pathways to Understanding*, 103-114. Switzerland: Springer.

Montello , D. R. (2005). Navigation. In P. Shah, & A. (. Miyake, *The Cambridge Handbook of Visuo-Spatial Thinking* (pp. 257-294). Cambridge, England: Cambridge University Press.

Montello, D. R., & Raubal, M. (2013). Functions and Applications of Spatial Cognition. In D. Waller, & L. Nadel (Eds.). *Handbook of Spatial Cognition*, 249-264. American Psychological Association.

Montello, D. R., & Sas, C. (2006). Human factors of Wayfinding in Navigation. In W. Karwowski (Ed.), *International Encyclopedia of Ergonomics and Human Factors, 2nd Ed.,* 2003-2008. London, England: CRC/Taylor and Francis.

Okolocha, C. C., & Onyeneke, E. N. (2013). Secondary School Principals' Perception of Business Studies Teachers' Teaching Effectiveness in Anambra State, Nigeria. *Journal of Education and Practice, 4* (2), 171-179.

Okoro, N. P. (2011). Comparative analysis of Nigerian Educational System. *International Journal of Business and Social Science, 2* (21), 234-238.

Olaniyan, D. A., & Obadara, O. E. (2008). A Critical Review of Management of Primary Education in Nigeria. *International Journal of African and African American Studies, 7* (1), 9-20.

Omilusi, M. (2016). The Multidimensional Impacts of Insurgency and Armed Conflicts in Nigeria. *Asian Journal of Social Sciences, Arts and Humanities , 4* (2), 29-39.

Omole, O., Welye, H., & Abimbola, S. (2015). Boko Haram insurgency: Implications for public health. *The Lancet, 385*, 941.

Ovaga, O. H. (2014). The Socio-Economic Implications of Boko-Haram Activities in Northern Nigeria. *Review of Public Administration and Management, 1* (2), 19-37.

Reinecke, K., Schenkel, S., & Bernstein, A. (2010). *Modelling a User's Culture.* Retrieved January 30, 2017, from http://ai2-s2-pdfs.s3.amazonaws.com/1471/cb51c889cebb57fb59dd98ed2ff0752ec51.pdf

Rooke, C. N. (2012). *Improving Wayfinding in Old and Complex Hospital Environments.* Unpublished Thesis (PhD), University of Salford.

Rooke, J., & Kagioglou, M. (2007). Criteria for Evaluating Research: The Unique Adequacy Requirement of Methods. *Construction Management and Economics , 25* (9), 979-987.

Rubinsten, O. (2015). Link between Cognitive Neuroscience and Education: the case of Clinical Assessment of Developmental Dyscalculia. *Frontiers in Human Neuroscience, 9* (304), 1-8.

Segun, M. (2016). *They Set the Classrooms on Fire: Attacks on Education in Northeast Nigeria.* Retrieved February 9, 2017, from Human Rights Watch: https://www.hrw.org/report/2016/04/11/they-set-classrooms-fire/attacks-education-northeast-nigeria*290612

Svensson, M. (1998). Social Navigation. In N. (. Dahlback, *Exploring Navigation: SICS Technical Report T98:01*, 73-88. Kista, Sweden: PERSONA.

Tenbrink, T., & Wiener, J. M. (2007). Wayfinding Strategies in Behavior and Language: A Symmetric and Interdisciplinary Approach to Cognitive Processes. In T. Barkowski (Ed.), *Spatial Cognition V, LNAI 4387*, 401-420.

Thovoethin, P.-S. (2012). Privatization of Education and the 6-3-3-4 Educational System in Nigeria: A Critical (Re)Assessment. *Conference on Globalization, Regionalization and Privatization in and of Education in Africa held at Crowne Plaza Hotel Johannesburgfrom 12th-13th October 2012*, 1-19. Johannesburg: Open Society Initiative for Southern Africa.

US Embassy Nigeria. (2012). *Nigeria Education fact Sheet.* Retrieved February 17, 2017, from https://photos.state.gov/libraries/nigeria/487468/pdfs/JanuaryEducationFactSheet.pdf

Vanderberg, A. E. (2016). Human Wayfinding: Integration of MInd and Body. In R. H. Hunter, L. A. Anderson, & B. L. Belza (Eds.), *Community Wayfinding: Pathways to Understanding*,17-32. Switzerland: Springer.

Weisberg, S. M., Schinazi, V. R., Newcombe, N. S., Shipley, T. F., & Epstein, R. A. (2014). Variations in Cognitive maps: Understanding Individual Differences in Navigation. *Journal of Experimental Psychology: Learning, Memory and Cognition, 40* (3), 669-682.

Weisman, J. (1981). Evaluating Architectural Legibility: Way-Finding in the Built Environment. *Environment and Behavior, 13* (2), 189-204.

Werner, S., & Schindler, L. E. (2004). The Role of Spatial Reference Frames in Architecture: Misalignment impairs way-finding performance. *Environement and Behavior, 36*, 461-482.

Winsor, M. (2015). *Nigeria's Education Crisis: Boko Haram Targeting Schools, Teachers, Students is Devastating Africa's Largest Economy*. Retrieved February 9, 2017, from ibtimes.com: http://www.ibtimes.com/nigerias-education-crisis-boko-haram-targeting-schools-teachers-students-devastating-2177842

Yalon-Chamovitz, S. (2009). Invinsible Access Needs of People With Intellectual Disabilities: A Conceptual Model of Practice. *Intellectual and Developmental Disabilities, 47* (5), 395-400.

Yomens, Y. (2000). *Business Statistics 3rd Edition.* Ibadan: Ibadan University Press.

Yusuf, M. A., & Afolabi, F. O. (2014). Effective Management of Tertiary Education in Nigeria as a Panacea to Good Governance and National Security. *Higher Education of Social Science, 7* (3), 1-6.

IMPROVING WATER RESISTANCE OF COMPRESSED EARTH BLOCKS ENHANCED WITH NATURAL FIBRES

Humphrey Danso[1]
Department of Construction and Wood Technology, University of Education Winneba, Ghana. P. O. Box 1277, Kumasi, Ghana

Studies have shown a great potential for the use of CEBs as a sustainable building material due to its economic, environmental and social benefits. This study investigates the water resistance characteristics of CEBs reinforced with natural fibres. The fibres were sourced from coconut husk, sugarcane bagasse and oil palm fruit at 1 wt% added to two soil samples. The CEB specimen size of 290 × 140 × 100 mm were made at a constant pressure of 10 MPa and dried in the sun for 21 days. Accelerated erosion test was conducted to determine the resistance of the specimen to continuous rainfall condition. It was discovered that the fibres helped in reducing the erodability rate of the blocks, though there were some degree of damage. The difference between the water resistance of the unreinforced and fibre reinforced CEBs were found to be statistically significant. Furthermore, the surface of the fibre reinforced blocks eroded rapidly in depth than the internal part, and there was reduction in the depth difference of the erosion with increase time of water spraying on the specimens. The study concludes that though the addition of fibres in soil blocks does not completely prevent the block from erosion, the impact of the fibres on the blocks significantly reduce the erosion.

Keywords: Compressed earth blocks (CEBs) , natural fibres, water resistance, accelerated erosion test

INTRODUCTION

Compressed earth blocks (CEBs) are building units made of damp soil and compacted at a high pressure for constructing walls of earthen structures. They are sometimes stabilised with: (1) binders such as cement and lime, and (2) fibres (natural and artificial) to improve their performance properties. This is necessitated by the weakness of the blocks when subjected to greater load and rain/water. The later has a devastating effect on the blocks especially in high rainfall areas, and the strength problem also limits the number of storeys used in buildings.

The benefits of the use of CEBs for earthen structures such as affordability, environmentally friendly, socially acceptance, easy to work with and

[1] hdanso@uew.edu.gh; dansohumphrey@yahoo.co.uk

Danso, H. (2017) Improving water resistance of compressed earth blocks enhanced with natural fibres *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 886-896

availability has generated a renewed interest over the past decade (Danso, 2013, Danso et al., 2015a, Quagliarini and Lenci, 2010, Donkor and Obonyo, 2016). Recent studies have investigated the properties of various units used for earthen structures (Danso et al., 2015b, Danso et al., 2015c, Danso et al., 2017, Millogo et al., 2014, Parisi et al., 2015, Taallah et al., 2014, Eires et al., 2016). Their findings have shown a great potential for the use of CEBs as a sustainable building material. Most studies focused on the physic-mechanical properties of the blocks without considering the durability properties.

Measuring the durability properties of CEBs is important because blocks may easily erode under water (rain fall) and also the particle wear off under abrasion (Danso, 2015 and Heathcote, 2002). Durability of CEBs is usually measured by the use of erosion and wearing tests. The main erosion tests available are (1) drip test, and (2) water spray test. A study by Heathcote (2002) identifies and developed three types of drip test and eight types of water spray test. The wearing test is normally conducted using wetting and drying (wire brush) method which is described in detail by American Society for Testing and Materials ASTM D559-03 (2003).

Danso (2015) identified that there are limited studies on the durability properties of CEBs though one of the critical problems of earthen structures is erosion. Eires et al. (2016) studied the water resistance of earthen buildings enhanced with binders. They tested the water resistance properties of earth blocks enhanced with lime and oil. There is the need also to study the water resistance properties of earth blocks reinforced with fibres. This study therefore investigates the water resistance properties of CEBs reinforced with natural fibres. To achieve this, the study determined the failure mode of the fibre reinforced blocks, the depth of erosion and the depth difference of erosion of the fibre reinforced blocks.

MATERIALS AND METHODS

Soil

Two soil samples were used for the experimental work, they are (1) Red soil and (2) Brown soil which were obtained from Ghana. These soil types have different properties and characteristics and therefore were appropriate to determine if soil type has effect on the erosion properties of soil blocks for constructing houses. The general properties of the soils are shown in Table 1.

Table 1: Properties of the soil samples

Soil type	Grain sizes (%)				Atterberg limits (%)			Compaction	
	Grave (>2 mm)	Sand (2 - 0.063 mm	Silt (0.063 0.002 mm)	Clay (<0.002 mm)	wL	wP	PI	OMC (%)	MDD (Mg/m^3)
Red	15	39	16	30	51.2	27.3	23.9	19	1.79
Brown	12	46	28	14	13.3	17.2	13.9	18	1.78

OMC - Optimum moisture content; MDD - Maximum dry density; wL - Liquid limit; wP - Plastic limit; PI - Plasticity index

Fibres

Reinforcement of the compressed earth blocks was achieved by using three types of fibres from (1) coconut husk, (2) sugarcane bagasse and (3) oil palm fruit fibres. Sugarcane Bagasse fibres were obtained from sugarcane residue at a local sugarcane alcohol distillery mill. The coconut fibres were obtained from the husk of coconut fruit from coconut vending points. The oil palm fibres were also obtained from a palm oil extraction plant in Ghana. These were by-products from agricultural products, they were soaked in water for two days, mechanically beaten, the fibres extracted manually and dried in the sun. The properties of the selected fibres are reported in Table 2. The lengths of the fibres used are 125, 80 and 38 mm respectively for coconut, bagasse and oil palm fibres. These fibre lengths were used as a result of the lengths that produced optimum strength in the previous study by Danso et al. (2015c).

Specimen preparation

The compressed earth block specimens size of 290 × 140 × 100 mm were made with soil and 1 wt.% fibre content. The soil was first measured and spread on a platform. The fibres were measured and spread on the soil and mixed together until a uniform mixture was obtained. Water at optimum moisture content of 19 and 18 % for red soil and brown soil respectively was sprinkled on the soil-fibre mixture and mixed together to obtain a homogenous mixture. The fibres were soaked in water for 2 days to saturation before added to the mix. The blocks were made with BREPAC block making machine with a constant pressure of 10 MPa (Danso et al., 2015d). The blocks were then dried in the sun (Figure 1) at an average temperature of 27 °C and relative humidity of 72 % for 21 days. To ensure uniform drying, the blocks were turned each day. After drying, the blocks were packed and the surfaces cleaned with soft duster before testing.



Figure 1: Drying of specimens

Testing of specimen

A pressure spray test (accelerated erosion test) was conducted to determine the resistance of the specimen to continuous rainfall condition. This method was used instead of drip (Geelong) method because it is more representative of the field conditions such as rainfall that cause erosion to earthen

structures. The test is an empirical one developed by the former National Building Technology Centre (now Commonwealth Scientific and Industrial Research Organisation (CSIRO)) according to Australian Standard (Walker and Standards Australia, 2002) to simulate rain action. The purpose of performing this test was to determine the ability of the blocks to resist erosion which may be caused by continuous rainfall.

The test was conducted in accordance with Section D of New Zealand Standard (NZS 4298, 1998). The test rig (Figure 2) was set up with shield board positioned in the plastic bath and the pressure spray nozzle set on the bath at a distance 470 mm from the shield. Each block was mounted behind a thin shield and was exposed to spray through a 100mm diameter hole. The shield ensured that only limited area of the block face was subject to water spray. Tap water was connected to the pressure spray nozzle and then opened at pressure 50 kPa through the nozzle onto the block. The water was sprayed onto the block exposed surface and run out through the outlet of the plastic bath. The spray was interrupted at every 15 min to allow for assessment for a total of 60 min. The depth of erosion was measured using a 10mm diameter flat ended rod.

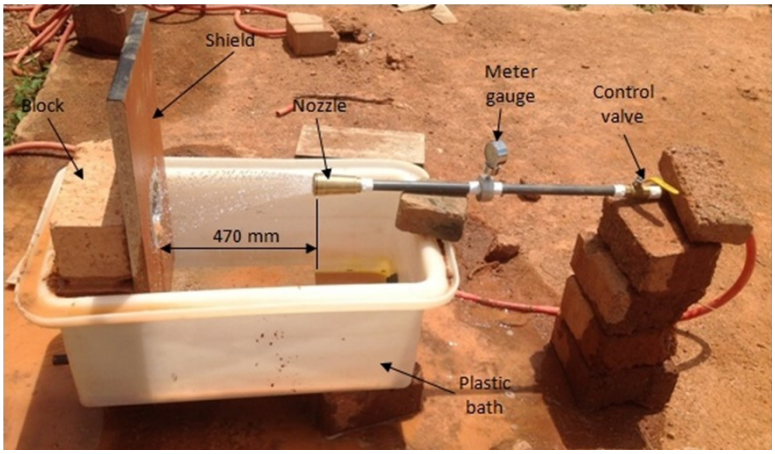


Figure 2: Water spray test set-up

Statistical analysis

Correlations were carried-out to establish relationships between unreinforced compressed earth blocks and fibre reinforced compressed earth blocks. Paired t-test (Two-tailed *p*-value) with SigmaPlot Version 13.0 were used to test for significant difference between the values of unreinforced block specimens and fibre reinforced block specimens, after conducting Shapiro-Wilk normality test.

RESULTS

Failure Mode

Figure 3 shows the failure mode of unreinforced compressed earth blocks (Brown specimen). The front surface that had direct contact with the spraying water created a bigger indent which narrowed through the block thickness and appeared smaller at the back of the block. This is expected as the front (in the normal sense the outer surface of the wall) surface always

has direct contact with water/rainfall, and therefore is prone to excessive damage. The Brown block specimens could not resist the erosion for the entire 60 min water spraying. All the five-specimen tested failed at between 54 to 58 min. However, the Red specimens survived the 60min water spray test but eroded deeply from between 81 to 86 mm for the five-specimen tested. This result suggests that raw earthen structures have poor resistance to erosion, hence the need for stabilisation to improve its durability property.

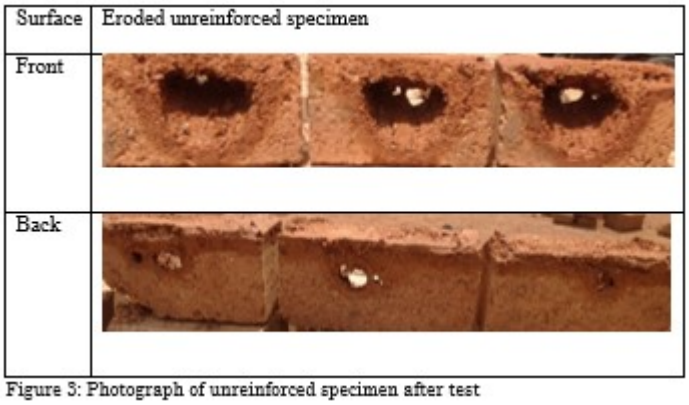


Figure 3: Photograph of unreinforced specimen after test

As can be seen in Figure 4, the compressed earth block specimens that were reinforced with natural fibres improved the blocks resistance to the water spray. For all the specimen tested, the water failed to penetrate through the blocks. The inclusion of the fibres in the blocks helped in reducing the erodability rate of the blocks, though there were some degree of damage. This means the addition of fibres in soil blocks does not completely prevent the block from erosion but reduce the impact of the erosion on the blocks. Similar result in the study by Balila et al. (2016) shows that all the specimens for the unstabilised Sudanese bricks were completely eroded in less than 60 min, while bovine stabilised specimen recorded a decreased erosion rate. Another study by Eires et al. (2016) indicated that the untreated soil recorded the highest erosion as compared to lime, oil and cement stabilised soil specimens. According to Heathcote (2002), the measurements carried out indicate a discharge of 29.6 l/min for the test which yields a total volume of water in the 60 min to approximately 85 years rainfall in Sydney, Australia. This indicates that the degree of damage observed in Figures 3 and 4 is a simulated result of a continuous erosion of the blocks over eight decades when the block surface is exposed to rainfall.



Figure 4: Photograph of fibre reinforced specimen after test

The values of unreinforced and fibre reinforced compressed earth blocks were subjected to paired t-test to determine whether there is statistically significant difference between the unreinforced and fibre reinforced with p-value at ≤ 0.05. The results obtained are presented in Table 2. The result shows that for all the pairs between the unreinforced and fibre reinforced for the erosion test measurement intervals (15, 30, 45 and 60 min), the *p*-values were between < 0.001 and 0.042. This indicates that there is a statistically significant difference between the water resistance of the unreinforced and fibre reinforced compressed earth blocks. This means that the inclusion of fibres in the compressed earth block is significant in improving the erosion resistance of the blocks.

Table 2: Correlation statistics for fibre reinforced blocks vs. unreinforced blocks (p-values)

Reinforced	Bagasse				Coconut				Oil Palm			
Unreinforced	15 min	30 min	45 min	60 min	15 min	30 min	45 min	60 min	15 min	30 min	45 min	60 min
15 min	<0.001	0.008	0.004	<0.001	<0.001	0.006	0.005	<0.001	<0.001	0.007	0.006	<0.001
30 min	<0.001	<0.001	0.001	0.028	<0.001	<0.001	0.001	0.042	<0.001	<0.001	<0.001	0.023
45 min	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
60 min	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Statistically Significant @ ≤ 0.05

Depth of erosion

The trend of the erosion of the reinforced soil block specimens are shown in Figures 5 and 6, respectively for red and brown soils. As clearly seen, the erosion of the blocks increased with increase time of water spraying on the specimens for all the two soil types and the fibre types. In both soil types, the bagasse fibre reinforced compressed earth blocks recorded the highest erosion while the coconut reinforced compressed earth blocks obtained the lowest. The erosion depth for the red soil specimens is between 15.2 to 43.2 mm, while for brown soil it is between 15.2 to 75.4 mm all within 60 min. This implies that red soil samples performed better in the erosion resistance than the brown soil. The result could be attributed to the higher plasticity index and the smaller particle sizes of the red soil samples as shown in Table 1. A study by Danso et al. (2015d) suggests that soil with higher plasticity index usually perform better than those with lower plasticity index. This is because the smaller soil particles are able to bond together and improve their plasticity, thereby improving their bond properties which resist the ease of water peculating through and wash the individual particle away.

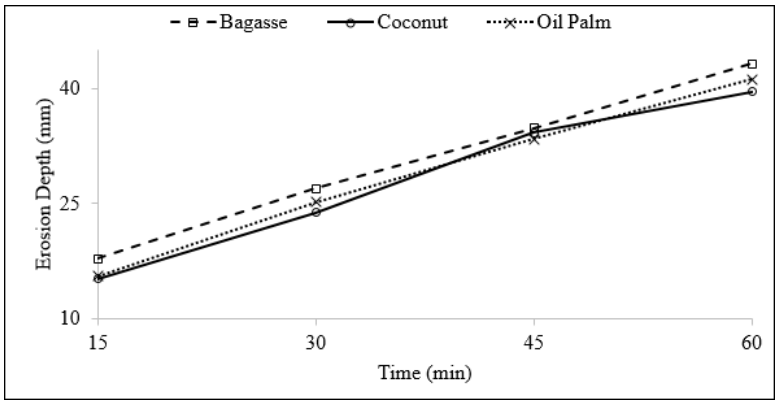


Figure 5: Trend of erosion depth of fibre reinforced compressed earth blocks for Red soil

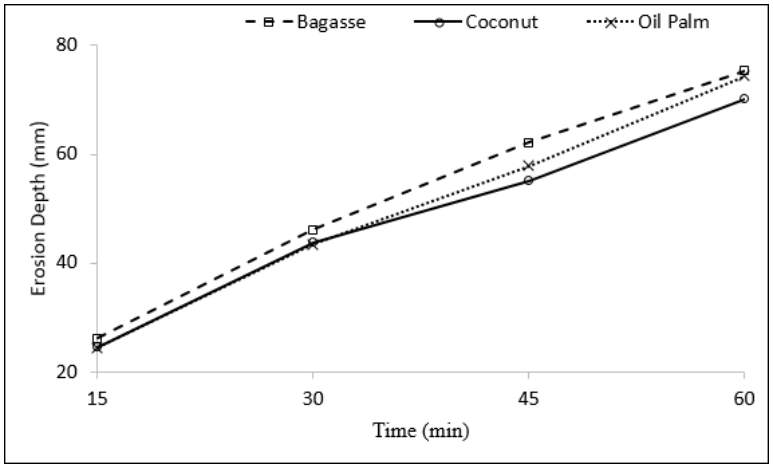


Figure 6: Trend of erosion depth of fibre reinforced compressed earth blocks for Brown soil

As the erosion measurements were taken at intervals by which the test was interrupted, that is between 1-15, 16-30, 31-45 and 46-60 min. This groups the depth difference into four quartiles (1st, 2nd, 3rd and 4th). This then places the depth of erosion in quartiles, the 1st quartile (1-15 min) recorded the highest erosion depth for all the soil and fibre types. The 2nd to 4th quartiles (16-30 to 46-60 min) were on the average half each of that of the 1st quartile. This depicts that the surface of the blocks erodes more rapidly than the internal part. This is because when the erosion starts on the surface of the blocks, there is few fibres encounter, as the erosion moves internally a number of fibres are encountered which cluster together and therefore protect the particles of the soil from been washed away. The behaviour of the fibres protecting the soil from been washed away is similar to tree roots protecting earth from erosion (Huat and Kazemian, 2010, Michalowski and Zhao, 1996).

Depth difference of erosion

The difference in depth of the erosion is define by the intervals by which the test was interrupted for taken of measurement, that is the four quartiles (1st, 2nd, 3rd and 4th). The difference in depth of erosion of the fibre reinforced compressed earth blocks are presented in Figures 7 and 8, respectively for red soil and brown soil specimens. It can be observed that

for both soil types and fibre types there is reduction in the depth difference with increase time of water spraying on the specimens. The reduction in erosion depths recorded from 1st quartile to 2nd quartile is between 51.7 – 62.6 % and 76.3 – 78.1 % for red soil and brown soil sample respectively for all the fibre types. Between the 2nd and 3rd quartiles is 43.8 – 68.4% and 46.3 – 61.1% respectively for red soil and brown soil, and between the 3rd and 4th quartiles are 35.5 – 50.3% and 49.6 – 68% for red and brown soil samples respectively. The result shows that for both soil samples, there was continuous reduction from the 1st to the 4th quartiles. This means that the amount of erosion in the compressed earth blocks kept reducing through the period of testing, implying that the rate at which the erosion occurred at the beginning, slowed down quartile way to the end. This means from the outer surface of the blocks, there occurs a speedy erosion, but as the water reach the internal of the blocks, the rate of erosion reduces. This can be linked to the accumulation of the fibres within the block, shielding and protecting the soil particles from been easily wash away (Danso, 2015). It can also be observed that the depth of erosion reduction for red soil was less than brown soil, implying that the red soil blocks have better resistance to erosion.

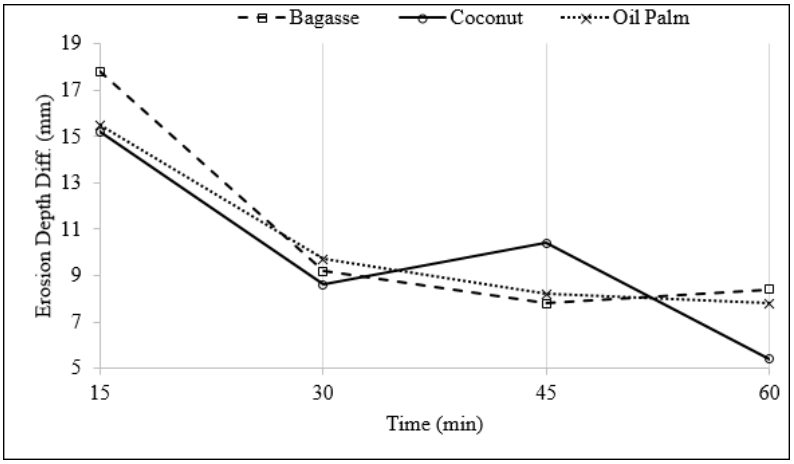


Figure 10: Difference in depth of erosion of fibre reinforced compressed earth blocks for Red soil

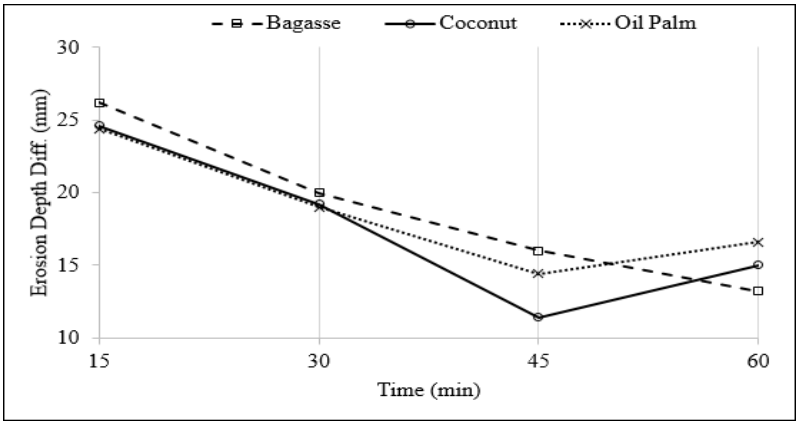


Figure 11: Difference in depth of erosion of fibre reinforced compressed earth blocks for Brown soil

CONCLUSION

This study investigated the water resistance properties of CEBs reinforced with natural fibres. From the results obtained, the following concluding summary can be drawn:

- The unreinforced block specimens (Brown) could not resist the erosion for the entire 60 min water spraying which suggests that the raw earthen structures have poor resistance to erosion. However, the fibres helped in reducing the erodability rate of the blocks, though there were some degree of damage to the fibre reinforced blocks. This means that the addition of fibres in soil blocks does not completely prevent the block from erosion but reduce the impact of the erosion on the blocks.
- The difference between the water resistance of the unreinforced and fibre reinforced compressed earth blocks were found to be statistically significant. This means that the inclusion of fibres in the compressed earth block is significant in improving the erosion resistance of the blocks.
- The surface of the fibre reinforced blocks eroded rapidly in depth than the internal part. This is because when the erosion starts on the surface of the blocks, there are few fibres encounter, but as the erosion moves internally a number of fibres are encounter which cluster together and therefore protect the particles of the soil from been washed away, which could be linked to the tree roots concept that the root of tree protect the soil beneath it from been washed away.
- There was reduction in the depth difference of the erosion with increase time of water spraying on the specimens. This means that the amount of erosion occurs in the compressed earth blocks keep reducing through the period of testing, implying that the rate at which the erosion occurred at the beginning, slow down quartile-way to the end.

The paper therefore concludes that though the addition of fibres in soil blocks does not completely prevent the block from erosion, the impact of the fibres on the blocks significantly reduce the erosion. In addition, the effect of the fibres inclusion in the blocks is greatly felt at the internal of the blocks than the surface.

REFERENCES

American Society for Testing and Materials ASTM D559-03 2003. Standard test methods for wetting and drying compacted soil-cement mixtures. Retrieved from http://www.astm.org/.

Balila, A., Vahdati, M., Lees, T. & Nortcliff, S. 2016. Sustainable bio-inspired stabilisers to enhance the strength, durability and structural stability of adobe bricks used for the construction of houses in the outskirts of Khartoum. Young Researchers' Forum III, Innovation in Construction Materials, 12 April 2016.

Danso, H. 2013. Building houses with locally available materials in Ghana: benefits and problems. International Journal of Science and Technology 2, 225-231.

Danso, H. 2015. Use of agricultural waste fibres as enhancement of soil blocks for low-cost housing in Ghana. PhD, University of Portsmouth, http://eprints.port.ac.uk/id/.

Danso, H., Martinson, B., Ali, M. & Mant, C. 2015a. Performance characteristics of enhanced soil blocks: a quantitative review. Building Research and Information, 43, 253-262. DOI: 10.1080/09613218.2014.933293.

Danso, H., Martinson, B., Ali, M. & Williams, J. B. 2015b. Effect of sugarcane bagasse fibre on the strength properties of soil blocks. 1st International Conference on Bio-based Building Materials. June 22-24, Clermont-Ferrand, France.

Danso, H., Martinson, D. B., Ali, M. & Williams, J. 2015c. Effect of fibre aspect ratio on mechanical properties of soil building blocks. Construction and Building Materials, 83, 314-319, doi:10.1016/j.conbuildmat.2015.03.039.

Danso, H., Martinson, D. B., Ali, M. & Williams, J. B. 2015d. Physical, mechanical and durability properties of soil building blocks reinforced with natural fibres. Construction and Building Materials 101, 797–809, http://dx.doi.org/10.1016/j.conbuildmat.2015.10.069.

Danso, H., Martinson, D. B., Ali, M. & Williams, J. B. 2017. Mechanisms by which the inclusion of natural fibres enhance the properties of soil blocks for construction. Journal of Composite Materials, DOI: 10.1177/0021998317693293.

Donkor, P. & Obonyo, E. 2016. Compressed soil blocks: Influence of fibers on flexural properties and failure mechanism. Construction and Building Materials, 121, 25-33.

Eires, R., Camoes, A. & Jalali, S. 2016. Enhancing water resistance of earthen buildings with quicklime and oil. Journal of Cleaner Production, http://dx.doi.org/10.1016/j.jclepro.2016.10.141.

Heathcote, K. A. 2002. An investigation into the erodibility of earth wall units. PhD Thesis, University of Technology, Sydney.

Huat, B. B. K. & Kazemian, S. 2010. Study of root theories in green tropical slope stability. The Electronic Journal of Geotechnical Engineering, 15, 1825-1834. http://www.ejge.com/2010/Ppr10.133/Ppr10.133ar.pdf.

Michalowski, R. L. & Zhao, A. 1996. Failure of fiber-reinforced granular soil. Journal of Geotechnical Engineering, 121, 152-162, http://dx.doi.org/10.1061/(ASCE)0733-9410(1996)122:3(226).

Millogo, Y., Morel, J.-C., Aubert, J.-E. & Ghavami, K. 2014. Experimental analysis of pressed adobe blocks reinforced with hibiscus cannabinus fibers. Construction and Building Materials, 52, 71–78.

NZS 4298 1998. Materials and Workmanship for Earth Buildings. New Zealand Standard. New Zealand: Standard New Zealand, Wellington.

Parisi, F., Asprone, D., Fenu, L. & Prota, A. 2015. Experimental characterization of Italian composite adobe bricks reinforced with straw fibers. Composite Structures, 122, 300–307, http://dx.doi.org/10.1016/j.compstruct.2014.11.060.

QUAGLIARINI, W. & LENCI, S. 2010. The influence of natural stabilisers and natural fibres on the mechanical properties of ancient Roman adobe bricks. Journal of Cultural Heritage, 11, 309-314, doi:10.1016/j.culher.2009.11.012.

TAALLAH, B., GUETTALA, A., GUETTALA, S. & KRIKER, A. 2014. Mechanical properties and hygroscopicity behavior of compressed earth block filled by date palm fibers. Construction and Building Materials, 59, 161–168, http://dx.doi.org/10.1016/j.conbuildmat.2014.02.058.

WALKER, P. & STANDARDS AUSTRALIA 2002. The Australian Earth Building Handbook. HB 195-2002. Standards Australia International, Sydney, Australia.

INFLUENCE OF POWER ON CLIENT-CONTRACTOR RELATIONSHIPS IN COLLABORATIVE CONSTRUCTION PROCUREMENT

Ladi Kevin[1] and Samuel Laryea[2]

[1,2]*School of Construction Management and Economics, University of the Witwatersrand, Johannesburg, South Africa*

Over the past two decades, there has been an increasing adoption of collaborative procurement practices such as partnering, alliancing and framework agreements. Thus, a growing research interest in the area collaborative procurement practices in the construction industry. Collaborative relationships among project participants are said to provide a means for achieving better performance, value creation, 'no-blame' culture, win-win scenario and other tangible benefits. Previous studies and anecdotal evidence indicate that power is generally a key factor which significantly influences commercial relationships. Power is an important dynamic in organizational behaviour. However, there is no comprehensive study reported on how power influences client-contractor relationships in collaborative construction procurement, considering the central roles clients and contractors play in construction contractual relationships generally. Clients and contractors have their sources of power which needs to be systematically understood in the context of collaborative procurement and contracting arrangements. This study proposes to determine the influence of relative power between clients and contractors on collaborative procurement arrangements. A phenomenological approach is being considered to examine power in collaborative contractual relationships. The following questions should be examined and analysed: What factors create power for the main parties in a construction contract? What is the nature of the balance of power between the client and contractor in different stages of the project lifecycle? How does the power position of the parties influence collaboration in construction projects/contracts? Clients and contractors engaged in collaborative construction contracts in South Africa will be interviewed to explore the research aim and questions. It is anticipated that a better understanding of the relationship between power and collaboration in construction projects will offer essential insights for improving collaborative working practices in construction, and ultimately project performance. This study is an ongoing doctoral research which is in the initial stage.

Keywords: collaboration, collaborative procurement, power, relative power

[1] 784038@students.wits.ac.za

[2] Samuel.Laryea@wits.ac.za

Kevin, L. and Laryea, S. (2017) Influence of power on client-contractor relationships in collaborative construction procurement *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 897

INFLUENCE OF PROJECT MANAGEMENT TOOLS AND TECHNIQUES ON PERFORMANCE OF BUILDING CONSTRUCTION PROJECTS IN LAGOS STATE

Olajide Julius Faremi[1], Barakat Temitope Lawal[2], Iniobong Beauty John[3], Kudirat Ibilola Zakariyyah[4], Aderemi Aderogba[5]

[1, 2, 3, 4, 5] *Department of Building, Faculty of Environmental Sciences, University of Lagos, Akoka, Lagos, Nigeria*

The underperformance of building construction projects remains a major issue in the Nigeria's construction industry despite the availability of numerous project management tools and techniques. For building construction projects, effective control of cost, time and quality are success factors. This study investigates the extent to which the use of project management tools and techniques influence building project performance. A survey of professionals managing construction projects in Lagos, Nigeria was conducted through the use of structured questionnaires. A total of 85 questionnaires were administered out of which 72 were duly completed, returned and found useful representing 84.7% response rate. With the aid of Statistical Package for Social Sciences (SPSS) version 20.0, descriptive and inferential statistical tools including, bar chart, mean, frequency tables, Kendall's tau_b correlation and independent samples T-test were used to analyse the data. The results showed that there is significant correlation between the use of Gantt chart and cost performance of projects. This study recommends amongst others regular and adequate training of construction project managers and construction site managers on the use of appropriate tools and techniques for effective control of building projects with a view to achieving optimum cost, time and quality performance.

Keywords: building, management, performance, projects, tools and techniques

INTRODUCTION

The construction industry plays an important role in the Nigerian economy as the activities of the industry are vital to the achievement of the national socio-economic development goals of providing shelter, infrastructure and

[1]juliusfaremi@gmail.com
[2] temitopeblawal@yahoo.com
[3] domass120@gmail.com
[4] zakaryyki@gmail.com
[5] aaderogba@unilag.edu.ng

Faremi, et al. (2017) Influence of project management tools and techniques on performance of building construction projects in Lagos State *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 898-910

employment ((Ibrahim 2012, Memon et al. 2010). The geometric growth in construction activities over the years comprising increase in projects of high magnitude and of various complexities have justified the need for the deployment of project management principles, tools and techniques. Although literature have shown (Arnaboldi et al. 2004, Kerzner 2009) that using project management methodology has helped many projects in developed nations to avoid project failure and enhanced continuous communication on projects. However, Idoro and Patunola-Ajayi (2009) listed some drawbacks that may be experienced in the implementation of project management strategies especially in developing nations to include social and political systems, cultural blocks and lack of financial support. These factors probably are mitigating the use of project management tools and techniques in Nigeria as the deployment of available tools on projects are yet to be widely adopted with consequent high number of project underperformance.

Previous studies on underperformance of construction projects in Nigeria were from the social-political perspective. Such studies (Akanni et al. 2014; Olateju & Alamutu 2011; Idoro 2009) conclude that capital flow and labour resources issues were the key influencers of construction project performance. Petersen (2013) argues that project managers require soft skills to enable them work more efficiently and effectively. The competence of project managers on the use project management tools and techniques are therefore essential for successful delivery of construction projects. However, there are limited studies on the frequency at which project management tools and techniques are employed on building projects and the extent to which the use of project management tools and techniques influence the performance of building projects within the study area. There is therefore the need to investigate the level of use of various project management tools and techniques on building construction project sites in Lagos state and the extent to which project performance are influenced by the use of such tool or otherwise with a view to make recommendations that could assist project managers derive benefits from the use of project management tools and techniques.

AIM AND OBJECTIVES OF THE STUDY

This research is aimed at investigating the extent to which the performance of building construction projects are influenced by the use of project management tools and techniques.

The objectives of the study are as follows:

1. To assess the frequency of use of project management tools and techniques on construction sites in Lagos State.
2. To evaluate the factors affecting the use of project management tools and techniques on construction sites.

RESEARCH HYPOTHESIS

The hypotheses formulated for the study are as follows:

H $_{01}$: There is no significant difference in the factors affecting project management tools and techniques between consulting and contracting firms on construction sites.

H $_{02}$: There is no significant relationship between the use of project management tools and techniques and performance of construction projects in Lagos State.

LITERATURE REVIEW

Turner and Muller (2007) posit that project management refers to the organization of human. materials and financial resources in a novel way, to undertake a unique scope of work, of given specification, within the constraints of cost and time, defined by quantitative and qualitative objectives so as to achieve a beneficial change. Furthermore, Lewis (2007) explain that project management is a system or process of planning, designing, scheduling, managing and controlling interconnected project activities in order to achieve specific objectives or goal within a specific time, budget and standards. Kwak (2005) argue that project management emerged out of the field of engineering and architecture in the1950s, and between 1950 and 1979, several core project management tools including CPM/PERT, Material Requirement Planning (MRP) and others were introduced.

Munns and Bjeirmi (1996) opine that the use of project management concepts, tools and techniques have vital role in the success of a project as poor project management can often affect the overall construction time, quality and budget (Kasim, Latiffi and Fathi, 2013). Abbasi and Al-Mharmah (2000) argue that for a project to be successful, it requires appropriate skills and techniques beyond technical expertise, but such that encompasses good and sound skills to manage limited budgets, and monitor shrinking schedules and unpredicted outcomes.

Furthermore, Zanen and Hartmann (2010) explain that with the aid of project management tools, project managers are able to plan and execute construction projects to maximize the project's chances of success. Such tools support and facilitate the various aspects of project management. Such aspects include adequate communication, control mechanisms, feedback capabilities, troubleshooting, coordination effectiveness, decision-making effectiveness, monitoring, project organization structure, plan and schedule followed, and related previous management experience.

(Javed and Shahzad, 2012) opine that there are a variety of project management tools available for the project managers to plan, implement and evaluate the projects. Most commonly used tools include Work Breakdown Structure (WBS), Gantt Chart, Network Diagrams (Critical

Path Method, Program Evaluation and Review Technique), and Earned Value Analysis. Kogi (2013), Zanen and Hartmann (2010) explain that some of the common tools and techniques that can be employed by project managers for managing building construction projects in order to achieve desirable outcome include Work Breakdown Structure (WBS), Gantt Charts, Projects in Controlled Environments 2 (PRINCE 2), Project Networks (Critical Path Method and Programme Evaluation and Review Techniques), Project Sensitivity Analysis, Cost Benefit Analysis, Graphical Evaluation and Review Technique (GERT), as well as a host of computer softwares. This study seeks to investigate the level of awareness of project managers who participated in this survey on the various highlighted project management tools and techniques with a view to establishing the most frequently used tools and techniques on construction projects within the study area.

Performance of construction projects

Project management is believed to be justified as a means of avoiding the ills inherent in the construction and production sectors of the economy and for which reasons most projects fail and or abandoned (Nwachukwu et al., 2011). The success parameters for any project are in time budget and requisite performance (technical requirement). Large construction projects are exposed to uncertain environment because of such factors as planning, design and construction complexity, presence of various interest groups (owner, consultants, contractors, suppliers, etc.), resources (manpower, materials, equipment, and funds) availability, environmental factors, the economic and political environment and statutory regulations.

Idoro (2013) classify the indicators of project performance into two categories, namely: subjective and objective project performance indicators. Three parameters comprising clients' assessment of project duration, cost and quality used in the study are subjective project performance indicators. Four parameters comprising project time-overrun, project cost- overrun, percentage of time-overrun to initial contract period and percentage of cost-overrun to initial contract sum are used as objective project performance indicators.

The stakeholders of a construction project are many and they include the project sponsors such as the client, developer and financier, the project team members and the customers. Client satisfaction can be measured from several perspectives (Godwin Iroroakpo Idoro, 2009) however three parameters (time, cost and quality) have remained the most prominent in research studies.

RESEARCH METHOD

A survey research design was adopted for this study to achieve the outlined objectives. Specifically, a cross-sectional research design was used where samples are drawn from the population of study at one point in time. The study was conducted in Lagos State. As the economic nerve centre of Nigeria and being the second most populous state in Nigeria, there is high demand

for residential, commercial and institutional buildings, civil and heavy engineering works.

The population of the study consists of building projects in Lagos state. The data on building projects was collected from the registered firms with Nigerian Institute of Building (NIOB) and the Nigerian Society of Engineers (NSE). A simple random sampling technique was adopted for selecting the organizations. Questionnaires were distributed by hand to the members of the site management team on construction sites. Personal phone calls and visits were made to sites of respondents to retrieve the questionnaires. Data for the study was processed and analyzed with the aid of the Statistical Packages for Social Science (SPSS Version 20.0). The data were analysed using descriptive statistic tools such as frequency distribution, percentages, bar charts, Relative Importance Index (RII) and ranking while inferential statistic tools such as t-test and correlation analysis were used to test the hypotheses for this study. The RII was calculated using the formulae below:

$$\text{RII} = \frac{\sum W}{A * N}$$

Where W= weight given to each factor by the respondents and ranges from 1 to 5 (Where 1 is "no importance" and 5 is "extreme importance")

A = is the highest weight (i.e. 1 to 5 in this case) and

N = is the total number of respondents

DATA ANALYSIS AND RESULTS

Figure 1 Demographic data of the respondents

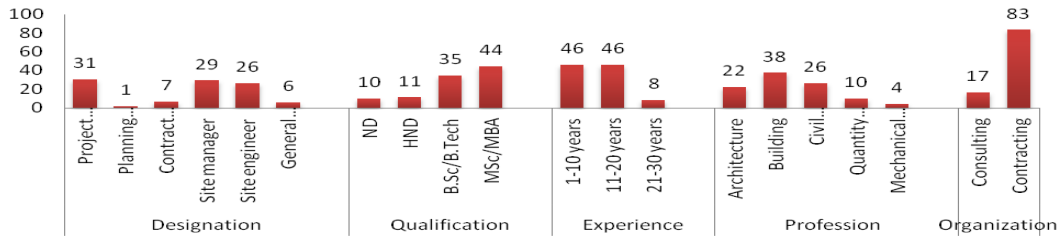


Figure 1 shows that Project managers (30.6%), site managers (29.2%) and site engineers (26.4%) constitute a high proportion of respondents and participants on building construction sites in Lagos state. This shows that the responses of the respondents can be relied upon since it is expected that these designated professionals have a sound knowledge of project management tools and techniques.

Also, figure 1 shows that a sizeable proportion of the total population possesses Masters Degree (44.4%) and Bachelor of Science Degree (34.7%). This shows that all of the respondents have formal education which makes them suitable to provide valuable information required for the study.

It is shown in figure 1 that 45.8% of the respondents who participated in the survey have construction experience between 1-10 years and 11-20 years respectively. The remaining 8.3% have been working in the industry for between 21-30years. The results show that the respondents are well experienced and the information supplied by them can be relied upon.

Furthermore, figure 1 shows that Building professionals constitute the highest proportion (37.5%) of the total population, while Civil Engineering and Quantity surveying professionals constitute about 26.4% and 9.7% respectively of the total respondents. Architects amount to about 22.2% representation in the survey while mechanical engineering professionals had 4.2% representation. This shows that the respondents have the right academic background to contribute to the data needed. Contracting firms make up a major constituent of the respondents of this study (83.3%) while 16.7% of the respondents are engaged in consulting services. This shows that both consulting and contracting firms are represented in this study.

DATA PRESENTATION AND ANALYSIS OF THE STATED OBJECTIVES OF THE STUDY

This section presents the analysis and discussion of the findings emanating from the study in the form of the descriptive and inferential statistics in respect of the stated objectives.

Figure 2: Frequency of use of project management tools and techniques

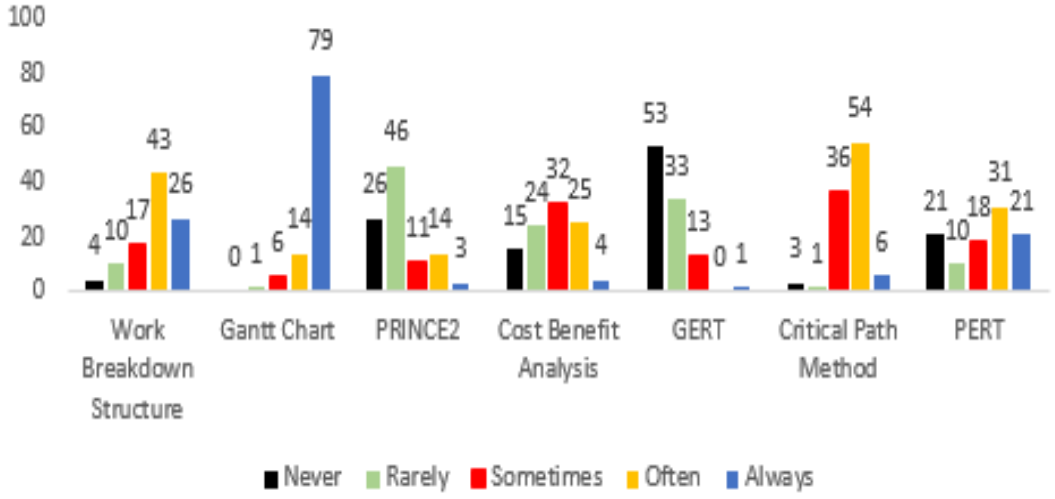


Figure 2 shows the frequency of use of project management tools and techniques on construction sites in Lagos state. The most frequently used tools are Gantt chart (79%) and Work Breakdown Structure (26%). 21% of respondents always make use of Programme Evaluation and Review Technique while 21% never make use of it. 54% of respondents often use Critical Path Method, 43% often use Work Breakdown Structure and 31% often use Programme Evaluation and Review Technique. 24% rarely use Cost Benefit Analysis.

Therefore, the most frequently used tools and technique are Gantt chart, Work Breakdown structure, Critical Path method, and Programme Evaluation and Review Technique while Graphical Evaluation and Review Technique, Projects in Controlled Environment 2, and cost benefit analysis are rarely used on construction sites

This study also assessed the factors affecting the use of project management tools and techniques on construction sites in Lagos. The respondents were asked to assess ten hypothesized factors affecting project management on construction sites. The Relative Importance Index (RII) of these factors were calculated and the factors were ranked. The results are presented in Table 1 below:

Table 1: Factors affecting the use of project management tools and techniques

Factors affecting the use of project management tools and techniques	N	RII	Rank
Troubleshooting	72	0.77	1
Monitoring and feedback	72	0.76	2
Project schedule/plans	72	0.74	3
Project mission	72	0.72	4
Communication	72	0.71	5
Personnel	72	0.69	6
Technical tasks	72	0.67	7
Top management support	72	0.61	8
Client's consultation	72	0.56	9
Client's acceptance	72	0.54	10

Table 1 shows that the difficulty in identifying and resolving issues associated with features of project management tools and techniques which was tagged as troubleshooting (RII=0.77) ranked first among the factors affecting the use of project management tools and techniques. Monitoring and feedback (RII=0.76) ranked second, project schedule/plans (RII=0.74) ranked third and project mission ranked fourth with (RII=0.72). Communication (RII=0.71) was ranked fifth and personnel (RII=0.69) was ranked sixth. Technical tasks with (RII=0.67) ranked seventh, top management support ranked eight with (RII=0.61), client's consultation with (RII=0.56) ranked ninth and client's acceptance with (RII=0.54) was ranked tenth.

Therefore, the important factors affecting the use of project management tools and techniques are the ability to troubleshoot through operational issues associated with the use of each of the project management tools and techniques. The level of ease at which project progress are monitored and the ease at which feedback are provided into the project management tools and techniques were also considered to major influencers. The ease at which project schedule or plans are tracked and updated also affect the use of

project management tools and technique on construction projects within the study area. Project mission/scope and the communication demands of projects also affect the use of project management tools and techniques as project managers rarely employ the use of project management tools and techniques on small scale projects with minimal stakeholders' interest. However, the category of manpower/personnel engaged on construction projects does not affect the use of project management tools and techniques on construction projects. Other factors not affecting the use pf project management tools and techniques include: the nature of technical tasks, top management support, client's consultation and client's acceptance.

Hypothesis One

H_o: There are no significant differences in the perception of consulting and contracting construction firms on the factors affecting the use of project management tools and techniques on construction projects in Lagos state.

Table 2: T-test of factors affecting the use of project management tools and techniques on construction sites.

Factors	Equal variances	F	Sig(2-tailed)	Decision
Project Mission	Assumed	0.015	0.422	Ho Accept
Top management support	Assumed	0.202	0.002	Ho Accept
Project schedule/plans	Assumed	0.55	0.112	Ho Accept
Client consultation	Not assumed	7.667	0.004	Ho Rejected
Personnel	Assumed	3.352	0.015	Ho Accept
Technical tasks	Assumed	0.11	0.479	Ho Accept
Client acceptance	Assumed	2.967	0	Ho Accept
Monitoring and feedback	Assumed	0.029	0.024	Ho Accept
Communication	Not assumed	4.247	0	Ho Rejected
Troubleshooting	Assumed	2.925	0.013	Ho Accept

The results in table 2 reveal that the p-values of the test of differences between the factors affecting the use of the techniques were 0.422 for project mission, 0.002 for top management support, 0.112 for Project schedule and plans, 0.004 for Client's consultation, 0.015 for personnel, 0.479 for technical tasks, 0.000 for client's acceptance, 0.024 for monitoring and feedback, 0.000 for communication and 0.013 for troubleshooting.

Therefore, factors for which there are no significant differences in the perception of contracting and consulting firms on the use of project management tools and techniques include: the nature of the project mission, top management support, project schedule and plans, personnel, technical tasks, monitoring feedback, and troubleshooting as their respective p-values are greater than 0.05. Thus, the null hypotheses were accepted in each case. However, there are significant differences in the perception of contracting and consulting firms on two of the hypothesised factors affecting the use of

project management tools and techniques. The two factors are client consultation and communication with 0.004 and 0.000 p-values respectively.

Hypothesis Two

H_o: There is no significant relationship between the use project management tools and techniques and performance of construction projects in Lagos State.

The results in table 3 show that there is a positive correlation between Gantt chart and cost performance of project (r= 0.254, p= 0.023). This means that projects in which Gantt charts are used have better cost performance than those where it was not used. Furthermore, correlation among the project performance measures indicates that there is a correlation between project schedule and project quality (r= 0.345, p= 0.001), and project cost performance (budget) and project quality (r= 0.522, p= 0).

Table 3: Relationship between PM tools and techniques and project performance measures.

		WBS	Gantt chart	PRINCE 2	CBA	GERT	CPM	PERT	Schedule	Budget	Quality
WBS	Corr. Coeff.	1									
	Sig. 2-tailed	.									
Gantt chart	Corr. Coeff.	.244*	1								
	Sig. 2-tailed	0.022	.								
PRINCE 2	Corr. Coeff.	-0.076	-0.068	1							
	Sig. 2-tailed	0.449	0.523	.							
CBA	Corr. Coeff.	.474**	0.048	0.175	1						
	Sig. 2-tailed	0	0.648	0.079	.						
GERT	Corr. Coeff.	-0.055	-.391**	.217*	.268**	1					
	Sig. 2-tailed	0.596	0	0.038	0.009	.					
CPM	Corr. Coeff.	-0.038	0.207	0.201	-0.134	0.017	1				
	Sig. 2-tailed	0.716	0.063	0.057	0.195	0.875	.				
PERT	Corr. Coeff.	.545**	.355**	-0.035	.384**	0.011	0.085	1			
	Sig. 2-tailed	0	0.001	0.721	0	0.916	0.408	.			
Schedule	Corr. Coeff.	-0.204	0.058	0.101	-0.066	-0.087	-0.065	-0.185	1		
	Sig. 2-tailed	0.05	0.602	0.332	0.523	0.423	0.548	0.07	.		
Budget	Corr. Coeff.	0.094	.254*	-0.021	-0.013	-0.052	0.076	0.111	0.191	1	
	Sig. 2-tailed	0.368	0.023	0.841	0.896	0.63	0.488	0.279	0.078	.	
Quality	Corr. Coeff.	-0.079	0.194	-0.033	-0.162	-0.127	0.108	0.064	.345**	.522**	1
	Sig. 2-tailed	0.45	0.08	0.754	0.117	0.243	0.324	0.534	0.001	0	.
	N	72	72	72	72	72	72	72	72	72	72

* Correlation is significant at the 0.05 level 2-tailed.

** Correlation is significant at the 0.01 level 2-tailed.

DISCUSSION OF RESULTS

The key research findings from this study are summarised as follows:

This study revealed that Gantt chart (RII=0.94) was ranked first and is regarded as the most used project management tools and techniques on construction sites in Lagos state. The technique of Work breakdown structure (RII=0.76) was ranked second followed by the use of Critical path method (RII=0.72) ranking third on the list. PERT (RII=0.64) ranked fourth while Cost benefit analysis (RII=0.56) was ranked fifth. This concur with Olawale and Sun (2010) that the most popular time planning and control technique used on construction projects is the Gantt (Bar) Chart, closely followed by the use of critical path method (CPM). The study opine that the two methods are widely used by both contractors and consultants on construction projects. The reasons for the popularity of both techniques might be due to the fact that they are the most established techniques in the industry (Olateju and Alamutu, 2011) as tools for planning and scheduling projects. Although the ease of use and applicability to the construction process can also be argued as being responsible for their popularity (Olawale and Sun, 2010). The ranking of Gantt chart as the most significant is also supported by the findings of Kogi (2013) but in his own findings the PERT and Critical path method were jointly ranked second.

In addition, these results of factors affecting project management on construction sites shows that Troubleshooting (RII=0.77) was ranked first, followed by Monitoring and feedback (RII=0.76) as second, project schedule/plans (RII=0.74) ranked third. Also, project mission ranked fourth (RII=0.72) while Communication (RII=0.71) ranked fifth. Furthermore, the results of analysis of data performed on the problems relating to the use of project management techniques on construction sites shows that difficulty in modelling the real world (RII=0.74) ranked first. Lack of professional training (RII=0.70) ranked second. Rigid organisational structure (RII=0.63) ranks third while Lack of leadership commitment (RII=0.55) and Lack of PM knowledge (RII=0.55) were ranked fourth concurrently. This finding supports that of Olawale and Sun (2010) which had Lack of professional training ranked amongst the top problems mitigating the use of PM techniques. The study by Papke-Shields et al. (2010) gives an insight into the relative use of different project management tools and techniques and their results suggest incentives for greater application of less frequently used project management tools and techniques, more robust communication practices, quality control and effective project risk management.

Furthermore, this study shows that there is a relationship between the use of Gantt chart and the cost performance of projects. This finding aligns with the findings of Papke-Shields et al. (2010) that there is a significant positive relationship between the use project management tools and techniques and project success. The study provides empirical support for the assumption that the adoption of formal project management practices improves project performance. Also, it vindicates the efforts of professional organizations promoting project management standards, enterprises adopting the

standards as well as individual practitioners seeking to improve their own skills and knowledge through study and certification.

In addition, Ika et al. (2010) opine that project success is insensitive to the level of project planning efforts but a significant correlation does exist between the use of monitoring and evaluation tools and project profile, a success criterion which is an early pointer of project long-term impact.

CONCLUSION AND RECOMMENDATIONS

The need for the application of project management tools and techniques in construction projects especially developing countries cannot be over emphasised. This study identified the various project management tools and techniques that are used by consulting and contracting firms on construction sites in Lagos state. The study revealed that the mostly used project management techniques are Gantt chart, Work breakdown structure, Critical path method, Programme Evaluation and Review Technique, Cost benefit analysis, PRINCE2, Graphical Evaluation and Review Technique in their order of level of use. It was also revealed that PERT and Cost benefit analysis are rarely used on building construction sites in Lagos state.

Furthermore, an assessment of the factors that are likely to affect the use of project management tools and techniques in Lagos state reveals that the predominant factors that could influence the use of project management tools and techniques include; the ease of troubleshooting in the course of use, ease of monitoring and feedback of building construction activities, ease of interpreting project schedule/plans, the nature of the project mission, preferred communication practices on the project, the competence/ skills of personnel managing the building construction project, the nature and complexity of technical tasks required for the actualisation of the project, and the level of support received from top management with respect to deployment of systems to drive the operations of personnel managing building construction projects.

Based on the findings of this study, the following recommendations are proposed:

- Both building contracting and consulting firms should embrace the deployment of various project management tools and techniques on construction projects. Such effort should be demonstrated by investing in systems that would enable personnel on construction sites access these tools.
- Provisions should be made by the management of construction firms for both corporate and hands on trainings of personnel saddled with the responsibilities of managing building construction projects. Such training would increase the knowledge of employees on different project management tools and techniques, enhance them in making informed decision on the most appropriate project management tools and techniques for different project assignments.

- Top management of building construction firms and allied stakeholders should be cognizant of the predominant factors affecting the use of project management tools and techniques with a view to using them as benchmark when deciding on which of the project management tools and techniques to adopt for use on projects.
- Building contractors should leverage on the significant relationship that exist between some of the project management tools and techniques by increasing their current level of use of project management techniques and consequently achieve better project performance as suggested by the positive significant relationship results obtained in this study.

REFERENCES

Akanni, P. O., Oke, A. E. and Omotilewa, O. J. (2014) 'Implications of Rising Cost of Building Materials in Lagos State Nigeria', SAGE Open, 4(4), p. 2158244014561213-. doi: 10.1177/2158244014561213.

Arnaboldi, M., Azzone, G. and Savoldelli, A. (2004) 'Managing a public sector project: the case of the Italian Treasury Ministry', 22, pp. 213–215. doi: 10.1016/S0263-7863(03)00067-X.

Ibrahim, M. O. (2012) 'Analysis and Prediction of Cost and Time Overrun Of Millennium Development Goals (MDGS) Construction Projects In', Developing Country Studies, 2(10), pp. 140–147.

Idoro, G. I. (2009) 'Evaluating Level of Project Planning and Their Effects on Performance in the Nigerian Construction Industry', Australasian Journal of Construction Economics and Building, 9(2), pp. 39–50.

Idoro, G. I. (2009) 'Evaluating the Strategies for Marketing Project Management System in the Nigerian Construction Industry', Nordic Journal of Surveying and Real Estate Research, 6(2), pp. 25–36.

Ika, L. A., Diallo, A. and Thuillier, D. (2010) 'Project management in the international development industry the project coordinator' s perspective', 3(1), pp. 61–93. doi: 10.1108/17538371011014035.

Javed, M. and Shahzad, R. M. (2012) 'Effect of the learning support and the use of project management tools on project success: The case of Pakistan', 4(11), pp. 61–67.

Kasim, N., Latiffi, A. A. and Fathi, M. S. (2013) 'RFID Technology for Materials Management in Construction Projects – A Review', 2, pp. 7–12. doi: 10.5923/s.ijcem.201309.02.

Kerzner, H. (2009) Project management: a systems approach to planning, scheduling, and controlling. 10th edn, New York. 10th edn. John Wiley & Sons, Inc.

Kogi, D. M. (2013) Factors Influencing the Effectiveness of Implementation of The Economic Stimulus Programme (ESP), The Case of Construction Projects in Nairobi County, Kenya. University of Nairobi.

Kwak, Y. H. (2005) 'A brief history of Project Management', in The Story of Managing Projects: An Interdisciplinary Approach. 1st edn. Quorum Books, pp. 1–10.

Lewis, J. P. (2007) Fundamentals of project Management. 3rd edn. AMACOM.

Memon, A. H., Abdul-Rahman, I., Abdullah, M. R. and Abdu-Azia, Ade, A. (2010) 'Factors Affecting Construction Cost in Mara Large Construction Project: Perspective of Project Management Consultant', International Journal of Sustainable Construction engineering and Technology, 1(2), pp. 41–54.

Munns, A. K. and Bjeirmi, B. F. (1996) 'The role of project management in achieving project success', International Journal of Project Management, 14(2), pp. 81–87. doi: http://dx.doi.org/10.1016/0263-7863(95)00057-7.

Nwachukwu, C. C., Emoh, F. I. (2011) Building construction project management success as a critical issue in real estate development and investment, American Journal of Social and Management Sciences, 2(1), pp. 56–75. doi: 10.5251/ajsms.2011.2.1.56.75.

Olateju, O. I. and Alamutu, S. A. (2011) 'Project Management Practice in Nigerian Public Sector - An Empirical Study', Australian Journal of Business and Management Research, 1(8), pp. 1–7.

Olawale, Yakubu A. and Sun, M. (2010) Cost and time control of construction projects: inhibiting factors and mitigating measures in practice, Construction management economics, 28(2010), pp. 509–526.

Papke-Shields, K. E., Beise, C. and Quan, J. (2010) 'Do project managers practice what they preach, and does it matter to project success?', International Journal of Project Management. Elsevier Ltd and IPMA, 28(7), pp. 650–662. doi: 10.1016/j.ijproman.2009.11.002.

Petersen, C. (2013) The Practical Guide to Project Management Christine Petersen, PMP.

Turner, R. and Muller, R. (2007) 'The Influence of Project Managers on Project Success Criteria and Project Success by Type of Project', European Management Journal, 25(4), pp. 298–309. doi: 10.1016/j.emj.2007.06.003.

Zanen, P. and Hartmann, T. (2010) The Application of Construction Project Management Tools an Overview of Tools for Managing and Controlling Construction Projects.

INFLUENCE OF SOCIO-SPATIAL FACTORS ON TRADITIONAL MARKETS IN KANO STATE, NIGERIA

Muhammad Abdul-Azeez Abba[1], **Joy Joshua Maina**[2] **and Musa Lawal Sagada**[3]
[1,2,3]*Department of Architecture, Ahmadu Bello University, Zaria, Nigeria*

Traditional market being a place meant not only for economic activities but also a place for entertainment, political and social interaction. Due to rapid urbanization, stereo-typed shopping malls have constantly replaced traditional markets with little or no considerations of socio-cultural activities in their designs; this has led to the decline in activities of traditional markets making them a place for final sales only. The purpose of the study is to determine the influence of socio-spatial factors in Kurmi and Kantin Kwari Markets. The methodology employed a mixed methods approach; participant observation and survey questionnaires to determine the influence of socio-spatial factors of wayfinding, context, functionality, users' interaction, safety/security, and culture/identity in the study areas. 250 questionnaires were administered, 177 (71%) were valid. The findings reveal important outcomes notably that wayfinding is a significant missing factor in the two study areas, functionality is also a vital missing factor in Kurmi market while culture and identity is an essential missing factor in Kantin Kwari Market. The findings imply that in future, architects and other allied professionals need to pay much attention to these factors in designing markets in order to attract more users while supporting their needs.

Keywords: Kantin Kwari market; Kurmi Market; spatial; socio-cultural; traditional market

INTRODUCTION

Traditional markets were the focal points for the community. They include a wide range variety of uses; they are important centres of trade, commerce, exchange, entertainment and social interaction, and they helped in bringing people together as well as socialisation (Al-Maimani, et al., 2014). Traditional markets can be classified into three separate types: weekly markets, seasonal markets, and permanent markets. Most seasonal and

[1] sadisu93@gmail.com
[2] joyamina16@gmail.com
[3] sadisu93@gmail.com

Abba, M. A., Maina, J. J. and Sagada, M. L. (2017) Influence of socio-spatial factors on traditional markets in Kano State, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 911-929

weekly markets decline and disappeared while permanent markets continue to develop and exist permanently.

Traditional markets are also places where the culture of the locals develops daily (Khalilah , *et al*., 2016). Where cultural principles play an important role in defining group identity, and hence, influence the character and identity of the place they inhabit (Rapoport, 1977). Unlike a space, a place means a setting with meanings. When a space is perceived and felt by its users significantly, it becomes a place (Tuan, 1977). A place is seen as the way it is experienced by people who have a strong connection to time, senses and socio-cultural expression meaning is with the perceptual and the psychological aspects of environmental experience (Stokols & Shumaker, 1983). In this regard, people associate different meanings to similar places for various reasons. However, changes in the existing physical and activity patterns may erase what is significant and meaningful to them (Norsidah, 2014). This implies that place meanings that are embedded in the existing social and cultural setting can be disintegrated as a result of unfit physical development.

Kano state is located in the North-Western part of Nigeria with a population of 9,383,682 (National Population Commission 2006). It is considered the commercial nerve of Northern Nigeria. It is well connected to many cities in North Africa and some cities in southern Europe and largest industrial centre in Northern Nigeria. Commercial activities in Kano first developed with the establishment of *Kurmi* Market known for its crafts and local produce in the 16th century. The market keeps expanding, becoming the southernmost point of the famous trans-Sahara trade routes. In the 19th century, *Kurmi* Market gave birth to *Kantin Kwari* Market known for textile trade which is believed to be largest Nigeria. *Kurmi* Market and *Kantin Kwari* market today have faced different stages of development which has drastically affected the socio-cultural aspect of their space use.

Due to the rapid urbanization rate and population increases in Kano State which has contributed to the decrease in the quality the urban environment and quality of life of the inhabitants particularly in the ancient city of Kano. The traditional urban environment has been constantly replaced by modern structures with standardized images, with the emergence of shopping complexes, the importance of traditional markets as a place for trade and social interaction started to fade (Shuhana et al, 2004). The city witnesses the reduction of socio-cultural practices in markets due to the attraction of one stop commercial centres for shopping and leisure activities.

Every culture produces its own market form, highly reflective of the history and lifestyle of people. Traditional market that possess strong historical background and also serving as a place where glimpse of local lifestyle can be seen give a huge contribution to the country's economy (Shakur, Hafiz, Vrual-arslan, & Cahantimur, 2012). The context of traditional market means more than just buying and selling it is a place to meet friends, disseminate ideas and views and propagate information and mass mobilization for political and social reasons. Little or no consideration is now

given in the design or redevelopment of market and shopping centres largely due to the influence of western civilisation. Planners and designers mainly focus on the quality of the physical components of place and often disregard the importance of place meaning and association developed between people and places (Norsidah, 2014). This has made the economic aspect of the market to over shadow the non-economic aspects, thereby making the markets places of final sales only (Musa, 2005). Market is a symbol of socio-cultural identity of people, the need to preserve people's culture and history through market is crucial in order to prevent it from fading. Furthermore, illegal developments, demolition of historical buildings has caused traditional market decline in wayfinding, functionality, culture/ identity, safety/security, users' interactions and other socio-spatial factors (Al-Maimani, *et al.,* 2014).

Specifically it is unclear which socio-spatial aspects of market design will be employed to improve the traditional culture of Kano. This study therefore, sets to provide an understanding of socio-spatial features of markets that have been under researched in cultures being fast eroded by western standards.

The study poses one research question; which of the socio-spatial factors are of great influence to trading and commercial functions in the traditional Kano markets? Answer to this question explore trends initiated by users towards improving socio-spatial aspects of traditional market in Kano State. Importantly answer to this question will also inform architects and other allied professionals factors they need to pay attention therefore informing future design decisions.

The paper is structured along 6 sections after the introduction. The second section provides a brief review of literature on socio-spatial aspects leading to the framework presented in the methodology. The fourth section is analysis of results from the study. This is followed by discussion of results. The paper rounds up with conclusions, recommendations and references pertinent to the study.

LITERATURE REVIEW

Traditional Market

A traditional market is a city square where traders set up stalls and buyers browse through the commodities (Smith, 1971). It is under the leadership of the community leader and a place where people meet regularly in order to acquire locally produced or imported goods, to exchange information with people, friends, relatives and strangers, and also to engage in recreational activities.

The layout of Hausa market is simple, it has an orderly arrangement of vendors grouped by commodities; butchers remain together as do grain sellers, blacksmiths, tailors. Kola nuts sellers and other mobile goods sellers have their place as well but they may hawk around the market.

Market is an important communication channel, traditionally; announcement is made in the market by special town criers (*Shela).* Smith (1971) stated that market brings together people of neighbouring communities for trade and interaction.

Related Studies and Research Gap

Various researchers have studied different aspects of market globally (Al-Maimani et al., 2014; Bahanna & Dalton, 1962; Fava et al., 2010; Hanachi & Yadollahi, 2011; Jackson et al., 2006; Journeyman's review, 1997; Khalilah et al., 2016; Kim et al., 2004; Norsidah, 2014; Omer, 2005; Polanyi, 1957; Roth, 2010; Shakur et al., 2012; Shuhana et al., 2004; Vural Arslan, 2015) However, little researches addresses the socio-cultural aspects of space use globally (Al-Maimani et al., 2014; Khalilah et al., 2016; Norsidah, 2014).

In Nigeria, researchers have studied different aspects of market (Alkali, 1991; Hosea, 2014; Ibraheem, 2012; Mansur, 2004; Muhammad, 2009; Musa, 2005; Ogeah & Omofonmwan, 2013; Musa, 1999). Nonetheless, little or no attention is being paid to socio-cultural aspects of space use in Nigeria (Musa, 2005). This study tends to fill this gap to provide an understanding of influence of socio-spatial aspects of traditional markets in Kano State.

Norsidah's, (2014) research 'place meaning and significance of traditional shopping district in the city centre of Kuala Lumpur, Malaysia' was aimed to uncover how meanings are translated in everyday experience of the users in the traditional markets, two research questions were investigated; do these places continue to hold significant meanings to the attached users? How do the users associate with the streets in the past and the present? The methodology was case study approach; data were collected through interview with the visitors. The research revealed three major findings: The role of diverse economic transactions is very important in supporting attachment to a place, the socio-cultural interaction, memory and personal meanings helps develop the sense of belonging to the trading community and the cultural expression strongly manifested in the items sold and general atmosphere of the market.

Khalilah's, (2016) research 'sustaining cultural vitality of urban public market' using Pasar Payang in Malaysia as a case study aimed at examining the qualities of an urban public market that can sustain cultural vitality alongside physical redevelopment. It poses two research questions; what are the significant qualities of the market based on the perspectives of local visitors and tourists? What is the nature of the market's businesses and experience of the vendors? The methodology was case study approach, data were collected using a questionnaire and a semi structured interview with the market vendors. Data collected were analysed to establish the relationship between the visitors, the vendors and the market in order to synthesise how the market can sustain its vitality. Major findings from the research are: market venues need to have spaces and activities that can create opportunities for cultural participation, cultural vitality of the market can be sustained through the development and support of the local

businesses and local products are the vital components that contributes to the cultural qualities and attraction value of a market.

Musa's, (2005) research 'African shopping arcade, a study of socio-cultural aspects of traditional African Markets'was aimed to examine the socio-cultural of the typical African market in Nigeria and to determine the influence of change and modernity on the traditional African markets, was case study approach, the research looked into socio-cultural aspects, religious activities, Planning and circulation and goods sold. Major findings are: planning and circulation enhance social activities, hawkers should be avoided to enhance social interaction and building services have to be adequately provided to support people's need.

Al-Maimani's et al., (2014) research 'exploring socio-spatial aspects of traditional souq, a case study of souq Mutrah, Oman'. Was aimed to provide an understanding of socio-spatial aspects of urban spaces- market places within Souq Mutrah, methodology was case study approach, Data were collected using a walk through assessment and behavioural mapping. The major findings are: spatial and socio-cultural are related in a reciprocal manner the context and functionality supports peoples need, there is poor signage system which makes the users to be confused where to follow. The three spaces have unique identity and represents local culture, there is lack of security in the market.

From the studies above, we can conclude that Khalilah, (2016) and Musa, (2005) focused to determine the effect of change and modernity on socio-cultural aspects of traditional markets without considering the spatial aspects while Norsidah, (2014) focused on how people are attached to a place with little considration to the socio-cultural aspects. However, Al-Maimani et al., (2014) concentrated on both the spatial and the socio-cultural aspects of traditional market. In a nutshell, the study carried out by Al-Maimani et al., (2014) has much direct relationship with this research. This research will therefore apply Al-maimani's et al.,(2014) to determine the influence of socio-spatial aspects of traditional markets in Kano.

Research variables

In submission to Almaimani's et al. (2014) work, studies that relate to urban spaces and shopping places were reviewed in order to determine the research variables. Starting with that of urban spaces, Carmona, Heath, Tiesdell, & Oc, (2003) addressed six factors; morphological, perceptual, social, visual, functional and temporal, these factors are inter-related to each other, therefore helps to understand and evaluate urban spaces. Salama and Weidmann, (2013) addressed three facotrs; functional, social and perceptual as factors used to assess urban public spaces. However, these factors encourages considering; the nature of use, environmental conditions, comfort and relaxation, the social use of space, diversity and social mix, safety and security, environmental meaning and sensory experience, personal space and privacy, territoriality and personalisation. Salama, Al-Nesf, Hasson, & Al Ramahi, (2008) developed a tool which involves a method to assess shopping places, it include the following factors;

surrounding context, massing, interface, wayfinding, socio-spatial relationship, and comfort. These tools were examined to identify the key issues relevant to examination of the study area.

A total of six factors adopted from Al-Maimani et al., (2014) have been identified underlying two categories; spatial and socio-cultural characteristics. Recognizing that the spaces under investigation are considered urban spaces and shopping places, these factors combine the characteristics of both. The objective of this procedure is to attempt to translate the concepts involved in the assessment process into some measurable factors. While the weight of each factor varies according to its contribution to the overall quality of the urban space -shopping place- social fabric, they are treated equally in this assessment. Spatial aspects consist of; context, wayfinding, and functionality, while socio-cultural aspects consist of users and interaction, safety and comfort, culture and identity.

Spatial aspect

Spatial aspect addresses issues related to general layout of the market, patterns of the surrounding street, linkages to the surrounding, level of which space is memorable, and other related matters. For better understanding, spatial aspect is sub-divided into three factors. Context: This factor considers the environment the market is placed, it addresses pattern of surrounding streets, scale and character of the area, public-private relationship, connectivity, and land use. Wayfinding is all about effective communication and relies on a succession of communication clues delivered through our sensory system of visual, audible, tactile and elements. It addresses linkage to surroundings, moving modes, pathways legibility, and flows of traffic and people. Functionality: Functionality has to do with how effective a building is. It addresses level of interest in space, role of physical environment and atmosphere in achieving the space objectives, level of attracting tourists, businesses, and regular visitors. It also addresses the level in which the space is memorable, and its position as a major attraction in the neighbourhood and the city.

Socio-cultural aspect

Socio-cultural aspect of traditional market addresses issues related to accessibility and interaction of users, safety of the users, the cultural identity of a given region and other related matters. For better understanding also, it is also sub-divided into three factors. Users and interaction describes how users interact with the building. It addresses accessibility and equitability for all potential users, encouragement of interaction among them, diversity of social activities in the same time and in different times (temporal dimension) and level of personalization. Safety and comfort describes how comfortable users are and their feeling on how secure they are. It addresses boundaries, security personnel, security cameras, thermal comfort, noise level, lighting level, privacy and personal space. Culture and identity describes culture of the study area and the cultural features that can be identified. It addresses; the role of users, activities, space atmosphere/ambiance, representation of the cultural identity of the country, meaning, important events, and place attachment.

RESEARCH METHODS

The study employed Al-Maimani's *et al.*, (2014) research framework, however, some adjustments were made in order to best suit this research. The framework was choosen due to the fact that it has direct relationship with this study and also for its suitability to guide the study in achieving its aim and objectives. The methodology used was a case study approach using Souq Mutrah in Oman. Data were collected using a walk through assessement to asseess the level of significance of six factors of socio-spatial aspects of traditional markets placed on a four point scale. For the purpose of this research, questionnaire would be used to determine the level of significance of these factors instead of conducting a walk through assessment, this is because walk through assessemnt is highly subjective, it depends on an individual that carries out the research. A research is considered to be valid if and only if another researcher can carry out the same research using the same research instruments and arrive at the same result.

Mixed methods were employed for this research, this approach is employed in similar researches (Al-maimani et al. 2014). The advantage of employing this approach is for triangulation of results: quantitative data provides objective data and hard facts. Qualitative data provides more in-depth explanations and reasons behind established phenomena (Bryman, 2012). Qualitative methods through participant's observations, questionnaires and interviews, the disadvantage of this method is that it is time consuming, it requires repeated visits to the study areas. The questionnaire was structured in two parts, the first part seeking for information regarding demographics data; age, gender, duration of stay in Kano, category, how frequent do you use the market? The second will seek information regarding the six socio-spatial factors under which fives questions were asked each and it is placed on a 5 point Likert scale,

For research question 1, which assesses the level of reflections of socio-spatial factors in the study areas, numerical data obtained from Likert scale were analysed using simple frequencies and means and RAI to establish which of the six factors tested has highest influence in the two study areas, Individual items on the questionnaires were ranked based on a relative agreement index (RAI) obtained as a ratio of the sum of actual agreement scores (ASac) and maximum possible agreement score (PASmax) on the 5 point Likert scale for each question (Ibem, Opoko, Adeboye and Amole, 2013). Mathematically, this is expressed as:

$$RAI=\Sigma ASac/\Sigma PAS2max$$

A factor is considered to be satisfactory if mean ≥ 3.0 (Al-Maimani, et al., 2014). Moreover, three evaluations were carried out, first to compare the average means and RAI of the socio-spatial factors of the two study areas, secondly to compute a cumulative average means and RAI of the two study areas, thirdly, to specifically determine the level of reflections of the individual items tested in the questionnaire.

The research instruments were considered reliable and valid since it has been used by previous researchers; moreover, a pilot study was conducted to ascertain the validity and reliability of the instruments.

Data collection

There are 10 major markets in Kano state, however purposive sampling technique was used in selecting the two study areas, the criteria for selecting the study areas were based on: the market has to be traditional market, it has to undergo some stages of redevelopment, falls within the boundary of ancient city of Kano, it has to be in existence for over 50 years for people to have a strong connection to it. Based on these established criteria, only *Kurmi* Market and *Kantin Kwari* Market fulfil the above criteria.

The year Kurmi market was established is precisely unknown, but it is believed that this market to has existed for between 800 years and 1000 years. It is located in Kano Municipal Local Government Area, Kano State, it is strategically located within the heart of the Old city of Kano, covering an area of about 61,600 m^2 (Google Earth Pro. 2013) (Plate 1), it has more than 37 entrances which makes it almost impossible to control people entering into the market. The Market stretches into wards like *Gabari, Yan Doya, Bakin Zuwo* and *Jakara.* It is bounded by four access roads; *Baba Kusa* road (north), *'Yan Soso* road (south), *'Yan Mota* road (east) and *Jakara* road (west). It is a traditional market selling local items produced by residents of ancient city of Kano, and is believed to be under the custody of Kano Emirates Council. It has ancient buildings, even though they are being constantly demolished and replaced by modern ones, the two major historical artefacts are: a place where slaves were kept during salve days which were built in modules. One of the modules is conserved for historical purposes (Plate 2) and *Rijiyar 'Yan Goro* (a well) which is believed to be the origin of *Kurmi* market.



Plate 1: Location of Kumi Market

Source: Google Earth Images (2016)



Plate 2: A building where slaves were kept.
Source: Researcher's Fieldwork

Kantin Kwari Market on the other hand is believed to be in existence for over 60 years located in Fagge Local Government Area and covers about 91,000 m^2 (Google Earth Pro. 2013) (Plate 3). It has 15 defined entrances (Plate 4) which are closed after market hours. The market is bounded by three major roads; *IBB* Road (west), *Ibrahim Taiwo* Road (east), *Kofar Mata* Road (north). It is a semi-traditional market selling textile materials of all kinds and is believed to be the largest textile market in Nigeria. *Kantin Kwari* was formerly a Lebanese quarters, the buildings have shops at the ground floor and their dwelling at the first floor. During the regime of General Yakubu Gowon, he mandated that commercial activities should be taken over by the indigenes of Kano. This forced them to sell their properties to the residents of Kano. This is the major reason why the buildings do not carry the cultural attributes of the region.



Plate 3: Location of Kantin Kwari Market
Source: Google Earth Images (2016)



Plate 4: One of the major entrances into the market.
Source: Researcher's Fieldwork

The researcher employed four research assistants (two males and two females) to assist him in distributing and filling the questionnaires. The research assistants were trained by the researcher to make sure that they understood what is expected from them. The need for female research assistants became necessary due to the culture of the people living in the study areas. Going by the fact the majority of the respondents are Hausa, the questionnaire was translated by the researcher to the local language (Hausa) for easy comprehension. It was validated by a lecturer in School Of Languages, Department Of Hausa, Sa'adatu Rimi College of Education Kano. The validated questionnaire was tested by the students from the Department of Architecture and other related fields to make sure the instrument in a good shape before it was administered. Shop owners, market men and women were the target population, it was interviewer filled in cases where the respondent has little or no skills of answering questionnaire. The survey was conducted in two months (September, 2016 to October, 2016). 250 Questionnaires were administered by the researchers and research assistants randomly. 177 questionnaires (71%) were retrieved, 55 were missing (22%) and 18 were invalid (7%).

ANALYSIS OF RESULTS

Results from demographics reveal that majority of the respondents are male (80%) with Senior Secondary School Certificate Examination (SSCE) as their highest academic qualification (58%), aged between 31 and above (32%), mostly stayed in Kano for over 11 years (71%) and visits the two study areas very frequent (54%).

Comparative Analysis Between *Kurmi* Market And *Kantin Kwari* Market

Table 1 illustrates the results of assessing the two study areas. It provides an understanding of socio-spatial aspect of the two study areas. *Kantin Kwari* market received the highest average, while *Kurmi* Market received the lowest average.

Table 7 Comparative analysis of the socio-spatial factors of the two study areas

S/N	Aspect	Factors	Kurmi		Kantin kwari	
			Mean	Rai	Mean	Rai
1	Spatial aspects	Wayfinding	2.09	0.418	2.45	0.490
2		Functionality	2.88	0.559	3.13	0.625
3		Context	2.95	0.590	3.08	0.616
4		Average	2.64	0.522	2.89	0.578
5	Socio-cultural aspects	Users and interaction	3.07	0.615	4.03	0.807
6		Safety and comfort	2.95	0.560	2.96	0.593
7		Culture and identity	3.24	0.647	2.65	0.529
8		Average	3.09	0.607	3.21	0.643
9	Average score		2.86	0.565	3.05	0.610

Spatial Aspects

Wayfinding

Wayfinding is a missing factor in the study areas, (see table 1). *Kantin Kwari* Market received the highest score, while *Kurmi* Market received the lowest. The former has sufficient wider routes that connect various parts of the market and at the same time support different moving modes. Some shops have crew at the market entrances that direct people to their shops. This helps a lot in helping people to find their ways. But during peak hours, people find it difficult to move around the market without traffic jam more especially now that there are developments going on which limit people movement around places like *Filin Parking, 'Yan Hula* and other places. Lastly, visitors find it difficult to locate places without asking. The latter is characterised by haphazard arrangement of buildings. This is the major cause of decline in wayfinding. The routes also do not support different moving modes, and it is only comfortable way to move freely on foot than any other moving modes. Visitor cannot locate exit routes without asking largely due to its haphazard arrangement of buildings. Lastly there are no signage that aid peoples' movement.

Functionality

Functionality is a missing factor in *Kurmi* Market (Table1). *Kantin Kwari* Market received the highest score whilst *Kurmi* Market received the lowest, *Kantin Kwari* is characterised by attracting people from different parts of the world for business transaction. Because it is the largest textile market in the whole Northern Nigeria. It is not considered as a tourists' destination because it has no historical artefacts, and the physical layout is not interesting as it was not designed purposely as market. *Kurmi* Market on the other hand attracts tourists from various parts of the world due to its historical values. It also attracts business from various countries for local business, the architectural character of *Kurmi* Markets sounds to be memorable as it carries elements of Hausa traditional architecture, but its

physical layout is not interesting due to illegal developments which cause the market to be mazy in nature.

Context

Context is a missing factor in the *Kurmi* Market (table 1). *Kantin Kwari* Market received the highest whilst *Kurmi* Market received the lowest. *Kantin Kwari* Market is along three major roads; *Kofar Mata* Road, *IBB* Road and *Ibrahim Taiwo* Road, this is why it fits the site it is located. The scale of *Kantin Kwari* Market can also be considered as satisfactory because it has a potential for expansion. *Kurmi* Market on the other hand fits harmoniously to its surrounding because it fulfils the characteristics of siting a Hausa traditional market. However, the scale of *Kurmi* Market does not fit the site it is sitting upon, this is largely because it has no room for expansion which caused it to be crowded. Moreover the roads surrounding *Kurmi* Market are always busy causing congestion.

Socio-Cultural Aspects

Users Interaction

Users and interaction are considered to be satisfactory in the study areas (table 1). *Kantin Kwari* Market received the highest score in terms of Users and Interaction, while *Kurmi* Market received the lowest. *Kantin Kwari* is categorised as largest textile market in Northern Nigeria. This contributed in making it to be socially inclusive as it gathers people of different social groups together. Uses in *Kantin Kwari* serve different social groups largely because products sold in *Kantin Kwari* Market serve different social groups. *Kurmi* Market on the other hand also is categorised as being socially inclusive. It also serves different social groups, but the uses at points do not serve different social groups largely because vendors in *Kurmi* Market are grouped together which limits social interaction between the users of different social groups.

Safety and comfort

Safety and comfort are missing in the study areas (table 1). *Kantin Kwari* Market received the highest score, while *Kurmi* Market received the lowest. *Kantin Kwari* Market has no place that fosters the feeling of comfort and relaxation. However, it offers feeling of safety and security to its users, because it has controlled entrances into the market. The level of light is moderate, but it does not suit individuals' thermal comfort due to an extreme heat. Moreover, it is open to the sky which increases the temperature of the surrounding. Lastly, the perceived level of noise is unbearable. *Kurmi* Market is considered as a peaceful place. In the past, there had been no record of violence of any kind. The perceived level of noise is moderate due to a reduced amount of traffic at *Kurmi* Market. It is opened to sky, so it has an abundant day lighting, even though it doesn't have any shade covering the space which disturbs the level of comfort of its users, it relatively affects the users thermal comfort and users' relaxation, but still people feel a bit comfortable because they sit relax chat and eat inside or in front of their shops.

Culture and Identity

Culture and identity are missing in *Kantin Kwari* Market (table 1). *Kurmi* Market received the highest score, while *Kantin Kwari* received the lowest. The architectural character of *Kurmi* reflects the identity of Kano more especially the olden day's buildings. It also carries the two oldest historical artefacts as mentioned before which makes it to be culture sensitive. These attract tourists from different parts of the world. The general atmosphere and setting of *Kurmi* reflect the character of Kano. The users also represent the cultural identity of Kano, most importantly, the space reproduces memory of past, because it reminds someone how trade was done in the past, days of slaves trade, how it was being carried out, and where they were kept. *Kantin Kwari* on the other hand has no historical artefacts which does not remind one about the memory of the past. The architectural style has no relationship with the culture of Kano, and it resembles modern architecture.

Cumulative Result for Markets In Kano State

Results from questionnaire assess the six socio-spatial factors tested at the two Markets in Kano State is shown in Table 2.

Table 8 Cumulative result of socio-spatial factors

S/N	Aspect	Factors	Mean	Number	Sum	Rel. Index
1	Spatial aspects	Wayfinding	2.30	885	2035	0.460
2		Functionality	3.02	885	2674	0.604
3		Context	3.03	885	2680	0.606
4		Average	2.78	885	2463	0.557
5	Socio-cultural aspects	Users and interaction	3.63	885	3210	0.725
6		Safety and comfort	2.96	885	2615	0.591
7		Culture and identity	2.90	885	2564	0.579
8		Average	3.16	885	2796	0.631
9	Average score		2.97	885	2629	0.5941

Table 2 reveals the degree of reflections of these factors in the Markets in Kano State and it has shown that the spatial factors: wayfinding has a mean of 1.78, functionality has a mean of 2.61 and context has a mean of 2.96, while the socio-cultural factors: users and interaction has a mean of 2.55, safety and comfort has a mean of 2.45 and culture and identity has a mean of 2.60. In summary, spatial factors have a mean of 2.45 whist the socio-cultural factors have a mean of 2.53.

Specifically, socio-cultural factors were ranked high. The study areas, which are considered to be socially inclusive (Users/Interaction), the level of light in the study areas (Safety/Comfort), the users represent the identity of the region (Culture and Identity), these were ranked 1st, 2nd and 3rd respectively (Table 3). On the other hand, spatial factors were ranked lowest, A visitor will know where to go on entering and can easily locate exit routes (Wayfinding); this is due to narrow pathways and its mazy format in nature.

The circulation routes are marked well, clear and easy to understand (Wayfinding) and the space fosters the feeling of comfort and relaxation (Safety and Comfort) basically due to congested traffic and overcrowding, these were ranked lowest among the socio-spatial factors.

Table 9 Ranking of individual socio-spatial factors

No.	Item	Σasac	Rai
Uiq1	The space can be described as being socially inclusive	702	0.793
Scq5	The level of light in this space during the day is appropriate	673	0.760
Ciq1	The users of the space represent the cultural identity of the region	638	0.721
Uiq2	The space encourage the use for several social groups	637	0.720
Uiq3	The space provide interaction between different social groups	636	0.719
Fq1	I consider this space as a major attraction in the market	632	0.714
Fq3	The space attracts business within/surrounding the city	632	0.714
Uiq5	Uses in this space serve different social groups	620	0.701
Uiq4	The space is accessible to diverse social groups	615	0.695
Scq2	The space offer the feeling of safety and security to its users	605	0.683
Wq1	There are sufficient pathways provided to and around the market	604	0.682
Cq1	The space fits harmoniously with the surrounding buildings	579	0.654
Cq5	The scale of this space suits the site it sits upon	578	0.653
Ciq3	The general atmosphere of the space reflects the identity of the region	538	0.608
Cq2	The space is well connected to the surrounding buildings	520	0.588
Scq5	The perceived level of noise in this space is appropriate	516	0.583
Cq3	The appearance of this space fits well to the character of surrounding	513	0.580
Fq4	The space can be considered as a shopping/touristic destination	513	0.580
Ciq2	The activities in this space represent the cultural identity of the region	508	0.5074
Cq4	The scale of this space suits the character of the surrounding	490	0.554
Scq3	The space suits individual's thermal comfort	489	0.553
Ciq5	The space reproduces memory of the past	472	0.533
Fq2	The architectural character of this space is memorable	463	0.523
Wq2	The routes support different types of moving modes	456	0.515
Fq5	The spatial experience and the physical layout of this space is considered interesting	434	0.490
Ciq4	The architectural character reflects the identity of the region	408	0.461
Wq5	During peak hours, i find it easy to go round the market without traffic jam	375	0.424
Scq1	The space fosters the feeling of comfort and relaxation	334	0.377
Wq3	The circulation routes are marked well, clear and easy to understand	320	0.362
Wq4	A visitor will know where to go on entering and can easily locate exit routes	280	0.316

(W- Wayfinding. F-Functionality, C- Context, UI- Users Interaction, SC- Safety and Comfort, CI- Culture and Identity.)

DISCUSSION OF RESULTS

Spatial Factors appears to be poor in the two study areas

Results from questionnaire have shown that spatial factors are poor in Kano State markets. This goes contrary to the finding of Al-maimani (2014) which shows that the spatial factors in Souq Mutrah were satisfactory. Wayfinding in Markets in Kano is poor due to haphazard arrangement of the market. Also, overcrowding contributed to poor wayfinding due to narrow and insufficient pathways. This is in line with Musa's (2005) findings which suggests planning and circulation should be improved. Visitors have to constantly ask for directions due to poor signage systems. Functionality is also a bit poor, even though markets in Kano attract users from every part of the country. Their physical layout is poor due to uncontrolled developments which cause congestion. The historical buildings were constantly replaced by modern ones. This has drastically affected the number of tourists visiting the markets. The context of the markets in Kano is also considered to be a bit poor basically due to their locations, even though markets like *Kurmi* fulfils the criteria of siting a traditional market, but the major roads taking you to the Markets are always busy. This has affected the context of markets in Kano State. In a nutshell spatial factors averagely can be considered to be poor due to the above mentioned reasons

Socio-Cultural Factors affected by Developments going on in the Two Study Areas

Results from questionnaire have shown that socio-cultural factors appear to be satisfactory in the Markets in Kano State. This goes in line with findings of Norsidah (2014) and Khalilah (2016). In terms of Users Interaction, Kano being the centre of commerce, it has contributed in making Markets in Kano to be socially inclusive as it gathers people of different social groups together. In terms of safety/comfort, Markets in Kano appear not to be supporting users need. There are no places that foster social interaction within the markets. The perceived level of noise is unbearable, even though they offer a bit feeling of safety and security to its users. Hawkers also help in boosting social interaction among users. This goes contrary to Musa (2005) which says hawkers should be avoided. In terms of culture and identity, users represent the identity of the region, but the buildings do not represent the character of the region. Old buildings that carry the identity of the region as well as serves as tourists' attraction are being constantly demolished and replaced by modern ones. This has drastically affected the socio-cultural factors of Markets in Kano. Historic buildings and local products are two major tourists' attraction in Markets in Kano State, this is in line with Norsidah (2014) and Khalilah (2016) where they stated that historic buildings and local produce should be supported in order to enhance cultural vitality.

CONCLUSION AND RECOMMENDATION

This paper investigated the concepts of socio-spatial aspects of Traditional Markets in Kano State using *Kurmi* Market and *Kantin Kwari* Markets as study areas. This was done to improve the gap in research on socio-cultural aspects of space use in traditional Markets in Northern Nigeria.

In response to the research which investigated which of the socio-spatial factors are of great influence to trading and commercial functions in the traditional Kano markets? Both socio-cultural and spatial factors are inter related, relating people together in a reciprocal manner. The examination of the spatial aspects of the two study areas, while the factors functionality (M=3.13) and context (M=3.08) appear to support people needs in *Kantin Kwari* Market, functionality (M=2.88) and context (M=2.95) are missing in *Kurmi* Market largely due to illegal development and its location respectively. Wayfinding (*Kurmi*= 2.09, *Kwari* =2.45) seems to be poor in the two study areas due to poor signage systems and narrow undefined pedestrian routes. The study areas attract locals from both genders. Tourists are found in *Kurmi* Market only due to the presence of historical buildings and local products. *T*he architectural character of part of *Kurmi* Market remains memorable as it resembles the olden day's buildings. Locals surrounding the markets neighbourhood visit it for various reasons which may include work, social interaction and business transactions.

Socio-cultural factors revealed that the study areas foster interaction (*Kurmi*= 3.07, *Kwari* =4.03) among users. There are notable numbers of low and medium incomes due to the quality of products and services do not satisfy the high income earners. *Kurmi* Market has unique identity (M=3.24) and represents local culture. *Kantin Kwari* has low identity (M=2.65) in terms of culture but users represent their local cultures. This allows interaction in both the study areas. However they face a significant issue in terms of safety and comfort (*Kurmi*= 2.95, *Kwari* =2.96) of its users. The two case studies are not considered as spaces that fosters the feeling of comfort and relaxation. There are low presence of security personnel in the two study areas Level of light is suitable but lower than that of shopping malls. Level of noise is unbearable. This paper, therefore, recommends that in order to improve socio-cultural activities happening within traditional markets, the following measures be adopted by the management of the market/ Kano State Government at large and included in a maintenance/improvement policy document:

- Wayfinding should be improved significantly in order to improve planning and circulation of Markets in Kano, circulation and planning should be considered
- Historic buildings, a place where slaves were kept for instance should be declared as Heritage sites.
- The development and support of local businesses should be done in order to sustain its cultural identity.

- As established from the demographics survey, 90% of the respondents are literate with SSCE as their lowest qualification. This can now call for modern signage systems to aid wayfinding for the users.
- There should be defined entrances and exits in order to control peoples' movement within the market. Moreover, social spaces should be created to foster the feeling of comfort and relaxation.

Similarly, as a recommendation for practice, architects and other allied professionals need to pay much attention and re-evaluate spatial and socio-cultural factors in designing markets in order to attract more users while supporting their needs. Though considered default in architectural practice, it has become imperative for design professionals to pay special attention to these factors, precisely the spatial factors helps to improve planning and circulation, while the socio-cultural factors helps in attracting users and get people attached to it due to its cultural roots. This will go a long way in enhancing the functionality of the market.

As part of limitations faced during the study, problem of understanding what the questionnaire is all about was faced, this has been taken care of by translating the questionnaire to local language (Hausa) for the respondents to comprehend easily. Also, due to the problem of insecurity faced in Northern Nigeria, the researcher took permission from the market authority carry along letter of introduction during the field study. Lastly, the respondents have little or no skills of answering questionnaire, the researcher and his assistants administered an interviewer filled questionnaires to tackle this issue.

REFERENCES

Alkali, G. L., (1991). An Attempt to Solve the Problem of Circulation and Congestion in Market. Zaria, Kaduna: Unpublished MSc thesis, Ahmadu Bello University, Zaria.

Al-Maimani, A., Salama, M. A. & Fadli, F. (2014). exploring socio-spatial aspects of traditional souqs:The Case of Souq Mutrah, Oman. *International Journal of "Architectural Research"* 8(1),50-65.

Bryman, A. (2012). "*Social Research Methods"* (4th Ed.) New York: Oxford University Press.

Bahanna & Dalton (1962). "*Markets in Africa*." London: Northweatern University press, Britain.

Carmona, M., Heath, T., Tiesdell, S. & Oc, T. (2003). Public Spaces–Urban Spaces: The dimensions of urban design. Oxford: Architecture press.

Fava, N., Guàrdia, M. & Oyón, J. L., (2010). Public Versus Private: Barcelona's Market System 1868–1975. "*Planning Perspectives'* s.l.: s.n.

Hanachi, P. & Yadollahi, S., (2011). Tabriz historical Bazaar in the Context of Change. Paris, s.n.

Hosea, B., (2014). Market Suitability Assessment of the Use of Remotely Sensed Data in The Suitability Assessment for Market Facility in Kachia LGA, Kaduna. Kaduna: Unpublished MSc thesis, Ahmadu Bello University, Zaria.

Ibem, O. E., Opoko, U. P., Adeboye, A. B. and Amole, D. (2013). Performance evaluation of residential buildings in public housing estates in Ogun State, Nigeria: User's satisfaction perspective. "*Frontiers of Architectural Research"*, 2: 178-190.

Ibraheem, A. B., (2012). An Appraisal of Kaduna Central Market Redevelopment Scheme. Kaduna: Unpublished MSc thesis, Ahmadu Bello University, Zaria.

Jackson, M. R., Herranz, J. & Kabwasa-Green, F., (2006). Cultural vitality in communities: Interpretation and Indicators. Washington, D.C, The Urban Institute.

Journeyman's Review,)1997). The Role of frww and Open Market in any Future economy. [Online] Available at: http://www.egroups.com

Khalilah, Z., Zumahiran , K. & Nor , Z. H.(2016). Sustaining The Cultural Vitality Of Urban Public Markets:A Case Study of Pasar Payang, Malaysia. "*International Journal of Architectural Research*" 10(1),228-239.

Kim, J., Lee, C. M. & Ahn, K. H. (2004). Dongdaemun, a Traditional Market Place Wearing a Modern Suit the Importance of the Social Fabric in Physical Redevelopments. "*Habitat International*" 28(1), 143–161.

Mansur, A., (2004). Design proposals for Malunfashi main market, Katsina state. Zaria: Unpublished B. URP Dessartation Ahmadu Bello University.

Muhammad, I. B., (2009). A design proposal for new Sabon Gari market Zaria, contemporary approach to fire safety in market design. Zaria: Unpublished PGD Thesis, Ahmadu Bello University.

Musa, (2005). African Shopping Arcade: A Study of Socio Cultural Aspects of Traditional African Markets. Kaduna, Unpublished MSc Thesis, Ahmadu Bello University, Zaria.

Musa, M., (1999). `Evaluation of the Spatial Distribution of Markets in Kaduna Metropolis. Zaria: Unpublished M.sc thesis, Ahmadu Bello University.

National Population Commission (2006). Population Census, Abuja

Norsidah, U. (2014). Place Meaning and Significance of the Traditional Shopping District in the city centre of Kuala Lumpur, Malaysia. *"International Journal of Architectural Research*" 8(1), 66-77.

Ogeah, F. N. & Omofonmwan, S. I., (2013). Urban Markets as a Source of Employment generation in Benin city. "*African Journal of Social Sciences*" 3(4), 62-78.

Omer, S., (2005). *The Prophet Muhammad (PBUH) and Urbanization of Madinah*. Kuala Lumpur: IIUM press.

Polanyi, K., 1957. The Economy as an Instituted Process. In Trade and Market in the Early Empires: "*Economies in History and Theory*." Glencoe: Free Press.

Rapoport, A., 1977. Human aspects of Urban form: Towards man-environment Approach to Urban form and Design. Pergamon Press: Oxford

Roth, A. (2010.) Market Design Conclusion. s.l.: s.n.

Salama, A. M., Al-Nesf, B. E., Hasson, R. A. & Al Ramahi, H. R., (2008). Learning from Experience: Evaluating Sustainable and Spatial Characteristics of the Architecture of Shopping Malls in Qatar, Doha: Qatar National Research Fund.

Salama, A. M. & Wiedmann, F. (2013). The Production of Urban Qualities in the Emerging City of Doha: Urban SpaceDiversity as a Case for Investigating the 'Lived Space.' *Archnet-IJAR International Journal of Architectural Research*, 7(2), 160-172.

Shakur, T., Hafiz, R., Vrual-arslan, T. & Cahantimur, A. (2012). Economy and culture in transitions: A comparative study of two architectural heritage sites of bazaars and hans of Bursa and Dhaka. "*International Journal of Architectural Research*"6(3), 1-18.

Shuhana, S. & et al, (2004). Criteria for Successful Traditional Shopping Streets: The Case of Kuala Lumpur.

Shuhana, S. & Ahmad Bashri, S., (2002). The Vanishing Streets in the Malaysian Urbanscape. In Pu Miao. Public places in Asia Pacific. s.l.: Kluwers Academic Press.

Stokols, D. & Shumaker, S. A., (1983). *People in places: A transactional view of Settings*. New Jersey: Lawrence Erlbaum Assoc.

Tuan, Y. F. (1977). "*Space and Place: The perspective of Experience"*. London: Edward Arnold.

Vural Arslan, T., (2015). Developing a Strategic Approach for Managing Sustainable Revitalisation in World Heritage Sites: Historical Bazaar and KhansDistrcit, Bursa - Turkey. "*International Journal of Architectural Research"* 9(1), 289–304.

INFORMAL SPACE-USE IN FORMAL LEARNING ENVIRONMENTS: CASE STUDY OF ARCHITECTURE DEPARTMENT AT AHMADU BELLO UNIVERSITY

Joy Joshua Maina[1]
[1]*Department of Architecture, Ahmadu Bello University, Zaria-Nigeria*

Recent changes in higher education (HE) has led to the evolution of learning activities taking place in virtually every space on campus-from formal environments such as classrooms, libraries and lecture theatres to informal settings such as spaces in between buildings, cafes and social spaces. Few studies report the way students employ informal spaces for formal learning purposes in Sub-Saharan Africa, a region with increasing rates of HE enrolment. To this end, the study, conducted in a design related discipline at the oldest department of Architecture in Nigeria employs documentation of space use via participant observation, interviews and a questionnaire survey to establish ways students integrate informal spaces in HE learning. Results reveal that studios, classrooms and lobbies are employed for informal individual and group learning purposes. Such informal spaces are not designed nor optimally modified to cater to informal learning in terms of comfortable seating, natural lighting and ventilation, Internet connectivity and availability of electrical charging points. Additionally, traditional media such as textbooks, notebooks, drawing sheets, modelling materials and jotters are still relevant in a technological era for design related disciplines. The paper recommends that such features be carefully integrated within formal academic buildings during design as well as refurbishments and renovations of already existing structures to adequately enhance sustainable HE learning and educational environments in future.

Keywords: architecture, environments, informal spaces, learning, space use

INTRODUCTION

The way we learn is changing as a result of many factors: shifts in educational paradigms of learning, changing student characteristics /demographics, a trend towards knowledge based economies and increased funding for Higher Education (HE) especially in developing countries as well as pressure from employers relating to the decline in quality of

[1] jjmaina@abu.edu.ng

Maina, J. J. (2017) Informal space-use in formal learning environments: case study of architecture department at Ahmadu Bello University *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 930-944

graduates (Oblinger, 2006; Chism, 2006; Radcliffe, 2008; Al Ohali & Al Aqili, 2010; Crook & Mitchell, 2012; McDaniel, 2014). Shifts in educational pedagogy from a teacher-focused curriculum or 'sage on stage' to a more learner-centered pedagogy have encouraged the use of virtually every available space on campus for learning especially where technology and the internet are present (Andrews & Jones, 2015). Contemporary students' characteristics have also drastically changed in the last decade, leading to the terms Net Generation or Digital Natives (Oblinger & Oblinger, 2005; Jones, Ramanau, Cross & Healing, 2010). Students also come into HE favoring the learning style they exhibit in their personal lives. This is often social, active, participatory, Internet dependent and experiential, with a lot of time constraints as many work, commute and have outside responsibilities (Oblinger, 2006; Lomas & Oblinger, 2006). The consequence on HE is a general move towards providing learning spaces that foster favorable conditions for learning that is social (Crook & Mitchell, 2012) and flexible.

A lot of experimentation and case studies on informal learning spaces (ILS) have been undertaken in countries such as the United States, United Kingdom and Australia. The vast majority of these case studies focus on libraries, cafes, Student Commons and Union buildings (Ellis & Goodyear, 2016) with few examples within faculties, lecture rooms and spaces where traditional academic functions of lectures and seminars occur. These arguably constitute the majority of academic related buildings on university campuses. Research on how these spaces are designed for traditional academic use is important because emerging research suggests that the majority of student learning occurs outside of lecture and seminar sessions (Cotterill, n.d.). Teaching the traditional way involves the usual form of lectures and discussions requiring physical presence of both teacher and student (Dimitros, Labros, Nikolaos, Maria & Athanasios, 2013). It refers to "a teacher-centered approach where students follow a strict set of instructions, with perhaps little understanding of the purpose therefore, and in the case of practicums, many students are not able to produce satisfactory interpretation of the observations of results" (De Wet and Walker, 2013, p. 1). The implication is that "linear instruction from teacher to student in the form of lectures, tutorials and seminars will fail to achieve the most important educational objectives" (ibid p. 48).

It is therefore important to understand ways in which spaces designed for traditional teaching and learning purposes support or hinder current student learning activities (Crook & Mitchell, 2012) as students in the Nigerian context are still taught following the traditional teacher centered pedagogy (Cabaces et al. 2014) but are exposed to informal experiential learning styles via availabiltiy of ICT facilities and social media (Ejechi, 2014; Abubakar, 2010). Little research efforts on how students employ spaces designed for traditional education for informal learning purposes have been undertaken in developing countries especially Sub-Saharan Africa and Nigeria despite the increase in HE enrollment rates (McCowan, 2014; British Council, 2014) as well as changing teacher-student

characteristics in terms of ICT usage (Ejechi, 2016; Andrews & Jones, 2015; Abubakar, 2010). Specifically, studies establishing qualities of ILS from the student perspective are few (Ellis & Goodyear, 2016). Establishing these qualities is important in order to aid construction and university management professionals in the design and renovations of contemporary HE buildings and structures for future campuses. Consequently, this paper poses the following research questions: Which categories of ILS are most popular in formally designed environments in the study area? What activities occur within such spaces? What qualities and amenities make such spaces popular? The Department of Architecture at Ahmadu Bello University was chosen as a case for this explorative study because it is the oldest school of Architecture in Nigeria and home to leading professionals of design in the largest university south of the Sahara (ABU, 2011). It has also been recently renovated in part to improve on student learning in a digital age. The architecture curriculum centers on the design studio. Classrooms, a library, staff offices and other spaces serve as support facilities.

This paper is structured into five sections after the introduction. The succeeding section presents examples of similar case studies, followed by the methodology adopted for the study. Sections four, five and six present results and discussions from the study, conclusions and references respectively.

LITERATURE REVIEW

Learning connotes what students do when engaged purposefully in an educational setting (Ellis & Goodyear, 2016). Successful learning usually results in understanding a phenomenon, process, principle, mechanism or event and/or acquiring a skill or ability to complete a task. Informal learning spaces (ILS) sometimes called social learning spaces are spaces where learning occurs without formal supervision and instruction by a teacher or instructor. These spaces can be physical, virtual or hybrid, the latter being a combination of the first two (Ellis & Goodyear, 2016). Physical learning environments include "physical elements, features and spaces that support self-directed learning activities undertaken by students outside their classroom period" (Ibrahim & Fadzil, 2013, p. 345). It is space "where students meet, without teacher supervision, usually outside of scheduled class time" (Ellis & Goodyear, 2016, p. 165). Virtual learning spaces relate to online environments and how these foster learning in Human Computer Interaction (HCI), learning sciences and Computer Supported Collaborative Learning (CSCL) research (Ellis & Goodyear, 2016). Hybrid spaces combine both physical and virtual environments as learning spaces often in traditional spaces designed for formal traditional pedagogy, which have been transformed to cater to changing student needs (Andrews & Jones, 2015; Oswald & Hammons, 2008). Riddle and Souter (2012) note that some HE institutions do not have adequately designed spaces that foster community and collaborative learning.

Consequently, the use of space in HE is under-represented and under-researched (Temple, 2007). Associated with this lack of representative research is a deep fracture in conceptualization of university space (Ellis & Goodyear, 2016). Although available literature has been categorized in two broad themes-abstract space and salient experiential qualities (ibid), the distinction is often blurred as recent case studies exhibit qualities of both categories.

Studies that focus on abstract space generally aim at providing quantitative data to aid improvements in planning and management of university spaces. These are usually in the form of quantitative measures of observable behaviors as well as space usage patterns (ibid). Matthews, Andrews, & Adams (2011) report that the use of ILS at the University of Queensland correlates positively with levels of student engagement, specifically cohort identity and peer interaction. Student feedback during the review process had revealed a lack of informal spaces to support interaction for science students. Similarly, Kumar and Bhatt (2015) found that the library is no longer the main reading space at the Indian Institute of Technology, Delhi. Students remotely access information from the library for academic purposes in ILS. A good number of students also feel ILS are equivalent to the library.

Studies in the second category attempt to relate salient experiential qualities of specific learning spaces to activities as well as good learning outcomes using qualitative observations and interviews to understand the dynamics of human users and the artifacts/materials employed to perform learning tasks. Hunter & Cox (2014) report similar findings in a study of an open space and a coffee shop within the Students' Union building and a café within the Information Commons building at the University of Sheffield. The study also reports students often in groups spend less than an hour filling gaps between scheduled activities or over four hours studying. The latter indicates that ILS are their main study base. Background atmosphere was found to be both the main positive and negative quality of ILS. Activities observed include individual reading, group discussions and collaboration with staff. Findings also suggest that better access to technology may not be the reason for choosing to study in ILS. This finding is collaborated by Harrop & Turpin (2013) who note that the proportion of learners using ILS without technology in Learning Centers at Sheffield Hallam University was significant. Observed levels of laptop usage were lower than expected, but higher where students readily access plug points. Students also preferred access to food/drinks, comfortable seating and working surfaces, good natural lighting as well as flexible layouts. Respondents in Gebhardt's (2014) study of the HEDCO building in the College of Education, University of Oregon also noted natural lighting, comfortable booth seating, social ambience as well as the fireplace (ambient temperature and a sense of hearth/home) as features that attract them to the building for individual/group study and socialization. These foster a sense of community. Results from the study suggests that while ILS in the building encourage student success and community in the form of individual

and group learning activities, collaborative activities between staff and students may require more formal quiet environments with relatively controlled noise levels and minimal chances for interruptions. Overall, McDaniel (2014) notes the following qualities as vital in supporting the ideal ILS: Flexibility to allow students to adapt the spaces to their individual preferences throughout the course of the semester as student needs change over time. Students have been shown to prefer a sense of ownership over their space. Spaces should be fitted with comfortable furniture, varieties of table sizes, access to food and drink and a more casual, relaxed atmosphere in contrast to formal instructional spaces. ILS such as lounges, study rooms, courtyards and other auxiliary facilities should be located in close proximity to specialized classrooms. These serve as break out spaces for further discussion, collaborations and personal study.

METHODOLOGY

In order to achieve the aim of the study, which was to establish qualities of ILS conducive to student learning, the two thematic approaches discussed in literature were employed. The first regarding salient and experiential qualities of ILS, a qualitative survey, explored the study setting to obtain a basic understanding of how students employ ILS in the department via participant observation. This was conducted between May and June 2016. Visual sweeps of functional spaces were conducted in two-hour intervals for a period of eight weeks in the middle of the semester. Students were also approached to proffer reasons for using a specific space in the form of interviews. This first stage was instrumental in generating an overall picture of space use within and around the department. Results from this section are presented as a descriptive narrative with quotes from students where necessary.

To quantitatively establish these observations in line with the second theme regarding abstract space, a self-administered questionnaire survey was conducted between June and August 2016. The questionnaire, adapted from Kumar and Bhatt (2015) as well as Randall and Wilson (2008) solicitied information regarding demographics (department/faculty, gender and level of respondent) and data to address the research questions. Space used in the department while filling the form, the number of times the space was used in a week and the length of stay per visit addressed the first research question. Data on activities and tools/media employed when using the space addressed research question two while amenities and atmospheric conditions which influence and impact the use of ILS in the study area was employed to address the third research question. Results from these sections are presented as descriptive statistics in form of counts (N) and percentages (%). A correlation analysis was also conducted to establish the observed relationship between favorite space and space used while filling the questionnaire. The target population included students from within and outside who were found using these spaces during the timeframe of the study, a common approach employed by similar studies reviewed. 250

questionnaires were distributed within ILS in September 2016. 180 were retrieved and 172 valid cases employed for analysis.

RESULTS AND DISCUSSION

Results from observations

Architecture is one of seven departments in the Faculty of Environmental Design situated in the academic core of the Samaru main campus. The departments of Building, Urban and Regional Planning (URP), the university library and the Faculty of Engineering border it. The department of Architecture is housed in two three-story concrete structures. The first, directly opposite the department of Building accommodates the undergraduate administrative section, staff offices and technical workshops on the ground floor. The first floor contains three professorial offices, the library (popularly known as the Data room), postgraduate administrative offices, a concourse for presentations, and a boardroom adjacent to the Head of Department's office. The third floor is made up of staff offices and classrooms for lectures. All floors except the fourth floor containing studios are linked by a staircase, which opens up to a central lobby linking the aforementioned spaces. Toilets are located directly opposite the staircase landing on all floors (Figure 1). Access to the department on the ground floor is through the car park or another lobby to department of Building. The second structure, directly opposite URP houses Faculty offices on the ground floor. The remaining three floors are taken up by studios, which at the time of this study between March and June 2016 were not accessible due on-going renovation works.

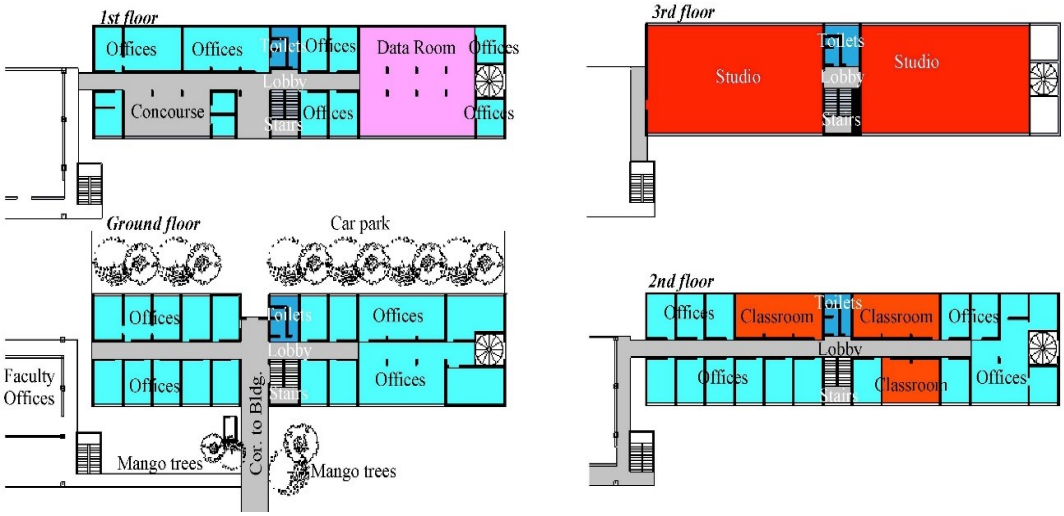


Figure 1: Layout of the study area

Observations of activity patterns and space use reveal two trends of informal space use in formally designed spaces for informal learning purposes. The first is that students use available free spaces in the department for learning and academic purposes during formal office hours between 8am to 4pm. During timetabled hours when classrooms and studios are officially in use for lectures and formal teaching, students were observed

to employ circulation areas notably lobbies and the concourse for informal discussions. The corridor leading to the department of building was popular for informal social discussions during the day largely because of the presence of cool shaded areas under mango trees, concrete seats and convenience to the main entrance into both departments. Few encounters of students discussing assignments were also observed on the staircase. A student noted that discussions on the staircase occur largely due to the lack of space for serendipitous and private discussions in the department. The data room is another favorite study space but is restricted to formal study. The informal socially related learning is often difficult as a no-noise policy is expected within the library, which is closed at the end of each working day.

The second trend of informal space use reveals that students convert formal spaces to informal learning spaces after official hours for learning purposes whenever the need arises and the space is available and conducive for such activities. Both individuals and groups occupy classrooms for assignments and collaborations whenever lectures were not being delivered despite the rigid seating arrangement. Many students noted the seating as uncomfortable and unsuitable for group meetings. Nonetheless, classrooms were always occupied at any given time during the day mainly due to internet connectivity and power charging points/outlets. These two amenities constitute a major attraction for informal learning as most students own laptops and mobile phones employed online for assignments and access to social media. This was also true for studios, which were found to be multi-functional in nature and used throughout both day and night for drawing, modeling, group discussions and collaborations. This is expected for architecture and design related courses. Qualities that attract students to the studios include ample light from curtain walls spanning the entire southern and northern elevations, flexible space, spacious room and cross ventilation. A few students noted discomfort in the form of glare and overheating in the afternoon along studio walls. Noise was also cited as a disadvantage when using studios as ILS especially for personal study. Security related problems with students from other departments taking up limited studio tables were also observed. This occurred largely because the studios are open 24 hours, making it an attractive alternative to students from allied disciplines that also require drawing space and tables. The department is however currently taking proactive steps to ensure only architecture students have all day access to the studios.

Results from the questionnaire survey

Results from the questionnaire demographics reveal over half the respondents are students from the department despite a relatively large number of missing responses for this variable (Table 1). Non-architecture students account for only 12% of the sample and are unlikely to skew overall findings as half of that number are from design related departments in the faculty. 70% of the respondents are male while 200 and 300 level undergraduate students filled out the questionnaire more than other levels.

In response to the first research question regarding the most popular ILS, studios were revealed to be most popularly used space, followed by classrooms in the department (Table 2). A high positive correlation, r (5) = 0.99 was established between favorite space and the space used to fill the questionnaire, supporting observations of space use described in the foregoing section. This trend is reflected in the number of visits and length of stay for these spaces.

Table 1: Demographic profile of questionnaire respondents

Demographic variable		N	%
Department	Architecture	89	52
	Within Faculty of Environmental Design	11	6
	Students from Other Faculties within ABU	10	6
	Missing	62	36
Gender	Male	121	70
	Female	28	16
	Missing	23	14
Level	100	20	12
	200	37	21.5
	300	35	20
	400	24	14
	500 (MSc I)	17	10
	600 (MSc II)	26	15
	Missing	13	7.5

Table 2: Favorite ILS, space in use when filling the questionnaire, number of visits and length of stay

Space	Favourite ILS		ILS in use		Number of visits				Length of stay			
	N	%	N	%	1-3x	4-6x	7-10x	10+	1/2-2hrs	3-4hrs	> 4hrs	Depends on Mood
Studios	58	34	95	55	19	26	25	18	28	16	17	33
Classrooms	34	20	41	25	7	12	5	15	12	7	4	10
Data Room	15	9	23	14	15	8	0	0	8	7	2	5
Mango tree/cor. to bldg.	11	7.5	4	2	2	1	0	0	2	0	1	1
Corridors/lobbies/stairs	5	3.5	3	2	1	0	1	0	0	0	0	0
Car park/rooftop	4	2	3	2	0	1	1	0	0	1	0	1
Concourse	4	2	0	0	0	0	0	0	0	0	0	0

Overall, individual study and internet-use were the dominant informal learning activities reported by respondents (Table 3). These are followed by group work and collaborative efforts between students. Traditional writing and drawing media in form of notebooks, textbooks, drawing sheets, jotters, modeling materials and sketch pads are employed extensively in spite of the availability of technological tools such as laptops, mobile phones and tablets.

Table 3: Activities and media/tools in ILS

	Activities						Tools			
	Individua study/ internet use	%	Group work/ collaborat on	%	Meet witl friends/ taking a break	%	e-tools (laptop, mobile phone, tablet, e- notes)	%	Traditional tools (notebooks, textbooks, drawing sheets modelling materials, jotters, sketch pads, cardboard)	%
Studios	105	55	60	60	26	50	141	53	215	70
Classrooms	52	27	27	27	19	37	72	27	48	16
Data Room	31	16	5	5	2	4	37	14	34	11
Mango tree/cor. to bldg	0	0	3	3	1	2	3	1	2	1
Cor./lobbies/stairs	2	1	0	0	1	2	5	2	5	2
Car park/rooftop	2	1	5	5	3	6	6	2	4	1
Total	192		100		52		264		308	

In response to the third research question, qualities that make ILS popular in the study area include the presence of internet connectivity, sufficient ventilation, sufficient day lighting and comfortable seating (Table 4). These had between 40-50% response rates. Noise and distraction had a negative influence for learning in ILS.

Table 4: Amenities and atmosphere

Amenities/atmosph ere	N	%	Positive impact	N	%	Negative impact	N	%
Internet connection	88	52	Sufficient ventilation	82	49	Noise/distraction	89	53
Freedom to relax	73	43	Sufficient daylight	71	42	Busyness	48	28
Social networking	43	25	Comfortable seatin	67	40	Impractical for studying	31	18
Information in e-form	31	18	Convenience	61	36	Unavailable study mat	27	16
Collaboration with staff	8	8	Informality	56	33	Poor ventilation	24	14
			Design of space	44	26	Uninspiring views	16	10
			Sense of escapism	18	11	Inconvenient locatio	12	7
			Food & drink	10	9	Poor day lighting	9	5

DISCUSSION

Formally designed spaces will be employed informally if amenities and atmosphere are conducive to learning

Results from the both surveys reveal that informal learning activities will take place anywhere in the department providing the atmosphere and environment are conducive. Two insights can be garnered from this finding. First, results reveal that studios were the most favorite ILS in the study, closely followed by classrooms and the data room (Table 2). This was supported by corresponding amounts of time spent and number of visits paid by students to these spaces. This implies that spaces employed in traditional pedagogical training notably studios and classrooms will be converted for informal learning purposes in architecture especially when spaces designed for informal learning are not available. The tendency for this transition from formal to informal space use for learning increases with the availability of facilities considered indispensable to a technologically aware generation, notably internet connectivity/charging points, sufficient ventilation and daylight as well as comfortable flexible seating. This supports findings by Hunter & Cox (2014), Gebhardt (2014) and McDaniels (2014). The implication for design professionals in Nigeria and Sub-Saharan Africa is that changes in learner activities have to be speedily considered in the future designs of academic buildings in spite of the relatively slower progress observed in educational pedagogy, as findings from this case study reveal that students will use formal spaces such as the design studio informally. Designers need to anticipate and incorporate facilities and amenities conducive to contemporary campus students. Practical instances are the design of staircases not only for vertical movement but also for study and possible interactions. Corridors and lobbies between offices and lecture rooms need to incorporate breakout spaces for discussions (ibid) while controlling for the effects of noise and distractions for traditionally more private zones in academic environments. Learning Spaces (n.d., p. 71) notes, "Learning can and should happen everywhere in campus-from the classroom to the library to faculty offices. In between these destination sites are lounges, hallways and informal areas that can be so much more than transition spaces".

Secondly, studios are considered the primary instruction and learning space for architecture and design related disciplines largely because design studio is at the core of the architecture curriculum (Bashier, 2014; Nazidizaji, Tome, & Regateiro, 2014; Ibrahim & Utaberta, 2012). This suggests that core spaces for formal instruction or learning have high tendencies to be employed informally by students due to the large amount of time spent and number of visits paid them. Design for studios and indeed other core instructional spaces namely classrooms, lecture theaters etcetera will greatly benefit from more in-depth studies especially in developing countries where the pedagogy is still largely teacher-centric in a generation of students whose learning styles are becoming more experiential, technological and social in nature.

Traditional media is still relevant in a technological age

Contrary to the pervading belief that students on campus generally prefer digital media, traditional media of learning are still commonly used for learning purposes as revealed by this case study (Table 3). This result supports the findings of Hunter and Cox (2014), as well as Harrop and Turpin (2013). The implication on design is that future learning environments for architecture and design related disciplines may require creative incorporation of flexible furniture and spaces for both traditional modes of learning and digital technology as emphasized in literature. "Traditional soft seating and rigid hallway chairs are limiting and typically poorly suited for the work done in today's in-between spaces . . . people are most comfortable and most productive . . . when furinture easily adjusts to suit various workstyles and postures (Learning Spaces, n.d., p 71).

CONCLUSIONS AND RECOMMENDATIONS

This study set out to investigate student views on informal space use in formally designed educational facilities on campuses to inform future design policies using the department of Architecture, Ahmadu Bello University, Zaria-Nigeria. Results reveal that studios, classrooms and the library are the favorite ILS, with a high correlation between space use and time spent within them. Breakout spaces such as corridors, lobbies, outside open spaces as well as the staircase also featured as ILS. The study also reports that traditional media are still in use by students. Physical qualities/amenities conducive for ILS are internet connectivity/charging points, good ventilation and daylight as well as comfortable, flexible seating.

Consequently, the study recommends a change in paradigm for built environment professionals regarding future designs of academic structures especially in design related courses to cater to the current needs of students. Specifically, the study recommends maximizing break-out spaces such as lobbies, corridors, staircases and open spaces with internet connectivity, charging points and provision for comfortable seating to leverage on collaborative opportunities while controlling for noise and movement. The creative design of furniture and work areas in between major formal lecture destinations will also go a long way into maximizing educational facilities in future. Further research in other disciplines and campuses across the region will also provide designers with a wider variety of ideas for improving the learning experience of contemporary campus students.

Study Limitations

This was a case study conducted in a single department and discipline. Results can therefore not be generalized across campus facilities. More studies regarding the impact of ILS on student learning in other disciplines is essential to obtain a holistic view of the relationship between ILS and student learning experiences.

REFERENCES

ABU (2011). ABU Postgraduate Students' Handbook (2011-2013). Zaria: Ahmadu Bello University.

Abubakar, B. M. (2010). Availability and Use of Information Communications Technology (ICT) in Six Nigerian University Library Schools. Library Philosophy and Practice, Paper 378, 1-5.

Al Ohali, M. B., & Al Aqili, A. B. (2010). Higher Education in Saudi Arabia 1998-2008: Towards Building a Knowledge Society. In B. Lamine (Ed.), Proceedings of the Arab Regional Conference in Higher Education (31 May-2 June 2010),Towards an Arab Higher Education Space: International Challenges and Societal Responsibilities, 739-759. Cairo: UNESCO.

Andrews, J., & Jones, M. (2015). What's Happening in 'Their Space'? Exploring the Borders of Formal and Informal Learning with Undergraduate Students of Education in the Age of Mobile Technologies. Journal of Interactive Media in Education, 1 (16), 1-10.

Bashier, F. (2014). Reflections on architectural design education: The return of Rationalism in the Studio. Frontiers of Architectural Research, 3, 424-430.

Bickford, D. J., & Wright, D. J. (2006). Community: The hidden Context for Learning. In D. G. Oblinger (Ed.), Learning Spaces, 4.1-22. Boulder, CO: EDUCAUSE.

Blackmore, J., Bateman, D., O'Mara, J., & Loughlin, J. (n.d.). The connections between learning spaces and learning outcmes: people and learning places? Retrieved January 27, 2017, from http://www.learningspaces.edu.au/learningspaces-literature-review.pdf

British Council. (2014). Postgraduate Student Mobility Trends to 2024. British Council: Education Intelligence.

Brooks, D. C. (2011). Space Matters: The impact of formal learning environments on student learning. British Journal of Educational Technology, 42 (5), 719-726.

Cabaces, J., Blanco, A. J., Cabanas, J. E., Casapao, C. G., De Guzman, J. P., De Villa, M. A., et al. (2014). Perception of Nigerian Students towards Outcome-Based Education. International Journal of Academic Research in Progressive Education and Development, 3 (1), 208-219.

Cavetello, J., Dugdale, S., Felix, E., Holeton, R., & Meyers, C. (2013). Learning Spate Rating System . Retrieved January 26, 2017, from EDUCAUSE: http://www.educause.edu/eli/initiatives/learning-space-rating-system

Chism, N. V. (2006). Challenging Traditional Assumptions and Rethinking Learing Spaces. In D. G. Oblinger (Ed.), Learning Spaces, 2.1-12. Boulder, CO: EDUCAUSE.

Cranz, G., Taylor, A. & Broudehoux, A. (1997). Community and Complexity on Campus. Places, 11 (1), 39-51.

Cotterill, S. (n.d.). An exploration of the impact that the educational environment has on student learning. Retrieved June 1, 2016 from http://www.winchester.ac.uk/Studyhere/ExcellenceinLearningandTeaching/research/e-journals/Documents/An%20exploration%20of%20the%20impact%20that%20the%20educational%20system%20has%20on%20student%20learning.pdf

Crook, C., & Mitchell, G. (2012). Ambience in social learning: student engagement with new designs for learning spaces. Cambridge Journal of Education, 42 (2), 121-139.

de Oliviera, J. M., Henriksen, D., Castaneda, L., Marimon, M., Barbera, E., Monereo, C., et al. (2015). The educational landscape of the digital age: Communicationn practices pushing (us) forward. RUSC Universities and Knowledge Societies Journal, 12 (2), 14-29.

De Wet, L. & Walker, S. (2013). Student Perceptions of Problem-Based Learning: A Case Study of Undergraduate Applied Agrometeorology. ISRN Education, 2013, Article ID 982942, 1-9.

Dimitros, B., Labros, S., Nikolaos, K., Maria, K. & Athanasios, K. (2013). Traditional teaching methods vs. teaching through the application of information and communication technologies in the accounting field: Quo Vadis? European Scientific Journal, 9 (28), 73-101.

Echenique, E. G. (2014). An investigation of the social and academic uses of digital technology by University students. Universitat Rovira i Virgili, Department of Pedagogy. Tarragona: Universitat Rovira i Virgili.

Ejechi, E. O. (2016). Information Communication Technology: Are Nigeria's University Students Using It More for Social and Leisure Activities? International Journal of Humanities and Social Science, 6 (5), 67-73.

Ellis, R. A., & Goodyear, P. (2016). Models of Learning Space: Integrating Research on Space, Place and Learning in Higher Education. Review of Education, 4 (2), 149-191.

Gebhardt, C. (2014). The Spaces Between the Rooms: A Post Occupancy Evaluation of Informal Social Spaces in the HEDCO Education Building. Unpublished thesis (B. Arch.), University of Oregon, Department of Architecture. Portland: University of Oregon.

Graham, C. (2012). Transforming spaces and identities: the contributions of professional staff to learning spaces in higher education. Journal of Higher Education Policy and Management, 34 (4), 437-452.

Hanover Research. (2010). Flexible Teaching and Learning Spaces-Trends and Best Practices. Retrieved January 26, 2017, from Hanover Research: http://www/planning.salford.ac.uk/_data/assets/pdf_file/0020/20774/Flexible-Teaching-and-Learning-Spaces-Trends-and-Best-Practices-Membership.pdf

Harrop, D., & Turpin, B. (2013). A study exploring learner's informal learning space behaviours, attitudes and preferences. New Review of Academic Librarianship, 19 (1), 58-77.

Hunter, J., & Cox, A. (2014). Learning over Tea! Studying in Informal Learning Spaces. New Library World, 115 (1-2), 34-50.

Ibrahim, N. L., & Utaberta, N. (2012). Learning in Architecture Design Studio. Procedia: Social and Behavioral Sciences , 60, 30-35.

Ibrahim, N., & Fadzil, N. H. (2013). Informal Setting for Learning on Campus: Useage and preference. Procedia: Social and Behavioural Sciences, 105, 344-351.

Jones, C., Ramanau, R., Cross, S., & Healing, G. (2010). Net Generation or Digital Natives: Is there a distinct new generation entering university? Computers and Education, 54, 722-732.

Krishnan, S. (2015). Student-Centered Learning in a First Year Undrgraduate Course. International Journal of Learning, Teaching and Educational Research, 11 (2), 88-95.

Kumar, A., & Bhatt, R. K. (2015). A Study of Using Informal Learning Spaces at Indian Institute of Technology, Delhi (Paper 1239). Library Philosophy and Practice, 1-17.

Learning Spaces (n.d.). Learning spaces in between. Retrieved January 27, 2017, from https://www.k12blueprint.com/sites/default/files/informal_learning_spaces_in-between_0.pdf

Lomas, C., & Oblinger, D. G. (2006). Student Practices and their impact on Learning Spaces. In Diana G. Oblinger (Ed.) Learning Spaces, 5.1-11. Boulder, CO: EDUCAUSE.

Matthew, I. A. (2014). The Challenges of Being a Student of any Public Tertiary Institution in Nigeria of today. Journal of Studies in Education, 4(1), 128-141.

Matthews, K. E., Andrews, V., & Adams, P. (2011). Social learning spaces and student engagement. Higher Education Research and Development, 30 (2), 105-120.

McDaniel, S. (2014). Every space is a learning space; Encouraging informal learning and collaboration in higher education environments. Knowledge Series, 1-8.

Nazidizaji, S., Tome, A., & Regateiro, F. (2014). Search for design intelligence: A study on the role of emotional intelligence in architectural design studios. Frontiers of Architectural Research , 3, 413-423.

Neto, P., Vieria, A., Ribeiro, L., & Pinto, M. (2013). The e-learning Cafe project of the University of Porto: Innovative learning spaces, improving students' engagement in active collaborative learning. eLearning Papers, 34, 1-8.

Oblinger, D. G. (2006). Space as a Chage agent. In D. G. Oblinger (Ed.), Learning Spaces, 1-4. Boulder, CO: EDUCAUSE.

Oblinger, D., & Oblinger, J. (2005). Is it Age or IT: First Steps Toward Understanding the Net Generation. Retrieved January 27, 2017, from EDUCAUSE.edu: http://judicialaffairs.tamucc.edu/assets/IsItAge.pdf

Ojogwu, C. N., & Alutu, A. G. (2009). Analysis of the Learning Environment of University Students in NIgeria: A Case study of University of Benin. Journal of Social Sciences, 19 (1), 69-73.

Oswald, L., & Hammons, A. (2008). Transforming Informal Learning Spaces. EDUCAUSE 2008 Annual Conference, 102B Centennial Hall, Missouri University of Science and Technology on Thursday, October 30, 2008, 1-9. Rolia, MO: EDUCAUSE.

Radcliffe, D. (2008). A Pedagogy-Space-Technology (PST) Framework for Designing and Evaluating Learning Places. In D. Radcliffe, H. Wilson, D. Powell, & B. Tibbetts (Ed.), Procs. of the Next Generation Learning Spaces 2008 Colloquium, 11-16. Brisbane: University of Queensland.

Randall, M., & Wilson, G. (2008). Making it My Street: The Bond University "Street" Area. In D. Radcliffe, H. Wilson, D. Powell, & B. Tibbetts (Eds.), Learning Spaces in Higher Education: Positive Outcomes by Design, Procs. of the Next Generation Learning Spaces Colloquium, 107-110. Brisbane: University of Queensland, Australian Learning and Teaching Council.

Riddle, M. D., & Souter, K. (2012). Designing Informal Learning Spaces using Student Perspective. Journal of Learning Spaces, 1 (2), 1-6.

Rooke, J., & Kagioglou, M. (2007). Criteria for Evaluating Research: The Unique Adequacy Requirement of Methods. Construction Management and Economics , 25 (9), 979-987.

Wilson, H. (2008). The Process of Creating Learning Space. In D. Radcliffe, H. Wilson, D. Powell, & B. Tibbetts (Ed.), Procs. Next Generation Learning Spaces 2008, 19-24. Brisbane: University of Queensland.

INTANGIBLE ASSETS VALUATION IN NIGERIA: A REVIEW OF THE CONCEPT AND PRACTICE

Sodiya, Abiodun K.[1] , Adetokunboh, Olaseni O.[2] and Agbato, Samson E.[3]

[1,2,3]*Department of Estate Management & Valuation, Moshood Abiola Polytechnic, Abeokuta, Nigeria*

Asset valuation is an important aspect of valuation in Nigeria but little or nothing have been heard about the way and manner in which intangible components in such valuations are handled in Nigeria most especially at this time that debate about its value measurement and reporting to external user is gaining renewed interest. This study assesses rate of asset valuation relative to other valuation instructions received by Valuers in the study area, the level of familiarity of the real estate practitioners with various classifications of intangible assets as well as identification criteria, approaches and methods adopted. Structured questionnaire was administered on 300 registered Estate Surveying and Valuation firms in Lagos and Federal Capital Territory out of which 227 were retrieved and found good for analysis. The data obtained were analysed using simple descriptive and weighted mean score. The findings revealed that much importance is not attached to intangible assets in value creation process. Some practitioners are unfamiliar with the criteria for identifying intangible assets while some considered it convenient to summarize intangible assets as goodwill therefore avoiding conduct of in-depth analysis using appropriate valuation approaches and methods. It is therefore suggested that expertise development and specialization should be encouraged in the profession to ensure valuations involving such volatile form of assets are handled by competent and experienced valuation analysts.

Keywords: estate surveyors, non-physical asset, valuation approaches, valuation methods, valuers

INTRODUCTION

The term intangible asset is a concept to which no unanimous agreement exists on its definition. They are non-physical assets which can neither be seen nor felt yet have a value. Their contribution and significance to business organizations and government corporate investments amongst

[1] abiodun.sodiya@yahoo.com
[2] detokunboh@gmail.com
[3] samsonagbato@yahoo.com

Sodiya, A. K., Adetokunboh, O. O. and Agbato, S. E. (2017) Intangible assets valuation in Nigeria: a review of the concept and practice *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 945-960

others is irrefutable as highlighted by various authors (Hall 2000; Bookstaber, 2007; Lopez & Gomes-Rodrigues, 2007; Namakura, 2008). In fact, many technological and science based organizations derive greater portion of their value from them (Lopez & Gomes-Rodrigues, 2007).

There are different angles to intangible assets discussions depending on who is involved. For Financial Accountants, the subject has been discussed since 1950s (Artsberg & Mehtiyeva, 2010). Meanwhile, Lopez and Gomes-Rodrigues (2007) believed it emerged around two decades ago as an important phenomenon in business organizations, asset valuation discourse and accounting theories. More so, there exist differences in the manner in which some balance sheet elements are considered and treated by Accountants and Valuers. In preparing financial performance and net worth of a business, assets and liabilities are reported at their net book value by the former while the latter reports the assets at their current market value. Accountants treat goodwill as an asset provided it will be written off from the balance sheet but from the point of view of the Valuer, goodwill always remain in the organization unless adverse business conditions turn it to zero or even bad will (Ezeude, 2003).

As important as intangible assets are considered, they are normally excluded in annual financial reports due to the volatile nature of the assets and considerable difficulties in their value measurement thereby providing incomplete information for the users of the document (Lopez & Gomes-Rodrigues, 2007; CGMA, 2012; Omoye, 2013). Meanwhile, some scholars have noted that for financial statement to become value relevant in this modern time, recognition of intangible assets is imperative (Mandel, Hamm & Farrel, 2006; Bookstaber, 2007; Zeghal & Maaloul, 2011). The extent of consideration given to this class of assets in the general valuation practice are shrouded in mist as little have been revealed from available studies. Lately, the topic on intangible assets value measurement and reporting to external users have been gaining renewed interest in financial accounting through a number of relevant studies, hence, the need to assess the general practice in intangible asset valuation among the Valuers with a view to addressing relevant challenges as it affects value measurement.

The aim of the paper is to evaluate the concept and practice of intangible assets valuation among real estate practitioners (ESVs) in Nigeria. Thus, the objectives are to:

- assess rate or volume of asset valuation briefs relative to other valuation instructions received by Valuers in the study area,
- examine the level of familiarity of the real estate practitioners with various classifications and identification criteria relevant to intangible assets, and
- examine the conversance of Valuers with approaches and methods adopted in intangible asset value measurement.

LITERATURE REVIEW

Concept of Intangible Asset

Asset valuations are value estimation of all the tangible and intangible assets of an individual or company including land, building, plant and equipment, furniture and fittings, working capital, goodwill and other intangible assets for a variety of purposes. Such valuation may be required for company asset register, floatation of shares, merger and takeovers, liquidation and tax purposes amongst others. This description of asset valuation explains clearly that the term 'asset' comprises of two broad components, namely: tangible and intangible assets.

Intangible asset which is the focus of this work is defined by SAS 31 and IFRS 3 as "an identifiable non-monetary asset without physical substance". According to Blair and Wallman (2003), they are non-physical factors that contribute to or are used in the production of goods or the provision of services that are expected to generate future productive benefits to the individuals or firm that control their use. Typical intangible asset cannot be bought or sold in an organized market and are sometimes interlinked with a specific activity, product/service or business. The measurement of its value requires many technicalities as it is prone to fluctuations which are not common to physical assets. They cannot be touched, grasped, easily cost, counted and quantified (Blaug & Likki, 2009). Examples of these are brand name, computer software, copyrights, patents, trademarks, internet domain names, mastheads, customers list, books, magazines, pictures, maps, trade secrets etc.

In the work of Ogunba (2013), intangible assets summarily comprise of contract benefits, non-contractual benefits, goodwill and intellectual properties. This explanation about the composition of intangible assets stemmed from and in fact the same as the four categories as provided in IVSC (2007:204), namely: intangible assets arising from rights (contracts), relationships (non-contractual), grouped intangibles (goodwill) and intellectual properties.

Whenever Estate Surveyor and Valuers are commissioned to undertake asset valuation it is implied that regards will be given to the two basic components of assets (i.e. tangible and intangible). According to Ikedianya (2001), tangible components are the static, physical body of a business enterprise whose values are usually deduced through conventional asset valuation methodologies while intangible components are the 'spirit and soul' of the entity determined through her performance of Operation Efficiency Coefficient. This underscores the indispensability of the intangibles in determining the asset value of any business concern. As important as it is, valuation of intangibles usually stretch the professional skills of the valuer who is certainly more at home with the valuation of tangible elements (Ogunba, 2013). Though, the writer noted that recently Estate Surveyors and Valuers are becoming more skilled and experienced in valuing intangible assets, their proficiency is more or less limited to goodwill. Ezeude (2003) posited that more often than not, when undertaking

asset valuation, valuers tend to highlight only the physical assets while de-emphasizing the contribution of intangible assets or summarizing it simply as goodwill.

The concept of goodwill is often confused with intangible asset. Historically, intangible assets have been treated as an aggregated amount which is summarized as goodwill without impact on national wealth included in financial statement of firms (Lopez & Gomes-Rodriguez, 2007). Meanwhile, intangible assets are non-physical resources that can be identified, measured and managed (e.g. corporate brand name). On the other hand, goodwill represents residual intangible factors which cannot be identified or measured separately, e.g. a company's good reputation (Epstein & Mirza, 2005). Therefore, identifiable intangible assets cannot however be combined with goodwill (Grant Thornton, 2008). This obviously relates that goodwill is an intangible resource, but is different and not equal to intangible asset. This, however, questions the valuation practice mentioned by some scholars (Kuye, 2000 and Ezeude, 2003) that deals mainly with the assessment of tangible elements and goodwill as an answer to asset value.

The debate on recognition of intangible is upcoming and heated. Intangible assets have become the point of attraction to many organizations, investors, financial analysts, accountants, valuation analyst and regulations alike in recent times and this has spurred attempts to understand and streamline the gap between company's book of account and market value (Barton, 2005; Omoye, 2013). According to Zeghal and Maaloul (2011), if financial statements must become value relevant in this modern time, recognition of intangibles in the statement must be of essence. In fact, it is further noted by Omoye (2013) that businesses are being challenged by rapid industrialization and globalization to develop and acquire intangible assets as a survival strategy and a means of gaining competitive advantage amidst the dynamic business environment. To buttress this, Bookstaber (2007) gave an illustrative picture about the importance of intangible asset as compared to tangible asset. Summarily, he made manifest that hybrid corn seed, for instance, is *'80 percent science and 20 percent corn'*. That 80 percent of the value of such hybrid corn is constituted in the non-physical substance (science) and 20 percent physical (corn), referring to the extensive lab development behind its creation. In the same vein, Mandel et al (2006) also pointed out that though Apple computers sold more than 40million ipods in 2005 owing to the unique innovation and great design, however, published data did not capture in the value what Apple spent on research and development and brand development, which according to statistics totaled at least $800million in 2005 rather, they counted ipods. Meanwhile, the market price of ipod holds in it the "great design, technical innovation and brand recognition" which were brought about by research and development. These need to be properly identified and adequately accounted for as part of the effort (intangible assets) that gave the product its market value.

Identification and Classification

Classification criteria can never be true or false, only more or less useful according to suggested purpose (Rosing, 1978). Intangible assets have been

variously classified by scholars and standards. The classes of intangible assets based on NAB31 include; brand names, masthead and publishing, computer software, license and franchises, copyrights, patents and industrial property rights, services and operating rights, recipes, formulae, models, designs and prototypes and intangible assets under development. Collings (2011) in his view classify intangible resources to comprise assets such as licenses and quotas, patents and copyrights, computer software, trademarks, franchises and marketing rights. Meanwhile, Wyatt and Abenethy (2003) grouped intangible assets under four broad classifications: acquired intangible assets-this include acquired identifiable intangible asset (e.g. acquired patents and trademarks brand) and purchased goodwill that is acquired in business combination; research and development i.e. expenditures associated with R&D activities performed within the firm, expenditure for exploration, evaluation and development; internally generated intangible asset e.g. identified intangible asset produces by the firm and internal goodwill that is not that easily attributed as to its source of value etc. and intellectual property-which are subset of acquired and internally generated intangible asset e.g. patents, trademarks, designs, licenses, copyrights, firm rights and mastheads.

Levi (2001), writing in the tradition of intellectual capital classifies intangible into four groups namely:

i. Discovery/learning e.g. research and development
ii. Customer related e.g. brand, trademarks, distribution channels etc.
iii. Human resource e.g. education, training and compensation systems
iv. Organization capital e.g. structural organization design, business processes, unique corporate culture.

Walker (2009) concludes that it is difficult to find any stated purpose for classification in many papers that do classify intangibles. However, one purpose seems to be for management purpose. In order to manage successfully one has to make visible and put labels on different resources (Kaufman & Schneider, 2004). However, for a classification to be useful and accurate, there should rather not be any overlaps between the different categories. The Financial Accounting Standard Board (FASB) classification can be seen as particularly helpful in that regards as well as being more refined. FASB suggested classifications into the following seven categories:

i. Technology based assets
ii. Customer based assets
iii. Market based assets
iv. Workforce based assets
v. Contract based assets
vi. Organization based assets
vii. Statutory based assets

Identifiability is one unique characteristic that distinguishes intangible assets from goodwill. Only identifiable assets are recognized and accounted for independently while other non-physical unidentifiable assets are subsumed under goodwill. The two basic criteria to identifying intangible assets according to IFRS 3. B33 and IAS 38.12 are:

i. Capability of being separated or divided from the entity and sold, transferred, rented or exchange individually without selling the entity in its entirety.

ii. Availability of third party originated evidence of their existence (i.e. originating from legal or contractual right).

If the contractual legal criterion is not met, the intangible assets must be separable in order to be identifiable. Broadly, an asset is considered separable if it is capable of being sold or otherwise transferred without selling the entity. Where separation is possible only as part of a larger transaction, judgment is required to determine whether the items under review constitute the acquired business itself or part of it. For instance, the content of a database used by a provider of business intelligence may not be separable from the business itself- there would be no business remaining if the database content was sold to a third party. By contrast, where the content database is a by-product of the business activity and may be licensed out to a third party on non-exclusive terms, then this indicates separability. It is also relevant to note here that intangible assets are identified and measured individually, however, prevailing circumstances and available facts may make it preferable to combine similar assets for valuation purposes and subsequent accounting (Grant Thornton, 2008). A good example is a number of different patents which relate to same technology and contribute to the same income stream.

The below intangible asset categories highlighted overleaf is exactly similar to what is contained in IVSC (2017). It recognised that there are many intangible assets, but they are often considered to fall into one of the above five categories.

Other intangible resources are commonly found in business combinations, but do not meet the definition of an identifiable intangible asset. Examples are previously recognised goodwill, assembled workforce, synergies, market monopoly, market share, high credit rating amongst others. These resources are not capable of being separated and do not arise from contractual or legal right therefore are not considered as identifiable intangible asset, they are subsumed under goodwill within IFRS 3. Value is sometimes attributed to these items in order to determine the values of some other assets that do need to be recognised.

Examples of Items that meet Definition of Intangible Asset Based on Two Criteria

Class/Category	Items that meet definition of intangible asset based on two criteria
Market Related Intangible Assets	Trademarks, trade names, service marks, collective marks and certification marks #
	Internet domain names #
	Trade dress (unique colour, shape or package design) #
	Newspaper mastheads #
	Non-competition agreements #
Customer Related Intangible Assets	Customer lists*
	Order or production backlog #
	Customer contracts and the related customer relationships #
	Non-contractual customer relationship *
Artistic Related Intangible Assets	Plays, operas and ballets #
	Books, magazines, newspapers and other literary works #
	Musical works such as compositions, song lyrics and advertising jingles #
	Pictures and photographs #
	Video and audiovisual material including films, music video and television programmes #
Contract Based Intangible Assets	Advertising, construction, management, service or supply contracts #
	Licensing, royalty and standstill agreement #
	Lease agreement #
	Construction permits #
	Franchise agreement #
	Operating and broadcasting rights #
	Use rights such as drilling, water, air, mineral, timber cutting and route authorities #
	Servicing contracts such as mortgage contracts #
	Employment contracts that are beneficial contracts from the perspective of the employer because the pricing of those contracts is below their current market value #
Technology Based Intangible Assets	Patented technology #
	Computer software and mask works #
	Unpatented technology *
	Databases*
	Trade secrets such as secret formulas, processes or recipes #

Note:* #** and** denote items that are identifiable by satisfying the contractual-legal criterion and items that are identifiable by satisfying the separability criterion, respectively
Source: IFRS 3.IE16-44

Valuation Approaches and Methods

Specific valuation models and techniques have emerged for estimating values of intangible assets. These identifiable assets acquired in business are recorded by their acquirer at "fair value", therefore, the general

approaches and methods are targeted towards estimating fair value. Fair value is defined as the "amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction" (IFRS 3A). It is an estimate of the amount that would be paid or received on disposal of an item in a hypothetical transaction.

Valuation analysts have been valuing intangible asset independently for many years for the purposes of exchange between owners, estate or gift tax or as part of litigation assignment or for general consulting and transactional support engagements amongst others. Previous studies emphasize three basic approaches towards intangible assets value measurement, namely: cost, income and market approaches (Reilly & Schwechs, 1998; Cohen, 2005; Trugman, 2011; CGMA, 2012; IVSC, 2017). According to Holloway and Reillys (2012), for each intangible asset valuation, the analyst will typically choose the approach (or approaches):

i. for which there exist highest quantity and quality of data,
ii. that best reflect the actual transactional negotiation of market participants in the operators' industry,
iii. that are most consistent with practical experience and professional judgment of the analyst and,
iv. That best fit the characteristics (e.g. age, use etc.).

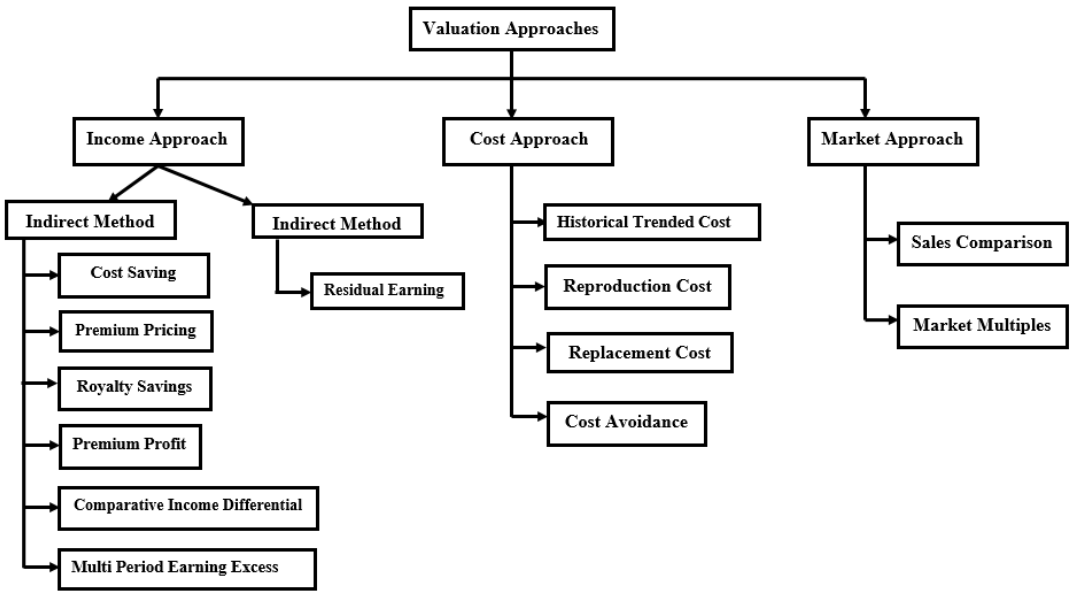
Market approach methods are based on economic principles of efficient markets and supply and demand (Holloway & Reilly, 2012). Under this approach, it is assumed that an asset can be related to the value of comparable assets priced in the market place. Market approach methods are particularly applicable when there is sufficient quantity of comparable (almost identical) intangible asset transaction data. E.g. direct market evidence is usually available in the valuation of internet domain names and emission rights amongst other. However, observable market based transactions of identical or substantially similar intangible assets recently exchanged in an arm's length transaction are often difficult to obtain (CGMA, 2012). The more heterogeneous assets are the more difficult it is to use the market approach and once there is no active market for substantially similar intangible, comparable approach cannot be used (Lopes & Rodriguez, 2007). Some of the market approach methods are sales comparison and market multiples methods amongst others. Sources of market based valuation data are published licensing surveys, published licensing deals, published court cases, license price list or rates offered.

Cost approach methods are based on economies principle of substitution, i.e. the value of the subject intangible assets is influenced by the cost to create a new substitute intangible asset (Trugman, 2011; Holloway & Reilly, 2012). The approach seeks to estimate fair value by quantifying the amount of money that would be required to repurchase or reproduce the asset being considered. It takes into consideration physical deterioration (usually has no bearing with intangible asset) as well as technological and economic obsolescence where applicable. Summarily, cost approach methods are

essentially applicable to the valuation of a recently developed intangible asset. In the case of relatively new intangible asset, the owner/operator development cost and effort data may still be available. More so, it is also applicable to valuation of an in-process and non-commercialized intangible assets. The cost approach for intangible is probably the most linear which considers the book cost or the replacement cost (Reilly & Schweihs, 1998). There are several cost approach valuation methods (e.g. trended historical cost, reproduction cost new and replacement cost new etc), each valuation method under this approach, use measurement metric. The commonest cost definition is reproduction cost new and replacement cost new. Thus, for intangible asset without an active market or under a comparison limitation, cost approach will be followed on systematic basis. Cost methods are primarily considered while valuing assembled workforce, internally developed software, internet domain names etc.

Income approach methods are based on the principle that the value of any investment is the present value of the income that the owner expects to receive on owning that investment. This according to Holloway and Reilly (2012) was called principle of economies of anticipation. Income based models are best used when the intangible asset is income producing or when it allows an asset to generate cash flow. Income approach techniques convert future benefit to a single, discounted amount, usually as a result of increased turnover or cost savings.

The major challenge within income approach method is distinguishing the cash flows uniquely related to the intangible asset to the whole company. Examples of income approach valuation methods are relief from royalty method, premium profit method, premium pricing method, cost savings method or avoided cost method etc. Income approach based methods are given primary consideration while valuing intangible assets as patents, technology, copyrights, brand names and customer relations amongst others.



RESEARCH METHODOLOGY

Data for this research was obtained from Estate Surveyors and Valuers who are registered with Estate Surveyors and Valuers Registration Board of Nigeria (ESVARBON) and have practicing firms in Lagos and the Federal Capital Territory. According to the information retrieved from the official website of NIESV (in January 2017) there are three hundred and sixty-three (363) and one hundred and eighteen (118) Estate Surveying and Valuation firms in Lagos and Abuja respectively. The most recent directory of the Nigerian Institution of Estate Surveyors and Valuers was published in 2014 which is three (3) years down the line. Therefore, it is believed that the information contained on the official website will be better updated and that it will reflect the firms that have probably changed addresses as well as new comers.

Using Taro Yamane formula for sample determination which is expressed mathematically as: $n = N/1+Nx^2$ (where n is the sample size, N = population size and x = acceptable margin of error 0.05), the sample size of 281 was arrived at and this was rounded up to 300 firms, representing 62 percent of the population. To use Taro Yamane formula, it is essential that population to be considered should be finite. The result of this formula gives the lowest acceptable number of responses to maintain a confidence level. The sample size of 281 derived above, therefore represent the minimum acceptable number of respondents required to maintain a 95 percent confidence level. This, however, means that the resulting sample size can be increased if so desired, but cannot be reduced. Hence, the need for rounding up to 300 firms. The proportional allocation of sample to Lagos and Abuja was done with the formula: $n_h = N_h/N \times n$, where N_h= population size of each selected location, N = total population of estate firms in Lagos and Abuja, and n= total selected sample size of both locations (281 approximated to 300); h is the location

$$N_{Lagos} = \frac{363}{481} \times 300 = 226 \text{ firms}$$

$$N_{FCT} = \frac{118}{481} \times 300 = 74 \text{ firms}$$

The sample was subsequently selected using simple random sampling technique. Out of the 300 questionnaires administered, two hundred and twenty-seven were retrieved (representing 75.7%) and were analysed using simple descriptive statistics and weighted mean score. In the study, weighted mean score was used to analyze responses on factors considered by Estate Surveyors and Valuers in their choice of classification, approach and methods and to test their conversance with same in intangible asset valuation. It is used in this survey to show the weight of each factor or components considered given the distribution of the responses among factors/components and inferences were drawn therefrom. This method is used for its ease of understanding and simplicity of communication of the

study. 3 and 4 points Likert scale were used and options were ranked in their order of strength. The weighted mean score is calculated as follows:

$$\sum_{i=1}^{n}(xi * wi) \qquad \sum_{i=1}^{n} wi$$

where x = the value; w = the weight

The research instrument was structured to examine how familiar the Estate Surveyors are with the acceptable classifications, valuation approaches and methods adopted in intangible asset value measurement. Also, it was designed to identify the intangible resources considered while undertaking asset valuation. The findings emanating from the analysis of the data therefore form the basis from which conclusion is drawn.

RESULTS AND DISCUSSION

Table 1: Professional Qualification of Respondents

Probationer (%)	Associate (%)	Fellow (%)
29.1	53.7	17.2

Table 1 shows that 29.1% of the respondents are probationer members, 53.7% are Associate and 17.2% are Fellow of the Nigerian Institution of Estate Surveyors and Valuers. This shows that majority of the respondents are qualified (70.9%) to undertake valuation of properties, therefore, information gotten from them can be relied upon for the purpose of this work and the result emanating therefrom can be reliably generalized.

Table 2: Frequency at which under listed valuation instructions are received

Valuation instruction	Very often (%)	Often (%)	Rarely (%)	Never received (%)	Weighted mean score
Land and building	62.6	37.4	0.0	0.0	3.62
Stock	0.0	0.0	79.7	20.36	1.79
Asset	16.7	50.1	33.1	0.0	2.32
Compensation	10.1	26.4	48.9	14.5	2.32

Table 2 indicates that 66.9% of the respondents receive asset valuation instruction frequently while 33.1% rarely received asset valuation briefs. The valuation instruction with highest level of frequency (i.e. very often/often) is land and building valuation with weighted mean score of 3.62 while second to this is asset valuation brief (2.83). This suggests that companies often engage the services of real estate practitioners in the valuation of their assets for different purposes. This confirms that the respondents are conversant with asset valuation and have knowledge of the topic under study. It also reveals that asset valuation is common in valuation practice amongst the valuers in the study area

Table 3: Factors informing Valuers' choice of classification, approach and methods while undertaking valuation of intangible assets

Factors	Always	Sometimes	Seldom	Never	Weighted Mean score
Experience	57	148	22	0	3.90
Common sense/rule of thumb	21	23	115	68	2.04
Consultation with Estate Surveyors & Valuers (ESVs)	65	97	48	17	2.92
Opinion of organization's Accountant/Book keepers	0	113	76	38	2.33
Theoretical guidelines from research work	50	101	25	51	2.66
Professional institutions guidelines/standards	28	112	55	32	2.59

Table 3 indicates that Valuers rely largely on experience to identify, classify, and determine approach, methods and procedures to be adopted in their intangible assets valuation exercise as indicated by the weighted mean score of 3.90 which ranked first. This is followed by the advice gotten from consultation with other colleagues in the profession (2.92) while consideration to guidelines established through research ranked third in the six (6) factors considered. Professional guidelines/standards which is expected to be a very essential factor ranked fourth with weighted mean score of 2.59. The implication is that out of the six (6) factors listed, majority of the respondent valuers feel more comfortable to go with their experience and advice from colleagues than relying on professional guidelines and standards to classify or select valuation approach and methodology while carrying out valuation of intangible assets. This suggests the existence of a high level of subjectivity in the choice(s) of the Valuers. Also, there is possibility that where Valuers are faced with some items of intangibles on which they have no prior exposition as well as few other colleagues consulted, the asset may not be properly identified and accounted for in the valuation. This may largely result in inconsistency and diversity in practice.

Table 4: Familiarity with the criteria for identifying intangible asset

Criteria	Very conversant	Conversant	Fairly conversant	Not conversant
Contractual-Legal	0 (0%)	25 (11.0%)	127 (55.9%)	75 (33.1%)
Separability	0 (0%)	42 (18.5%)	62 (27.3%)	123 (54.2%)

Table 4 shows the two (2) criteria recognised by IFRS 3 for identifying intangible assets from other intangible resources. It revealed that 11.0% of the sampled respondents are conversant, 55.9% are fairly conversant while 33.1% are not conversant with the contractual-legal criterion (third party originated evidence through contract or license). This altogether means that

an overwhelming majority (89%) either has little or no idea about what the contractual-legal criterion represents. On the other hand, 54.2% of the respondents, which represents a simple majority, are not conversant with separability criterion. None of the respondents is very conversant with the two criteria for recognizing intangible assets. This revealed that to identify intangible assets, use of standard criteria is still a challenge among the Valuers. It is not enough to have some knowledge about the workings of one criterion as the two are used simultaneously. Where this occurs, it means that the resources which are supposed to be identified using the separability criteria will probably be discountenanced and subsumed under grouped intangibles (goodwill).

Table 5: Valuers conversance with methods of valuation used in intangible asset valuation

S/N	Methods	Very conversant	Fairly conversant	Not conversant	Weighted mean score
1.	Premium profit	0	91 (40%)	136 (60%)	1.4000
2.	Premium pricing	0	45 (20%)	182 (80%)	1.198
3.	Royalty savings	125	9 (59%)	93 (41%)	2.141
4.	Cost saving	50	51 (45%)	126 (55%)	1.665
5.	Residual earning	46	44 (40%)	137 (60%)	1.599
6.	Comparative income differential	38	14 (23%)	175 (77%)	1.397
7.	Multi period earning excess	15	8 (10%)	204 (90%)	1.167
8.	Reproduction/replacement cost new	191	36 (100%)	0 (0%)	2.841
9.	Cost avoidance	82	21 (45%)	124 (55%)	1.815
10.	Historical trended cost	49	18 (30%)	160 (70%)	1.511
11.	Sales comparison	201	15 (95%)	11 (5%)	2.837
12.	Market multiples	89	8 (43%)	130 (57%)	1.819

Table 5 reveals that majority of the ESVs are only familiar with three (3) of the twelve (12) methods that are relevant to intangible assets valuation while the existence and concept of nine (9) other methods are still not clear to many. The ones they are conversant with are the reproduction/replacement cost new (2.841); sales comparison (2.837) and royalty savings methods (2.141).

All the respondents are familiar with the three common valuation approaches adopted in the valuation of intangible assets, namely: income, market and cost approaches. The principles behind these approaches are essentially similar to what obtain in the methods of valuing other physical assets like land and buildings.

Table 6: Treatment accorded to intangible resources that are not easily identified by the criteria in Table 4

Grouped under Goodwill (%)	Not Grouped under Goodwill (%)
57	43

57% of the Estate Surveyors and Valuers said they sometimes subsume intangible resources under goodwill where it is difficult to identify and determine the class of the non-physical asset. The implication is that intangible asset may perhaps be wrongly categorized as goodwill. Where this occurs, the intangibles will possibly be undervalued and inadequately accounted for.

SUMMARY OF FINDINGS

From the foregoing however, the following findings were made:

i. That Estate Surveyors and Valuers often receive asset valuation instructions. Next to land and building valuation, asset valuation appears to be the next common instruction they receive.

ii. That appreciable number of Estate Surveyors and Valuers are not conversant with intangible assets identification criteria, thereby sometimes difficult for them to differentiate intangible assets from goodwill.

iii. That majority of Estate Surveyors and Valuers are not conversant with the intangible asset valuation approaches and methods. They are very familiar with methods used in regular valuation of land and building and few intangible asset valuation methods that are similar in concept and principle to land and building valuation methods. This corroborates the position of Ogunba (2013) that valuers are "more at home at the valuation of fixed assets" and that intangible asset normally stretches the professional skill of valuers.

iv. That Estate Surveyors and Valuers rely more on experience and consultation with colleagues without giving cognizance to guidelines contained in international valuation standards while undertaking asset valuation.

RECOMMENDATION AND CONCLUSION

Intangible asset valuation is mostly required by business organizations and as such, conformity with the basic workings and international best practice recognized by the users is key to acceptance. Real estate practitioners from the result need to acquaint themselves more with the criteria for identifying, classifying and methods for measuring values of intangible assets. This will ensure uniformity of procedures and avoid unnecessary discrepancies between Valuers judgment and standards.

Some practitioners consider it convenient to summarize intangible assets as 'goodwill' therefore avoiding conduct of in-depth analysis using known

valuation approaches and methods. It is therefore suggested that valuation standards should be well considered by valuers as a useful guide in intangible asset valuation to ensure uniform approach to identification, classification and measurement of intangible assets.

Also, expertise development and specialization should be encouraged in the profession to ensure valuation involving such volatile form of assets is handled by competent and experienced valuation analysts.

Valuation curricula in higher institutions should be reviewed to reflect the need for this new reality in real estate profession in Nigeria. The curricula in Nigeria today does not include much on intangible assets. Therefore, there is need to include topics on classification, identification, approaches and methods as well as International Valuation Standards relating to intangible asset valuation in the curriculum at the higher level to enable better understanding and appreciation.

REFERENCES

Artsberg, K. &. (2010). A Literature Review on Intangible Assets: Critical Questions for Standard Setters. Lund, Sweden: Lund University.

Barton, A. D. (2005). The Anatomy of Accounting. Queensland: University of Queensland Press.

Blair, M., & Wallman, S. (2003). The Growing Intangibles Reporting Discrepancy. In J. Hand, & B. Lev, Intangible Assets: Values, Measures and Risks (pp. 449-468). Washington DC: Brookings Institution Press.

Blaug, R., & Lekhi, R. (2009). Accounting for Intangibles: Financial Reporting and Value Creation of the Knowledge Economy. Manchester: Research Republic LLP.

Bookstaber, R. (2007). A Demon of Our Own Design: Markets, Hedge Funds and The Perils of Financial Innovation. Wiley.

Chartered Global Management Accountant. (2012, January 26). Association of International Certified Professional Accountant and CIMA. Retrieved from CGMA Tools: www.cgma.org/content/dam/cgma/.../valuing-intangible-asset.pdf

Cohen, J. A. (2005). Intangible Assets. New Jersey: John Wiley and Sons.

Collings, S. (2011). Accounting for Intangible Assets. Global Accountant Magazine, pp. 22-25.

Epstein, B. J., & Mirza, A. A. (2005). Interpretation and Application of International Accounting and Financial Reporting Standards. New Jersey: John Wiley and Sons.

Ezeudu, C. (2003). The Place of Intangible Assets in Valuation and Management. The Estate Surveyor and Valuer, Journal of Nigerian Institution of Estate Surveyors and Valuers, Vol. 26 (1), Pg 33-37.

Grant Thornton International Limited. (2008, May). Intangible Assets in a Business Combination. Retrieved January 17, 2017, from Grant Thornton Web site: www.grantthornto.cn/.../intangible_assets_in_a_business_combination.pdf

Hall, R. (2000). The Stock Market and Capital Accumulation. California: Department of Economics, Stanford University.

Holloway, B. P., & Reilly, R. F. (2012). Intangible Asset Valuation Approaches and Methods. Insight, www.willamette.com.

Ikedianya, M. C. (2001, August 17). Need for Optimal Technical Valuation and Approach. The New Nigerian Newspaper, p. 14 and 20.

IVSC. (2017). International Valuation Standard 210: Intangible Assets. London: IVSC.

Kaufmann, L., & Schneider, Y. (2004). Intangibles: A Synthesis of Current Research. Journal of Intellectual Capital, 5(3), 366-388. Retrieved from http://dx.doi.org/10.1108/14691930410550354

Kuye, G. (2000). Property Valuation Principles and Practice in Nigeria. Igbosere, Lagos: Olusegun Kuye and Associates.

Lev, B. (2001). Intangibles: Management, Measurement and Reporting. Washington, D.C: Brookings Institution Press.

Lopes, I. T., & Gomes Rodrigues, A. M. (2007). Intangible Assets Identification and Valuation - a Theoretical Framework Approach to the Portuguese Airlines Companies. Electronic Journal of Knowledge Management, 5(2), 193-202.

Mandel, M., Hamm, S., & Farrel, C. J. (2006, February 12). Why The Economy Is A Lot Stronger Than You Think. Bloomberg Business Week.

Namakura, I. (2008). intangible Assets and National Income Accounting. Philadelphia: Federal Reserve Bank of Philadelphia.

Ogunba, O. (2013). Principles and Practice of Property Valuation in Nigeria. Ibadan, Nigeria: Atlantis Books.

Omoye, A. S. (2013). Determinants of Intangible Assets Disclosure in Annual Report: Evidence from Nigerian Quoted Companies. International Journal of Asian Social Science, 3(5), 1152-1165.

Reilly, R. F., & Schweihs, R. P. (1998). Valuing Intangible Assets. New York: McGraw-Hill.

Trugman, G. R. (2011). Understanding Business Valuation: A Practical Guide to Valuing Small to Medium Sized Businesses (Third ed.). American Institute of Certified Public Accountants, Inc.

Walker, R. G. (2009). Discussion of Lev, Radhakrishn and Zhang. Abacus, 45(3), 299-311.

Wyatt, A., & Abenethy, M. A. (2003). Framework for Measurement and Reporting on Intangible Assets. Intellectual Property Research Institute of Australia, 1-40.

Zeghal, D., & Maaloul, A. (2011). The Accounting Treatment of Intangibles: A Critical Review of Literature. Accounting Forum, 34(4), 262-274.

INVESTIGATING THE QUALITY OF RICE HUSK ASH PRODUCED USING LOCALLY FABRICATED INCINERATOR IN CONCRETE MIX

Dadu, D. W.[1] , Stanley, A. M.[2]. and Ehoche, E. P.[3]

[1,2,3]*Department of Building, Faculty of Environmental Design, Ahmadu Bello University, Samaru, Zaria, Nigeria*

The immense inevitability in this age is to achieve the sustainability of the environment by substituting Ordinary Portland Cement (OPC) with quality Supplementary Cementitous Materials (SCM) as partial cement replacements in concrete production mix designs; this can be realized by the use of rice husk, industrial by-products of agricultural waste. The research thus, investigated the environmental sustainability of rice husk ash (RHA) produced by a Locally Fabricated Incinerator (LFI); and the study of its quality when used in concrete mix designs. The RHA was produced by burning the rice husk under controlled conditions during which expelled Carbon Dioxides (CO_2) emitted were measured. Chemical and mechanical characteristics of the RHA were also analyzed to ascertain its quality. The results showed that the CO_2 released was 280ppm indicating that the production of the RHA was not harmful to the environment. The sum addition of Silicon, iron and Aluminum oxides from the chemical analysis totalled 78.73% by weight. The durability of the concrete was increased by 100% while the maximum compressive and tensile strengths of 34.66N/mm^2 and 3.44N/mm^{2}respectively were recorded at 10% replacements at 56 days. It is thus concluded that the quality of RHA produced by the LMI met the minimum requirements for it's used in concrete production; this guided the production of concrete which resisted abrasion and permeability. Thus, to increase the durability of the concrete and the production of environmentally friendly SCM, the incorporation of RHA at 10% in partial replacement in OPC production is recommended.

Keywords: cementitous materials, locally manufactured incinerator, partial replacements; rice husk ash; supplementary; sustainability

INTRODUCTION

Concrete is a fundamental material of preference in infrastructural development due to its outstanding versatility and flexibility in production

[1] wurim2004@yahoo.co.uk
[2] stanleywond@gmail.com
[3] ehocheechi@gmail.com

Dadu, D. W., Stanley, A. M. and Ehoche, E. P. (2017) Investigating the quality of rice husk ash produced using locally fabricated incinerator in concrete mix *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 961-977

and application. Its strength, durability and easy to make to any forms, shapes and sizes makes concrete utilisation superior to other materials such as wood and steel (Hossain *et al*, 2011). These inimitabilities of concrete are the major factors that universally make concrete a favourite material in buildings and civil engineering construction. Concrete is basically a mixture of fine and coarse aggregates; cement and water. Kosmatka *et al* (2011) averred that the volume of cement in concrete mix is usually between 7% and 15%; whereas, aggregates make up for the 70% to 85% by mass of the concrete mix design. The OPC are products of aptly proportioned mixture of argillaceous (clay such as shale) and calcareous (lime stone) materials, subsequently calcined to about 1450°C into incipient fusion in modern pre-calcinating plants. Though cement is only a fractional constituent in concrete mix production, the manufacture of the cement is of interest to mankind as it not only affects man shelter's development but also the sustainability of the environment.

However, the production of cement is responsible to the emission of CO_2 and other hazard gases to the atmosphere. For instance, the production of a ton of OPC is accountable for the release of about one ton of carbon dioxide CO_2. The global trend therefore is the use of cheaper pozzolanic SCMs to reduce the Portland cement contents in concrete mixtures principally to improve certain properties of concretes and environmental sustainability. This is achieved by substituting the OPC with by-products of industrial wastes and materials that require less energy and time to produce such as rice husk ash (RHA), fly ash (FA) and silica fume (SF).

Rice Husk Ash is an industrial by - product of agricultural waste obtained by the burning of rice husk to ash; and then used in cement blending or as cement partial replacement materials in concrete production mix designs. This study thus, is to examine the quality and sustainability of RHA produced by a Locally Fabricated Incinerator (LFI) in concrete mix designs.

LITERATURE REVIEW

Manufacture of ordinary portland cement.

The most widely use cement in the world today as affirmed by Shetty (2007) is the OPC. The quantity of cement manufacture yearly reflects global the volume of concrete utilisation.

Van Oss (1998) reported that in 2007 alone over 2.5billion tons of cement were produced. Day (1990) stated that major raw materials for cement production are limestone and argillaceous materials such as shale. Horst (2001) asserted that about 1 barrel of fuel or ¼ ton of coal is needed for the calcinations of the limestone alone for the production 1 ton of Portland cement; and that 60 to 130 kg of fuel; and 110 kWh of electricity are required to produce a ton of the cement. The Limestone ($CaCO_3$) is calcined to at about 1500°C; and product is a mixture of tri-calcium silicate ($3CaO.SiO_2$)-C_3S, di-calcium silicate ($2CaO.SiO_2$)-C_2S, tri-calcium aluminates ($3CaO.Al_2O_3$) - C_3A and tetra calcium aluminoferrites ($4CaO.Al_2O_3Fe_2O_3$) - C_3AF. The clinker is interground with approximately 2 to 5% of gypsum

($CaSO_4.2HO$) in the grinding process for the preservation the Cement (Neville, 2005). Cement manufacture is also typified by the release of poisonous gases to the atmosphere. Consequently, the cement industry contributes around 5% of anthropogenic CO_2 emissions globally; representing about 1,800 million tons of CO_2 emissions in 2005 alone from the use of fossil fuels, the calcinations process of limestone; and from power generation employed in grinding of raw materials and finished cement products (Worrell *et al*, 2001; Horst, 2001).

Pozzolanic supplementary cementitious materials

The use of SCM (such as pozzolans) in cement blending increased strength, enhanced the workability and durability of concretes and also contribution to the reduction in Green House Gases(A greenhouse gas abbrev. GHG is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range) to the atmosphere. These pozzolans are siliceous or siliceous and aluminous materials which, alone have little or no cementitious values, but when, in finely divided form and in the presence of moisture react chemically with calcium hydroxide $Ca(OH)_2$ produced from the hydration of the cement to form stronger gels of concretes (Parhizkar *et al*,2010; ASTM C 618;2005). Adam (2004) classified the SCM as Hydraulic and Pozzolanic based on their reacting mechanisms. The Hydraulic SCM such as slags react directly with water to form compounds possessing cement properties. The pozzolanic materials for example volcanic ash, react chemical with calcium hydroxide $Ca(OH)_2$ to form compound possessing cementitious properties. Kurtis (2002) classified the pozzolans into Natural and Artificial. The natural pozzolans are products of volcanogenic activities such as volcanic ash. Whereas the Artificial Pozzolanas are residues of waste products from Industrial Manufacturing and Agricultural Processes such as fly ash and rice husks.

Rice husk ash

Rice husks are used for the production of RHA, as artificial pozzolanic SCMs obtained from the de-husking of paddy rice. Rice is grown in all regions of the world a stable grain. Food and Agricultural Organisation (FAO, 2016) reported that about 496.7 million tons of rice were produced worldwide in 2016. Global Rice Science Partnership (GRSP, 2013) also gave the figure for sub-Saharan Africa in the region of 20 million tons in 2012. This has a potential of providing 800,000 metric tons of RHA annually. When the rice is de husk, about 20kg of rice husks are obtained from 100kg of rice; while burning of the husks provide 17 to 23% RHA. However, the quality of RHA for use as a pozzolanic SMC is usually evaluated during and after the production of concrete in terms of its physical and mechanical characteristics. But generally according to Adam (2004) RHA is highly pozzolanic and its used in concrete provides higher compressive strengths and a decrease in permeability of concrete.

The RHA reactivity depends on the burning or combustion techniques for the rice husk. When the ash is burnt at temperature below 700^0C, amorphous silica is formed. Uncontrolled combustion of the husk at

temperature above 800^{0}C (such as burning in refuse heaps) leads to crystallization of the silica making it crystalline silica (less reactive) resulting to poor pozzolanic properties (Cisse and Laquerbe, 2000; Dahiru and Zubairu, 2008). Therefore, the conversion of rice husk to ash for the purpose of pozzolan production is attained at temperature below 1000°C; with optimal temperature of 700°C(Olamide and Oyawale,2012). The When ASTM 618(2005) specification for the oxides composition is that the addition of the oxides of Silicon (SiO_2), aluminum (Al_2O_3) and those of iron (Fe_2O_3) should provide a minimum of 70% by weight; the loss on ignition should not exceed 10% for class N Pozzolan; and its fineness when it is allowed to pass though 45µm BS sieves should have a maximum of 34% retained. Thus, the United Nations Industrial Development Organization (UNIDO, 1985) reported that a typical chemical composition of RHA are: SiO_2 (93.1); K_2O (2.3); MgO (0.5); Al_2O_3 (0.4); CaO (0.4); Fe_2O_3 (0.2); Na2O (0.1); and with LOI OF 2.77%.

Local Fabrication of Rice Husk Incinerator

The RHA for use in cement blending or partial replacement of OPC in concrete production must be of good quality. Allen (2008) asserted that the production of high quality RHA can be achieved by the use of a locally constructed Incinerator. Thus, developed a principle for local productions of incinerators for the control combustion of rice husk into ash. The design comprised of two steel mesh baskets (figure 1); an outer and inner basket.

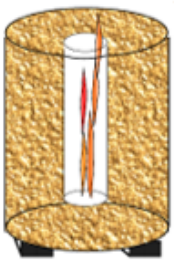


Figure1(a): Allen (2008) Baskets' Incinerator. Baskets' Incinerator.

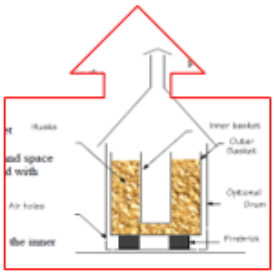


Figure 1(b): Typical cross-section of Allen (2008)

PROBLEM STATEMENT

Altwair and Kabir (2010) reported that although concrete is superior to other materials, the production cost of its main constituents (cement) is however excessive. European Commission (EC, 2001) ascertained that its electricity demand is about 90-1300Kwh per ton of cement produced. Cement production is also harmful to the environment as it is responsible for the emission of CO2 and other hazard gases to the atmosphere. Econoler International (2009) reported that the cement industry accounts for about 5% of the annual global anthropogenic carbon dioxide emissions; representing about 1,800 million tons of CO2 emissions in 2005 from the use of fossil fuels, the chemical reaction during clinker processing; and the use of electricity to grind raw materials and finished cement product. It is apparent that there is the need for environmentally sustainable cementitious materials for concrete production. Hashmi (2008) stressed that

even though the various cementitious alternatives may not be capable of replacing totally the Portland Cement at the moment, but they can however partially replace the OPC in a variety of construction applications such as in mortar and general concrete. The use of SCM such slags, fly ash, RHA in concrete mix design is innovative. It is cost effective as less energy and time are required for their production. Jha and Prasad (2004) established of that the use of Fly Ash in India, as a pozzolan in cement blending for Portland pozzolana cement production achieved an Energy Savings of about 20 %. Thus, a partial replacement of OPC with pozzolanic SCM in concrete mix design, even if it is a small reduction of the OPC in concrete, the resultant economic and environmental benefits are enormous. This is because of the huge quantity of concrete consumed on the daily basis globally.

MATERIALS AND EQUIPMENTS

Equipment

The Equipment used in the study include:

(i). An Incinerator was locally fabricated (Figure 2) at the Department of Building Ahmadu Bello University (ABU), Zaria. It was made up of two concentric steel mesh baskets and a metal sheet casing with overall dimensions of: Height-955mm, width-630mm. The larger basket was made of 600 mm in diameter and 900mm high and an inner basket of 250 mm diameter and 750 mm depth. The materials for the construction were sourced locally.



Figure 2(a): Locally Fabricated



Figure 2(b): Incinerator burning of Rice Husk

(ii). Energy Dispersive X-Ray Fluorescence method unit; a hydraulic press, a ball mill, an excitation source (that emits Ag - K X- rays- 22.1keV), a Computer, and thick Pure Metal foils

(iii). A thermocouple (Figure 3) with a range of temperatures up to 1,600°C (iii), a Gas Analysier (Figure 4), and (iv) a Rotary Ball Mill (Figure 5).



Figure 3: Thermocouple
Temp Range- up to 1,600°C



Figure 4: Imr 1400 Gas Analysier



Figure 5: A Ball Mill

Materials

The materials used in the study includes mechanically crushed granite; *Dangote* Cement and Fine aggregate; tap water; Rice Husks converted to Rice Husks Ash.

EXPERIMENTAL PROCEDURES

Burning of rice ash

The locally fabricate incinerator was used; the two baskets were placed concentrically during the burning activities. The small basket was placed concentrically inside the larger one throughout the process of burning of the rice husk to ash. The inner basket allowed for a more even combustion with sufficient access for air. The space between the two baskets was filled with the rice husk. Ignition was achieved by dropping a piece of burning paper or hot charcoal into the central (small) basket. The burning was controlled at 650°C temperature. At the end of the exercise, about 256kg of rice husks were burnt producing 20kg of grey colour RHA (Figure 6). A drum was occasionally placed to control and protect the equipment from rain or wind when the situation becomes evident; air holes were then provided at the upper and lower portions of the upper basket.

Measurement of carbon dioxide emissions

When the LFI was fed with the rice husk and ignited. The burning process started instantly. A thermocouple was used to measure temperatures at hourly intervals for 4 days for each of the husk placed for burning. The Gas Analysier (Figure 4) was used to measure the emissions of Carbon dioxide generated in the surrounding; before; during; and after each of the burning process.

CHEMICAL CHARACTERISTICS OF RICE HUSK ASH

Oxides composition of rice husk ash

The determination of the oxides of SiO_2, Fe_2O_3, Al_2O_3, MgO, CaO, SO_3, Mn_2O_3, and alkalis (Na_2O) were carried out by the use of Energy Dispersive X-Ray Fluorescence (EDXRF) techniques' procedure set by the Centre for Energy Research and Training (CERT) at ABU. The system used consisted of an excitation source and a Silicon (Si)-Lithium (Li) semiconductor detector coupled to a computer controlled Analog to Digital Control (ADC) Card. The samples milled to powder with a rotary ball mill to grain size of

less than 125µm. Pellets of 19mm diameter were then prepared from 0.3-0.5g powder with three drops of an organic liquid binder and pressed afterwards with 10 tons hydraulic press. The measurement of the elements was then performed using the Excitation Source by introducing the pellets of the samples into the X-Ray Fluorescence generator detector source emitting Silver (Ag)-Potassium (K) X-ray (22.1keV) in which all elements with lower characteristic excitation energies were accessible for detection in the samples for the analysis.

PHYSICAL CHARACTERISTICS AGGREGATES

The sands were quartzite river sands; and the crushed granite stones were obtained from a Local Quarry in Zaria. The crushed stones and sands were evaluated as described in B.S. 812 -109 (1960) to remove the impurities and to ascertain their particle size distribution to grading zone 3 of BS 4550: part 6 (1991). The aggregate met the specifications of BS 4550 and ASTM C 33(2003). Tap water from the university main was used for the production and the curing of the concrete cubes.

Specific gravity

The specific gravity tests were in accordance with Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate ASTM C 127 (2004). In this method 20 gms of the RHA materials samples were used for the samples. The weighed materials were placed in a calibrated cylinder containing 20 mls (v_1) of water with a density of 1.0 (g/cm3). The contents were allowed to settle to a new volume (v_2). The displacements (v_2-v_1) of the water were thus calculated for each of the samples studied.

Fineness of rice husk ash

The RHA materials samples were ground manually into powdered form with an agate mortar and pestle in the laboratory. 500g powder of each of the samples was then sieved in accordance with BS 812 (1985). Only powder particles which passed the 75µm standard BS sieve No. 200 were collected and kept back in their respective poly ethylene bags for use in the experiment.

Consistency test

The consistency standard test was carried out by the use of Vicat Apparatus. Using a 10-mm diameter plunger fitted into the needle holder. Trial mixes with water cement ratios of 0.4, 0.45, 0.5, 0.55 and 0.6 paste of cement and water was mixed in a prescribed manner and placed in the mould. In releasing the plunger to the mould, the penetration of the plunger from the bottom is measured and expressed as a % of mass of the dry cement.

Initial and final settings

The Initial Setting and Final Setting Times were determined according to American Society for Testing and Material ASTM C 451 (2005). The tests were conducted using Vicat's Apparatus'. A need is size 1 mm^2 was used to measure the penetration of on cement paste (prepare partially replacing OPC with 15% volcanic materials). The Initial Setting Times were recorded

when the needle stood 5mm (+0.5 mm) above the bottom of the paste mould. The Final Setting Times of the pastes were respectively recorded (the time from the addition of water) when the needle failed to make an impression on the paste.

Abrasion resistance test on hardened concrete.
After 28 and 56 days curing, abrasion resistance test was conducted with the method abrasion coefficient through subjecting the concrete cube samples to mechanical erosion by brushing for 60 circles in backward and forward motion for about 60 seconds with a 3.5kg mass attached to the brush.

Percentage weight loss = $\frac{weight\ before\ crushing - weight\ after\ crushing}{weight\ before\ crushing}$ x 100.

Water absorption test on hardened concrete.
The water absorption test was carried out in accordance to ASTM C 140(2004).The concrete cubes were surfaced dried after curing before oven dried for 24 hours. After the samples were removed from oven, they were cooled and weighed before they were immersed in water for 24 hours and weighed again after removing them from water. Increases in mass as a percentage of initial mass is expressed as its absorption and can be mathematically expressed as:

Water absorption = $\frac{\text{new weight} - \text{air dry weight}}{\text{air dry weight}}$ x 100; where; Air dry weight of concrete cubes after oven dried

Soundness test
Le chatlier's mould was placed on a small glass plate and filled with each of the cement paste of standard consistency. The pastes were leveled up and covered with another glass plate and the whole assembly immersed in water at room temperature of about 28°c for 24 hours. The gap between the indicators of the mould was measured and the whole assembly was immersed in the water bath and heated to the boiling point temperature of 100°c for one hour thirty minutes after which the moulds were removed from the water bath and allowed to cool for hours. The vertical gap in space between the indicators of the mould and the sample were re-measured after cooling and the values earlier recorded were subtracted from the current values. Le-chatelier's apparatus is the standard apparatus and cement is said to be sound when the expansion is below 10 mm.

MECHNICAL CHARACTERISTICS

Compressive strength of portland pozzolana cement concrete
The compressive strength test of the concrete cubes was done in accordance to BS 1881(1983) method for compressive strength tests were used for the production of the control concrete cubes with zero replacements of the OPC in the concrete mixtures. Cement, sand and coarse aggregates were used. The coarse aggregates and sand met the specifications of BS EN 882 (2004): Specification for aggregates from natural sources for concrete. Tap water was used for the production and the curing of the concrete cubes.

The control cubes concrete cubes were produced using the water cement ratio 0.55 based on the trial mixes. The workability was evaluated through slump test which varied from zero to 0.5. The materials were mechanically mixed using a concrete mixer. A total of 360 concrete cubes were subsequently prepared in 100 mm x 100 mm x 100 mm steel moulds in accordance to the ASTM C311(2005). The moulds were kept in the laboratory for 24 hours and de-moulded; curing was made were done in accordance to BS 1881(1983) by submerging the cubes in waters and the compressive strengths were taken at 7,14,28 and 56 days under same atmospheric condition. At each date of the tests the cubes were withdrawn from the tanks and kept for about 30 minutes preceding the tests. The cubes were surfaced dried after removal from water and weighed before they were subjected to the crushing machine. Three sets of cubes were each evaluated at 7,14, 28 and 58 days by destructive method using a digital operated compressive test machine and the failure loads for each sets of cubes recorded in Newtons. The failure is measured in Kilo Newton. It is expressed below as follows:

Compressive strength = $\frac{P}{A}$ Where: p = failure load (KN) and a = cross sectional area (mm2

The standard and specification for the control cubes were applied for concretes produced from the partially replaced cement with RHA at 5%, 10%, 15% but with the OPC and the RHA materials were each batched separately. The control cubes specimens were evaluated at 7, 14, 28 and 58 days.

SPLIT TENSILE STRENGTH TEST ON HARDENED CONCRETE.

Split tensile strength was done in accordance to BS 1881(1983). The concrete cylinders were surfaced dried after removal from water and weighed before it was subjected to the crushing machine. The cylinder was placed horizontally on the crushing machine. Each sample was placed between the plates of the machine with a flat wood at the top and bottom of the cylinder and pressure was exerted until the point of failure. The failure is measured in kilo Newton. it is expressed below as follows:

The failure is measured in Kilo Newton.

Cylinder = $\frac{2\,x\,P}{\pi ld}$; Where; p = failure load (kn); π = 3.142;l= height of cylinder (mm);d = diameter of cylinder (mm);

Pozzolanic activity index with portland cement

American Society for Testing and Material C 618 (2005) provides for the measurement of the Pozzolanic activity index with Portland cement concrete. These were established by evaluating of the strength of the concrete with zero pozzolan with the specific replacements of the volcanic materials at 28 days for all the samples using the expression; Pozzolanic Activity Index with Cement = $\frac{A}{B}\,x100$. Where A - average compressive

strengths of test mix cubes (N/mm2) and B - average compressive strengths of control mix cubes (N/mm2).

RESULTS AND FINDINGS

Burnt rice husk ash.

The whole process of combustions burning of 256kg of rice husk to producing 20kg of grey colour RHA (Figure 9). The ash was then ground in a ball mill and a fineness of 80 μm was achieved. The ground RHA was then sieved using 80 μm.



Figure 6: Rice Husk Ash

CARBON DIOXIDE EMISSIONS

Table 1 presents the CO_2 release. The average emission is 0.8% which is 280ppm. As stated in Minnesota Department of Health (MDH, 2010) Fact Sheet April outdoor concentration of carbon dioxide can vary from 350-400 parts per million (ppm) or higher in areas with high traffic or industrial activity. This conforms to the standard in Intergovernmental Panel on Climate Change (IPCC, 2007). Other anthropogenic greenhouse gases include Carbon monoxide, Nitrogen Oxide and Sulphur DiOxide which emissions in the conversion of rice husks to ash are not significant. Carbon monoxide (CO) in significant value reduces oxygen delivery to the body's organs and tissues, as well as adverse effects on the cardiovascular and central nervous systems.

Table 1: Carbon dioxide emissions

Gasses	1hr db	2hrs db	4hrs db	6hrs db	8hrs db	10hrs db	12hrs db	14hrs db
Oxygen O_2 (ppm)	20.6	16.9	19.9	20.4	20.6	20.4	20.6	20.6
Carbonmonoxide (ppm)	0	>2000	>2000	>2000	1824	10967	900	0
Nitrogen Oxide (ppm)	1	12		2.7	3	3	1	1
Sulphur DiOxide (ppm)	0	300	109	156	14.7	7	0	0
Gas temperature (^{0}C)	26.3	99	54	60	45	38	26	26
Carbon Dioxide (%)	0.3	3.7	3.5	3.0	1.5	1.2	0.5	0.4
Efficiency	0	83.8	94.9	84.2	82.7	78.7	0	0
Excess Air	0	56.65	19	17.3	19.11	17.8	0	0

Key bb - before burning db - during burning

PHYSICAL COMPOSITION OF RICE HUSK ASH

Specific Gravity of RHA - 2.0g/ms.

Fineness of rice husk ash

Table 2 shows the fineness of RHA. It can be observed that the pumice sample passed through the standard sieves. The percentage of the sample passing the least sieve is 100% which implies that 0% sample were retained.

Table 2: Fineness of Rice Husk Ash

BS Sieve	% passing	% retained
300µmm	100	0
150µmm	100	0
80µmm	100	0

Setting time

Initial and final setting times of cement paste at different percentages of rice husk ash (RHA). The initial setting time increases and became constant at 5% and 10% addition but decreases at 15% addition. The final setting time increases with rice husk ash addition. The final setting time increase as the percentages of RHA increases thereby retarding the hydration process. This result is in consonant with the work of Oyetola and Abdullahi (2004) and Ganesan *et al* (2008), showed that RHA increases the setting time of pastes as shown in table 5.

Table 3: Setting Time Test

Mix Design	Initial Setting Time (Mins)	Final Setting Time (Mins)
CM	116	108
5RHA	150	137
10RHA	150	137
15RHA	86	170

ABRASION OF CUBES AT 28 AND 56 DAYS

Fig 10 shows the Abrasion resistance of concrete cubes, the Abrasion resistance increases with increase in curing age. As seen at 10% replacement at 28and 56 days which recorded 100% each. It indicates that rice husk ash concrete can resist weathering action, chemical attack, abrasion or any other process of deterioration as stated by Arthur (2007).

ABRASION RESISTANCE OF CONCRETE

Water absorption of cubes at 28 and 56 days

From fig 4, the inclusion of rice husk ash in concrete prevents water intake into the concrete and decreases permeability. The permeability decreases with age as noticed at 10% replacement 28 and 56 days respectively which

has a value of 4 and 2.25. This agrees to the statement of Rodrigues *et al* (2006), that the incorporation of RHA in the composites could cause an extensive pore refinement in the matrix and in the interface layer, thereby decreasing water permeability. This is also stated in ASTM C 140 which states that the average absorption of the test samples shall not be greater than 5% with no individual unit greater than 7%.

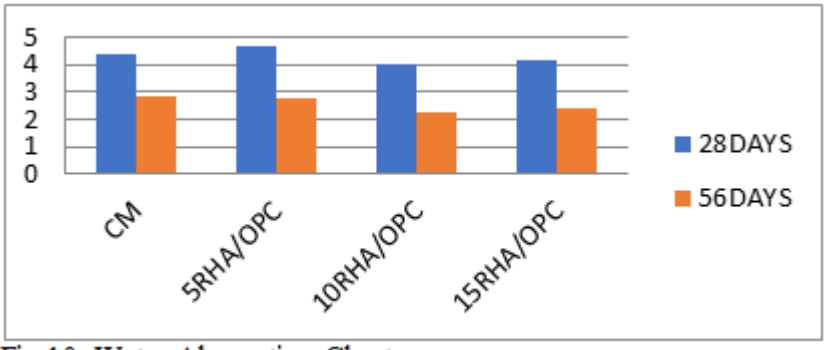


Fig 10: Water Absorption Chart

Soundness test

From table 6 the result from le chateliers apparatus of soundness tests. Le-chatelier's apparatus is the standard apparatus prescribed as per is: BS 5514 (1969) to check the presence of the impurities in cement. It shows that the RHA concrete is sound the highest value was 5mm which when compared to the standard tests which states that cement is said to be sound when the expansion is below 10 mm.

Table 4: Soundness test

Mix design	After 24 hours	After boiling	soundness
CM	0	4	4
5RHA	0	5	5S
10RHA	4	6	2
15RHA	3	4	1

Slump test

The table 4 shows the workability of the material and from the results it was observed that the workability reduces with increase in replacement of rice husk ash. This indicates that RHA absorbs all the mixing water and may need additional water. This is in line with (Abalaka *et al*, 2011) which states that the reduction in the slump as RHA content increased is due to water absorption of the RHA particles because of the cellular structure of the particles. There had been reported linear increase in water demand as RHA content increases in cement mortar at standard consistence. This is in line with (Abalaka *et al*, 2011) which states that the reduction in the slump as RHA content increased is due to water absorption of the RHA particles because of the cellular structure of the particles. There had been reported linear increase in water demand as RHA content increases in cement mortar at standard consistence.

Table 5: Slump Test

% addition	Slump (mm)
0	17
5	15
10	6
15	3

CHEMICAL CHARACTERISTICS

Oxide composition of rice husk ash

Table 2 shows the Chemical Composition of RHA. The addition of Silicon dioxide (SiO_2) plus iron oxide (Fe_2O_3) plus Aluminum oxide (Al_2O_3) gives a total of 78.73%.This satisfies the chemical requirements of the ASTM C 618(2005 which states that the addition of Silicon dioxide (SiO_2) plus aluminum oxide (Al_2O_3) plus iron oxide (Fe_2O_3), should give a minimum of 70% for class N Pozzolans.

Table 6: Oxides Composition of RHA

SiO2	CaO	Al2O3	Fe2O3	MgO	K2O	SO3	MnO	P2O5	TiO2	CuO	Rb2O
76.5	2.83	ND	2.23	1.33	5.52	0.62	0.45	7.56	0.25	0.05	0.05

MECHANICAL CHARACTERISTICS

Compressive strength of cubes.

Fig 11 shows that the compressive strength of Rice husk ash concrete is affected by the amount of Rice Husk Ash addition and the curing age. The compressive strength increases with increase in age. When compared with the control, 10% addition, 34.66kn/m2 at 56days increases with increase in curing days while 5% and 15% increased and decreased when compared to the control at different curing days. This satisfies the assessment by Ganesan et al. (2007), Abalaka and Okoli (2013) that Inclusion of RHA as partial replacement of cement enhances the compressive strength of concrete, but the optimum replacement level of OPC by RHA is 10%, is 34.66kn/m2.

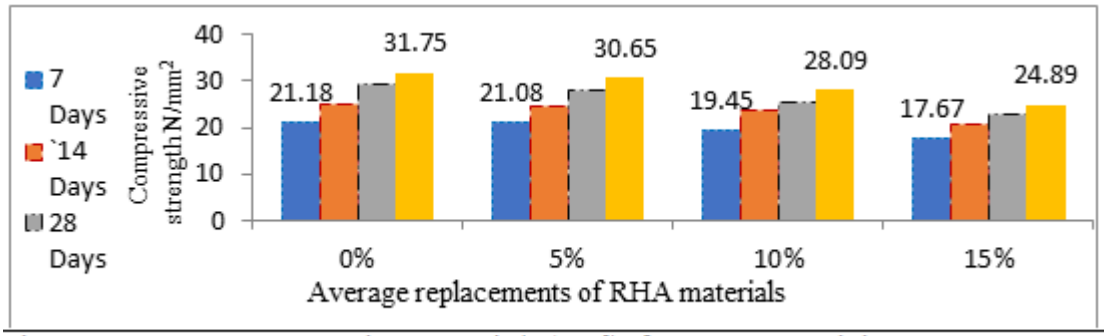


Figure 11: Average Compressive Strength (N/mm2) of Concrete Containing RHA

TENSILE STRENGTH OF CYLINDERS

Fig.12 shows the tensile strength of concrete cylinders, the tensile strength increases with increase in curing age. When compared to the control, at 14 days and 56 days the tensile strength of 5%(2.55and 3.32kn/m^2) and 10% (2.89 and 3.44kn/m^2) addition increase but decreased at 28days (1.63 and 2.29kn/m^2) when compared to the control whereas 15% produced lower tensile strength of 2.19 and 2.5 at 14 and 56days but the strength was greater when compared to the control. This is in conformity to a research by Abalaka (2012)

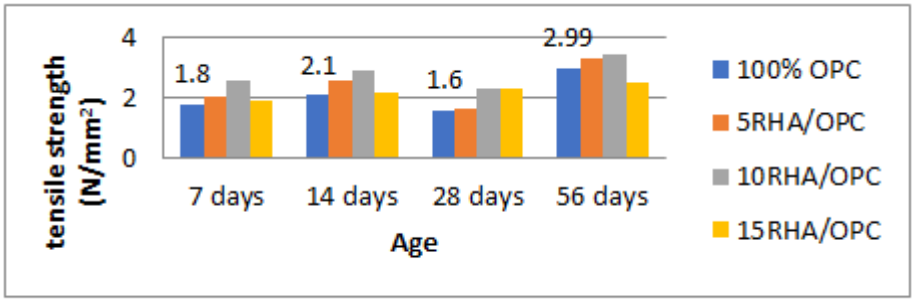


Fig 12: Relationship between tensile strength with age

SUMMARY OF MAJOR FINDINGS

A Locally Fabricated Incinerator can produce quality RHA. The results showed that the durability of the concrete was increased by 100% while the maximum compressive and tensile strengths of 34.66N/mm^2 and 3.44N/mm^{2}respectively were recorded at 10% replacements at 56 days. CO_2 released was 280ppm indicating that the production of the RHA was not harmful to the environment.

CONCLUSION

From the results of the assessment of the physical and the mechanical characteristics of Concrete made containing Rice Husk Ash made from Locally Manufactured Incinerator; and the physical and mechanical characteristics of concrete produced containing the RHA materials; it is conclusive that the rice husk ash produced using a locally fabricated incinerator is of good quality that can be utilized in the production of environmentally friendly concrete.

Recommendation

In view of the results of the tests and the evaluation of the RHA materials produced from a locally made Incinerator it is recommended for use as a partial replacement in concrete mixtures or in cement blending.

REFERENCES

Abalaka,A.E, (2012). "Effects of method of incineration on rice husk ash blended concrete". An article in ATBU journal of environmental technology, vol 5 pp1.

Abalaka, A.E, Okoli, O.G., Garba, M. M., and Zubairu, I. K. (2011). "Effects of Nigerian rice husk ash produced using a charcoal fired incinerator on properties of cement mortar and concrete"; preliminary results. In; Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs West Africa Built Environment Research (WABER) Conference, 19-21 July 2011, Accra Ghana, 379-389.

Abalaka, E.A and Okoli O.G (2013): "Strength Development and Durability Properties of Concrete Containing Pre-Soaked Rice Husk Ash". An article in construction science, vol. 14 pp 4-12.

Adam, N. D. (2004). Supplementary Cementitious Material. Part 2; Pozzolanic Supplement Cementitious Material, *In; Manufactured Concrete Magazine, app*. -17. Retrieved.www.precast.org/publicatios/mc/2005-janfeb/scm-part2.htm on 2 June 2007.

Allen, M.L (2008) "The manufacture of a cement extender from rice husks using a basket-burner", [Online]. available:http://www.journeytoforever.org/farm_library/RiceHusks.pdf.

Altwair, N. M., Kabir, S., (2010). Green Concrete Structures by Replacing Cement with Pozzolanic

Materials to Reduce Greenhouse Gas Emissions for Sustainable Environment. In: *American Society of Civil Engineers International Engineering and Construction Conference*, Cairo, 23-30 June

American Society for Testing Materials, ASTM Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete. 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

C618 (2005); C 311 (2005; C 451(2005); C127 (2004); C140 (2004); C 33 (2003).

Arthur L. (2007). Materials for Architects and Builders, Third Edition. Elsevier U.K. 70-71.

British Standard Institute, British Standard Board, 389 Chriswick High Road, London W4 4AL. BS 1881: part116 (1983); BS 4550: part 6 (1991); BS 812-109(1985); BS 5514 (1969) BS EN882(2004)

Cisse, I.K., Laquerbe, M. *Cement and Concrete. Res.* 30 (2000) 13.

Dahiru D.D. and Zubairu I.K. (2008): An assessment Of Properties of Concrete Made with Rice Husk Ash as Partial Replacement of Cement. Journal of Engineering and Energy Information

Administration. (EIA)(2006): Emissions of Greenhouse Gases in the U.S.A Article in Carbon Dioxide Emissions. US Department of Energy.

Day, R. L. (1990). Pozzolans for Use in Low Cost Housing. *In:* Report Prepared for the International

Development Research Centre, September, Ottawa, pp. 1-254.

Food and Agriculture Organization (2016): The United Nations, FAO Rice Market Monitor VOLUME XIX ISSUE No. 4. December 2016.

Econoler International. (2009). Cement Sector Programme in Sub- Saharan Africa: Barrier To Clean

Development Mechanism Project Development in Africa's Cement .In; report to World Bank Carbon Finance Assistance, April. Retrieved from www.econolerinter.com, pp.1-135.

European Commission (2001). Pollution Control on Best Available Techniques in the Cement and Lime Manufacturing Industries. *In European Commission Report,* Seville, *pp*. 10-14.

Ganesan, K., Rajagopal, K., and Thangavel, K. (2008); Rice husk ash blended cement: Assessment of optimal level of replacement for strength and permeability properties of concrete. Construction and Building Materials. 22(8):1675–1683.

Global Rice Science Partnership (2013), Rice Almanac; International Rice Research Institute DAPO Box 7777, Metro Manila, Philippines

Hashmi, F. (2008). Testing Method for Pozzolanas-*Practical Action Brief*. Retrieved from http://www.appropedia.org/Testing_Method_for_Pozzolanas_(Practical Action_ Brief), on 19th January 2011.

Hossain, M. A., Rashid, M. H., Mohammed, R. M. and Laz, O. U. (2011).

Performance of Concrete in presence of Supplementary Cementitious Material. International Journal of Civil & Environmental Engineering IJCEE-IJENS Vol: 11 No: 04.

Horst, S. (2001).Some Basics about Substituting Pozzolans for Portland cement in

Concrete; *In:* Proc at the Council of United States of America Green Building Council Summit, August, Tucson. Retrieved on 27 October 2009 from; uildingscience.com/documents/sc-studies

Intergovernmental Panel on Climate Change, IPCC (2007). Climate Change 2007: Synthesis Report. Contributions of Working Group I, II and III to the Fourth Assessment Report on the Intergovernmental Panel on Climate Change. Pg 104.

Jauberthie, R., Rendell, F., Tamba, S., Cisse, I. (2000): *Constr. and Build. Mat.* 14, pp 419.

Jha, C. N and Prasad, J. K. (2004). Fly Ash: A Resource Material for Innovative Building Materials.

New Delhi, Building Materials and Technology Promotion Council, July, New Delhi. Pp-124.

Kosmatka, Steven H. and Wilson, Michelle L., Design and Control of Concrete Mixtures, 15th edition,

Portland Cement Association, Skokie, Illinois USA, 2011.

Kurtis, K. (2002). Supplementary Cementitious Materials. In: Pres to PCA-2003, PCA CD 2038 pp1-19.

Minnesota Department of Health Fact Sheet April 2010, "Carbon Dioxide (CO2) in the Indoor Environment". Minnesota, USA.

Neville, A.M. (2005). *Properties of Concrete*, 3rd edition, Longman Scientific and Technical Publishing, London. Pp 58 – 70.

Olamide, O., Oyawale, F.A. *Intl. J. Sci. and Tech.* 2 (2012) 210.

Omotola, K. M. and Onojah, A. D. (2009). Elemental Analysis of Rice Husk Ash Using X-Ray

Fluorescence Technique. *International Journal of Physical Science*, 4(4), pp. 189-193.

Oyetola E. B. and Abdullahi M. (2006). The Use of Rice Husk Ash in Low - Cost Sandcrete Block Production, Leonardo Electronic Journal of Practices and Technologies, Department of Civil Engineering, Federal University of Technology, P.M.B. 65, Minna, Nigeria pp 58-70.

Parhizkar, T and Najimi, M and Pourkhorshidi, A. R., Jafarpour, F., Hillemeeier, B. and H, R. (2010). Proposing a New Approach for Quantification of Natural Pozzolans. Transaction A: Civil Engineering, Sharif University of Technology. Vol. 17, No.6, pp. 450-456

Rodrigues, C.S., Ghavami, K., and Stroeven, Piet. (2006)."Porosity and water permeability of rice husk ash-blended cement composites reinforced with bamboo pulp". Journal of Materials Science. vol 41 pp 21. 6925-6937.

Shetty M.S. (2007). Concrete Technology Theory and Practice. S. Chand and Company Ltd. am Nagar, New Delhi.

United Nations Industrial Development Organization (1985), Rice-Husk Ash Cements: Their

Development and Applications; United Nations Industrial Development Organization Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria

Van Oss H.G. (1998) Cement. *In*; *1998 Report. Mineral Industry Survey. U. S. Geological Survey,*

Wasiton D. C. Worrell E, Price L, Martin N, Hendriks C and Meida L.O(2001), "Carbon Dioxide Emissions from the Global Ce-ment Idustry," *Annual Review Energy Environment*, Vol. 26, 2001, pp. 303-329.

INVESTIGATION INTO GREEN ATTITUDES TOWARDS SHOPPING MALLS' DESIGN IN MINNA, NIGERIA

R. E. Olagunju[1], O. K. Akande[2], J. N. Metu[3] and S. C. Aremu[4]
[1,2,3]*Department of Arch**Error! Bookmark not defined.**itecture, Federal University of Technology, Minna, Nigeria*
[3]*Department of Architectural Technology, Federal Polytechnic, Bida, Nigeria*

In Nigeria, the growing human population and its consequent demand for commercial activities have contributed to the design of numerous shopping arenas and complexes. This in turn has its force on the ecological status of the built environment; the phenomenon, which, has led to the quest for 'energy conscious', 'eco-friendly' and 'energy efficient' design approach. Although, various works have concentrated on environmental concerns and the need of greening the building industry, nevertheless, few works have focused on retail properties such as shopping centres. Meanwhile, the multifaceted environmental impact of this building type in the built environment is undoubtedly demanding attention. This paper investigated green attitudes towards the integration of eco-design features in existing shopping complexes in Minna metropolis. The aim is to promote eco-friendlier shopping centres that maximize energy resources and minimise the current environmental burden emanating from the commercial buildings in the retail sector. Shopping complexes in Minna were purposively selected based on zoning and their commercial activities. Initial findings show that the majority of the shopping centres do not undertake green initiatives. This is perceived to be as a result of the owners' interest. Results from the findings indicated that environmental sustainability of these buildings depends on adequate knowledge of energy efficiency needs and other factors such as the resource capacity and available capital perceived to influence environmental sustainability initiatives of the project. It concludes the need for these issues to be addressed in order to realize a greener retail industry where "green" initiatives are embraced and implemented more extensively.

Keywords: built environment, eco-design, energy efficiency, shopping complex, sustainability

[1] rembenz@gmail.com
[2] fkakande225@googlemail.com
[3] jon_creekfieldenergy@yahoo.co.uk
[4] aremushola2004@gmail.com

Olagunju, R. E., Akande, O. K., Metu, J. N. and Aremu, S. C. (2017) Investigation into green attitudes towards shopping malls' design in Minna, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 978-993.

INTRODUCTION

The consideration regarding buildings' negative impact on the environment has indisputably become increased progressively in the few years. Consequently, the concept of green buildings has emerged along with huge multiples of environmental assessment methods and certification tools being introduced. Additionally, many studies such as Hara (2005); Ellison and Sayce (2007); Hinnells *et al.,* (2008); and Maneekum (2010) coupled with other investigations being carried are meant to present the advantages of committing to environmental concerns as an avenue of greening the industry. Nonetheless, very few of these studies and investigations have actually addressed the issue in association with retail properties such as shopping centres. Meanwhile, shopping centres are known to produce wastes and complex energy flow in abundance in such buildings.

Oladokun (2016) acknowledged that though several studies exist in respect of the causes of climate change and its effects on the environment yet, no direct focus on commercial buildings. A comprehensive overview of the attitude towards environmental concerns within a shopping centre context is therefore needed due to the paucity of studies in this area. This will hopefully function as a beginning spot for further deliberation on the issue (Maneekum, 2010). The issues that concern the environment such as climate change and global warming have significantly increase with much attention and main acceptance in the past few years. Meanwhile, along with this is the subsequent increase in consciousness and understanding of its implications on businesses.

Fundamentally, the environmental deprivation is undoubtedly negatively influencing businesses, irrespective of the industry. Moreover, the construction industry has been recognised as one of the most significant sector in combat with further environmental deterioration (Eichholtz et al, 2009). According to Nelson (2008) buildings are considered to make significant contributions to environmental degradation due to their heavy energy consumption and carbon emissions both during their construction and lifecycle phase. Furthermore, Maneekum (2010) show that the feeling of corporate social responsibility (CSR) has steadily gained foothold among businesses within the construction industry which has recognized the implications of sustainability.

Maneekum (2010) further observed that the concept of "green buildings" has naturally emerged and numerous works in relation to commercial properties and offices have been carried out to know the potential financial benefits related to sustainable practices implementation. Therefore, environmental commitment and "green" investments among commercial property owners and built environment professionals involved are key to interpreting the cause of disparities between some property owners in implementing sustainable practices than others. Hence, the clarification about this event will aid in determining possible factors for low response to the event. Thus, appropriate steps can be taken to promote greener real

estate, commercial industry where "green "initiatives are embraced and implemented more extensively (Maneekum, 2010).

In Nigeria, shopping centres have become one of the most socially and environmentally influential forms of real estate. Evidences exist to demonstrate how shopping centres are increasingly perceived as a social interactive space for people involving a mixture of public and private services besides shops. In Minna, Nigeria, shopping centres could be perceived to act in an unsurprisingly significant part of a broader urban economic context. This is viewed by Maneekum (2010) as producing numerous job opportunities as well as creating benefits and added value for the citizens. Therefore, the paucity of previous studies on sustainability and eco-friendliness of shopping centres plainly implies a requirement of launching a discourse to encourage further sustainable practices implementation in the construction and delivery of commercial facilities. Therefore, this paper seeks to investigate the current state of environmental responsibility or obligation that exists within shopping centre design and operation sector.

Aim and Objective

The main purpose of this paper is to investigate the current state of environmental sustainability awareness prevailing among shopping centre designers, developers and operators in connection to the implementation of sustainability practices. The objective is to provide a comprehensive overview of the attitude towards environmental concerns within a shopping centre context.

LITERATURE REVIEW

Green Building

The emergence of two most serious threats that confront the world today are: the threat to the atmosphere and the biosphere, which are fundamentally urban and the solution is known and clearly understood (Low *et al*., 2007). This requires the emergence of a green building movement in Nigeria, and the world as a whole, especially those countries who have not started the movement (Achyuthan and Balagopal, 2007). The world green building (WGB) movement started in early 1990 due to world global warming and climate change. It is a union of councils from around the world that aims to accelerate global sustainable building practices, (Aminu, *et al,* 2010).

A Green building (GB) is a high-performance property that considers and reduces its effect on the environment and human health. Usually, a green building is designed to use less energy and water and to reduce the lifecycle environmental effects of the materials used. Thus, it is achievable through better choice of site, design, material, selection, construction, operation, maintenance, removal, and possible recycling, (Yuldelson, 2008, Aminu, *et al*., 2010). GB exhibit high levels of environmental, economic, and engineering performance that include energy efficiency and conservation; materials and resource efficiency; occupant health and productivity;

transportation efficiency; and improved environmental quality including water, air, land, limited resources and ecosystems, (Foster *et al*, 2007, Emuze, *et al.,* 2012).

The terms 'Green Building' and 'Green Architecture' are used interchangeably and are often used when referring to the whole process and life-cycle of a building from the design, site selection, materials sourcing, construction, operation and ultimately decommissioning of buildings. Another term commonly used is 'sustainable construction' and this usually addresses the ecological, social and economic issues of a building in terms of its community (Kibert, 2005). This revolution is part of a paradigm shift toward sustainability, a growing realization that current ways of living, made possible mainly due to cheap and abundant fossil fuels, are not sustainable in the long term, (Aminu, *et al*, 2010).

A research that provided a detailed review of the GB guidelines in the USA, UK and Japan and analysed their impact on Indian guidelines show that many developed countries have made substantial progress in embracing the GB movement (Potbhare *et al*., 2009). The study further noted that there is a great need to promote the development and adoption of GB guidelines in developing countries. The basic goal of GB outlined by the Department of Environmental Affairs and Tourism (2009) is to create an attractive and comfortable shelter that does not harm the earth in its manufacture or use. It is further stated that this goal is motivated by other goals, which include:

i. Creating more desirable human experience;
ii. Reducing impacts that arise during occupancy;
iii. Reducing impacts on the environment of construction related activities, and
iv. Reducing the impact of the structure at the end of its life (demolition).

Therefore, increasing the awareness of GB benefits in Minna and Nigeria as a whole could lead to less harm to the already damaged environment, and buildings would also have more positive impacts on users in terms of improvements of indoor and outdoor climate from reduced productions of building materials in the environment. However, environmental impact, whether positive or negative, is the result of man's actions and it often leads to changes in the environment that affect the availability of resources.

Sustainable Development

According to the World Commission on Environment and Development - WECD, (1987), sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It further states that human activity is only environmentally sustainable when it can be performed or maintained indefinitely without depleting natural environment. Furthermore, cost efficiency is a prerequisite for sustainability and there are a number of key aspects to the design of green buildings (Snelling, 2009);

i. Conservation of energy and resource

ii. Ecological foundations and minimal site intervention
iii. Reduction of infrastructure; road pipes, lighting
iv. Elimination/reduction of materials and resource wastage.
v. Elimination/reduction of toxic materials and process.
vi. Use of renewable/biological material energy.
vii. Use of safe, recycled materials and products.
viii. Vapour-diffusive-air and wind tight construction
ix. Super insulation and ecological thermal energy storage
x. Use of natural (passive) heating and cooling
xi. Use of natural lighting (for heat and energy saving)
xii. Minimization of electro-magnetic fields
xiii. Long life, low-maintenance, robust design
xiv. Adaptable, inclusive (access to all) design
xv. Green surrounded-design with nature and climate

The Link between Buildings and Environmental Concerns

According to Oladokun (2016) commercial properties can be stated to be conceptualized, built big and occupied for trading and other office functions. This makes the sector a focus on large scale for foreign investors whose purpose is to take the benefits of stream of income from its use and occupation. Hence, the commercial and real estate sector plays an indispensable role in sustainable growth. Globally, buildings are purportedly known to take in nearly 32% of the world's natural resources (Bonde, et al, 2009) while about 50% of all the hazardous carbon dioxide emissions arising from buildings can be found in the world's most developed countries (Wilkinson and Reed, 2005). This, coupled with the with the growing realisation on the topics of environmental decline in quality and the increasing consensus regarding social responsibility, the concept of sustainability has gradually gained foothold within the construction and real estate sector (Eichholtz, et al, 2009).

As a result, numerous rating tools, certification systems, building codes and standards have been introduced during the past years as an attempt to facilitate the "greening" of the industry (Eichholtz *et al,* 2009). The instruments have been distinguished and accustomed due to prevailing differences between various property asset types and also due to various market participants (de Francesco and Levy, 2008). For example, certification systems such as Leadership in Energy and Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREEAM) have earned international recognition and increasingly demand by investors operating on the international market (Bonde et al, 2009).

However, new buildings entering the market are comparatively high standard due to the issue of the different means such as industry standards and evaluation tools. The critical issue with concerns is how the concept of sustainability and a green way of thinking can be fully unfolded to the existing building stock where most construction activities take place. Wilkinson and Reed (2005) stated the need for equal priority to be given to both new and existing building stock as both have the potential of negative environmental impacts. This view aligned with that of Pivo and McNamara (2005), who observed the possibility of existing building inventory to more than meet the improved tone of new buildings just by undertaking minor improvement measures.

Kats (2003) however, consider it relatively easier and less expensive to implement new standards on new building projects. Therefore, sustainable practices such as increased energy efficiency and reduction of greenhouse gas emissions are easier and more inexpensive to assume within the building and real estate industry (Nelson, 2008). Meanwhile, another widespread definition of a green building known as sustainable or high performance building is relatively hard to delineate. Nevertheless, efforts to provide a general description consisting of frequently recurring fundamentals have been made by a few numbers of scholars and institutions. Kats (2003) however, defined green buildings as utilizing resources such as water, energy, raw materials and land more efficiently than conventional buildings. Fundamentally, the primary purpose of green buildings is to trigger investments which are profitable and based on proven technologies in the area of energy efficiency and renewable energy technologies for non-residential buildings.

RESEARCH METHOD

To achieve the aim of this paper, several steps were taken to collect relevant information. Firstly, a thorough literature study on the subject matter was conducted. Information concerning green buildings; in terms of the definition, associated benefits and certification systems, and corporate social responsibility was obtained from publications and websites. The second step was the design of a suitable questionnaire in order to survey and assemble available information regarding the commitment of the architects and developers involved in the design and construction of shopping complexes in sustainable issues within their organization. The principal idea is to obtain a full impression of the ambition towards green initiatives of shopping centres.

The methodology for the second step of this study involves the data collection, identification of the participants and the data analysis. The data collection took place over several months and consisted of two phases: the pilot and the actual survey. The first step of the data collection process consisted of a pilot survey to evaluate the wordings of the questionnaire prior to the final administration of the study instrument.

The survey assessed the participants' educational level, length of years in architectural practice, number of shopping mall design/construction projects directly involved as a professional, level of understanding of eco-friendly design, level of integration of eco-friendliness in design of shopping mall, number of eco-friendly shopping complex project designed and constructed in past years, barriers to designing and implementing eco-friendly shopping mall building, key focus areas concentrated upon during the design of shopping mall and level of utilisation of eco-friendly features in professional practice with regards to shopping mall projects.

The survey was developed by the researchers while the participants were purposively selected as architects and developers. The participants were randomly selected because they had participated in the design and construction of shopping mall complexes. A structured questionnaire was administered to the participants between April and July 2016. Participants were asked questions on their level of agreement on the key focus area they concentrated on while designing a shopping mall based on 5-Likert type scale ranging from "1" for "Strongly Disagree" to 5 for Strongly Agree, so as to determine level of relevance of eco-friendliness to them. Another part of the questionnaire elicited responses from the participants on the level of utilisation of eco-friendly features in their professional practice with regards to shopping mall projects based on 5-Likert type scale of 'No Utilisation (NU)', 'Negligible Utilisation (N)', 'Limited Utilisation (LU)'; 'Adequate Utilisation (AU)' and 'High Utilisation (HU)'.

Sample size

The sample size for this study is determined by the requirement of the study for obtaining accurate and authentic findings for reaching at ultimate conclusions (Fink, 1995). In the like manner, Bulmer and Warwick (1993) stated that "the size of the sample is more a thing of convenience", and a compromise among many genes (i.e. expenses and precision etc.) For this study, the sample size was determined from the formula adopted from Creative Research Systems (2003) and Czaja and Blair (1996) given as:

$$ss = \frac{Z^2 * (p) * (1-p)}{C^2}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level)

P = percentage picking a choice, expressed as decimal

(.5 used for sample size needed)

C = confidence interval, expressed as decimal

Usually, in a study involving the use of surveys it is a common practice to seek a 95% confidence level or precision levels of 5%. Therefore, a confidence level of 95% was assumed with a confidence level (i.e. A significance level of $\alpha = 0.05$), z = 1.96 and a confidence interval (c) of ±10% deemed adequate.

To determine the sample size for a given level of accuracy, Czaja and Blair (1996) suggested the worst case percentage picking a choice (p) should be assumed which is given as 50% or 0.5. On the basis of these assumptions, the sample size was calculated as follows:

$$ss = \frac{1.96^2 \times 0.5\ (1 - 0.5)}{0.1^2}$$

$$ss = 96.04$$

The required sample size for the questionnaire survey was determined to be 96 professionals. Following this procedure of obtaining the sample size, a sample size of 100 participants was selected

DATA ANALYSIS

A total of 100 questionnaires were administered by hand to the participants through two research assistants who assisted in the data collection process. However, 74 valid questionnaires representing approximately 74% of the distributed questionnaires were retrieved. Data analysis was based on 74 total responses obtained from the survey. Reliability analysis (Table 1 and 2) was conducted to test the internal consistency and the scores on Cronbach's Alpha test for response indicated a score (i.e. 0.89 and 0.88) which exceed the accepted value for the alpha of the least of 0.60 for new scales (Nunnally, 1978).

Table 1: Reliability test on the key focus during the design of a shopping mall

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Response scale	No. of Items
0.891	0.893	5	4

Table 2: Reliability test on the Level of utilisation

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Response scale	No. of Items
0.884	0.884	5	13

The data were analysed with SPSS 20.0 using a number of descriptive and inferential statistics techniques to ascertain response consensus from the respondents. Relative importance index (RII) analysis was employed to analyse the responses in order to appropriately rank the responses of the respondents.

RESULTS AND DISCUSSION

Analysis was based on the researchers' survey data gathered. As previously pointed out, integration of eco-design features in existing shopping malls/buildings is a sustainable development, part of a social and technological system that provides for solutions for the tensions arising from

disharmonious development. That is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). The results of the data collected through the survey are presented as follows:

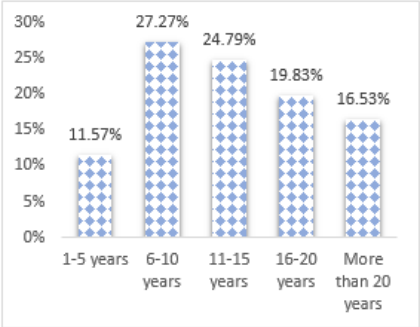


Figure1: Years in Architectural Practice

From figure 1 above, 11.57% of the Architects in Minna were in practice between 1 and 5years, while about 27.27% were in practice between 6 and 10years and 24.79% were in practice between 11 and 15 years. In addition, 19.83% of the architects were in practice between 16 and 20years, while 16.53% were in practice between 20years and above. This is an indication that number of architects in practice received commendable growth until last 6 years.

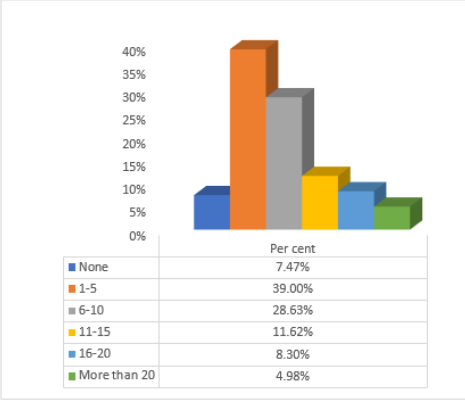


Figure2: Number of shopping mall design

From figure 2, shows that the architectural practitioners interviewed in Minna have been involved in the design of several numbers of shopping malls in Niger state. 7.47% of the practitioners have not involved in either shopping mall designs or construction. 39% have involved in shopping mall between 1 and 5, 28.63% have been involved in shopping mall design or construction between 6 and 10, while 11.62% have involved in design of shopping mall between 11 and 15. In addition, 8.30% practitioners

administered questionnaire have been involved in shopping mall design up to 16 and 20, while about 4.98% have been involved in the design of shopping mall between 20 and above. Thus, it shows an assured growth and interest of the young architects in practice in the design of shopping mall till last 6years. It is also an indication of more interest in city beautification by the architects in practice.

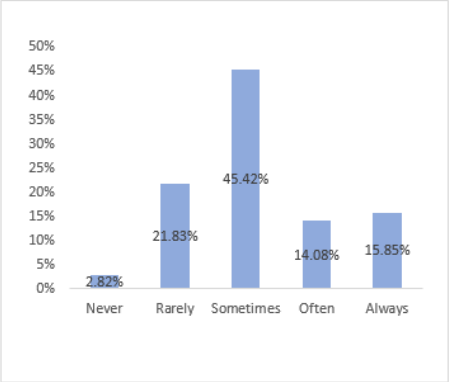


Figure3: Level of integration of eco-friendliness

From figure 3, the designers of shopping mall in Minna level of integration of eco-friendliness is in various degrees. The figure shows distribution and level of integration of eco-friendliness into the design of shopping malls in Minna by the practitioner Architects. 2.82% of the architects have never designed shopping mall with integration of eco-friendliness, while 21.83% rarely designed shopping mall with integration of eco-friendliness. It was also found that 45.42% of the architects sometimes integrate eco-friendliness into the design of shopping malls, 14.08% often integrate eco-friendliness into the design, while 15.85% always integrate eco-friendliness into the design of shopping malls. It is obvious with the level of integration of eco-friendliness into design of shopping mall that majority of the shopping malls do not undertake green initiatives and that the idea is just gaining attention in recent time.

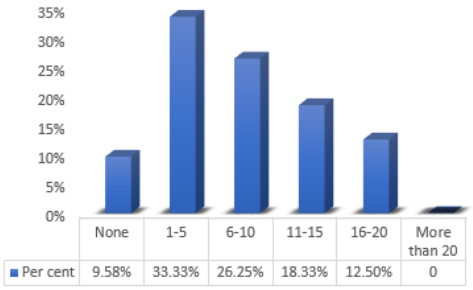


Figure 4: Number of eco-friendly shopping complex

Figure 4 above, shows that 9.58% of the Architects in Minna have never designed and be involved in the construction of eco-friendly shopping complex project. 33.33% of the Architects have been involved in the design and construction of eco-friendly shopping complex project in the past 1 to 5 years, while 26.25% of the Architects have been involved in design and construction of eco-friendly project in the past 6 to 10 years. Furthermore,

18.33% of the architects in Minna have been involved in both design and construction of shopping complex project in the past 11 to 15 years, 12.50% of the Architects have also been involved in its design and construction in the past 16 to 20 years, but non beyond 20 years. This revealed a steady growth in the awareness of eco-friendly design and construction of shopping complex project among the Architects in Minna until last 5 years.

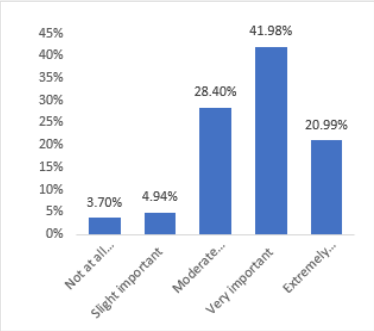


Figure 5: Relevant of eco friendliness

From figure 5 above, it shows that 3.7% of the Architects in Minna did not know the importance of eco-friendliness in design, 4.94% of the Architects claimed that eco-friendliness is slightly important to today's Nigerian society. About 28.40% affirm that eco-friendliness to today's Nigerian society is moderately important. In addition, 41.98% of the Architects in Minna agreed that eco-friendliness is very important to today's Nigerian society, while 20.99% of the Architects in Minna indicated that eco-friendliness to today's Nigerian society is extremely important. From the aforementioned varying positions of Architects in Minna, about 62% of the Architects in Minna can be said to know the relevance of eco-friendliness to Nigerian society. This indicates that eco-friendly design approach awareness is fairly high and promising.

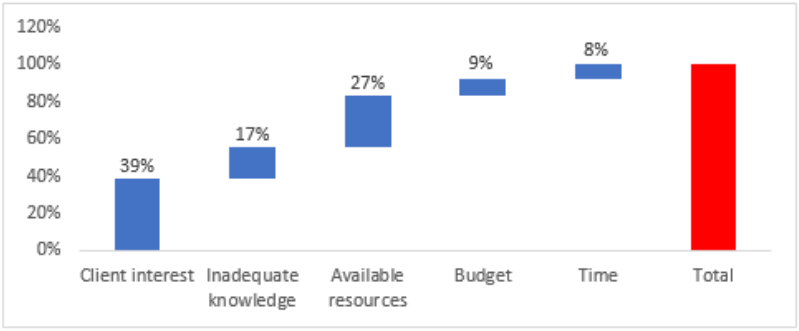


Figure 6: Factor preventing designing and implementing eco-friendly shopping mall

Figure 6 above, indicated that 39% of the factors preventing designing and implementing eco-friendly shopping mall is the client interest, 17% of the factors was due to inadequate knowledge, while 27% of the factors was due to available resources. In addition, 9% of the factors that hinders design and implementation of eco-friendly shopping mall is budget, while 8% was as a result of time. This is an indication that client interest, available resources

and inadequate knowledge are the three top most significant factors preventing designing and implementing eco-friendly shopping mall, while budget and time are the less significant factors.

Key Focus during the Design of a Shopping Mall

i. Harness the use of natural light for the interior: Table 3 revealed that among the key focus of Architects during the design of a shopping mall is to harness the use of natural light for the interior. This is the highest ranking factor among the four factors under consideration, with RII as 0.662. It has a high rating with the Mean test as significant. In the same vein, to integrate a comprehensive range of innovative energy and water efficient features also ranked second, with high rating, Mean test as significant and RII as 0.636. Furthermore, to build a prototype of an eco-friendly and community-friendly shopping mall, and to design a shopping mall with environmental sustainability in mind were ranked third and fourth respectively.

The two factors had low rating with Mean test as not significant. The earlier factor's RII is 0.598; while the later factor's RII is 0.572.

ii. Level of utilisation of eco-friendly features: Table 4 shows the top four main findings emerging from the level of utilisation of eco-friendly features by professionals in their professional practice with significance of the mean test. By ranking these are "have green planting environment" (ranked 1st); "have bright, airy and spacious surrounding" (ranked 2nd); "have effective energy-saving systems" (ranked 3rd) and "create green environment".

Table 3: Key focus areas concentrated upon by the architects during the design of a shopping mall

	SA 5	A 4	N 3	D 2	SD 1	$\sum f$	$\sum fx$	$\bar{x}$	RII	Rank	Rating	Mean test
Design a shopping mall with environmental sustainability in mind	14	26	20	10	29	99	283	2.859	0.572	4	Low	Not significant
Build a prototype of an eco-friendly and community-friendly shopping mall	10	30	19	25	13	97	290	2.99	0.598	3	Low	Not significant
Integrate a comprehensive range of innovative energy and water efficient features	17	33	14	12	19	95	302	3.179	0.636	2	High	Significant
Harness the use of natural light for the interior	25	28	9	15	17	94	311	3.309	0.662	1	High	Significant

Table 4: The level of utilisation of eco-friendly features by professionals in their professional practice with regards to shopping mall projects design.

	HU 5	AU 4	LU 3	N 2	NU 1	Σf	Σfx	$\bar{x}$	RII	Rank	Rating	Mean test
Use of renewable energy for power generation	7	15	29	16	31	98	245	2.5	0.5	13	Low	Not significant
Resident needs	5	35	24	15	14	93	281	3.022	0.604	10	High	Significant
Low carbon design	6	21	26	18	20	91	248	2.725	0.545	12	Low	Not significant
Well connected with transportation network	14	32	19	16	14	95	301	3.168	0.634	8	High	Significant
Easy accessibility and convenient to approach	19	20	25	22	8	94	302	3.213	0.643	7	High	Significant
Make adequate provision for specialty shops	12	18	37	15	11	93	284	3.054	0.611	9	High	Significant
Satisfied user's preference	16	34	15	18	9	92	306	3.326	0.665	5	High	Significant
Increase public awareness of environmental protection	12	27	23	18	16	96	289	3.01	0.602	11	High	Significant
Create green environment	19	31	22	14	7	93	320	3.441	0.688	4	High	Significant
Enhance sustainable urban development	18	25	28	14	11	96	313	3.26	0.652	6	High	Significant
Have effective energy-saving systems	20	36	17	8	11	92	322	3.5	0.7	3	High	Significant
Have bright, airy and spacious surrounding	24	36	22	5	7	94	347	3.691	0.738	2	High	Significant
Have green planting environment	40	17	24	7	6	94	360	3.83	0.766	1	High	Significant

From the findings in this study, it could be argued that to effectively integrate and implement eco-design features into commercial facilities it must constitute the dominance and the most prioritised during the design. To achieve this, client interest, available resources and adequate knowledge of energy efficiency must be effectively embedded at the pre and during design stage. Although analysis of the findings accounts for about 62% of the Architects in Minna understood the relevance of eco-friendliness to Nigerian society; unfortunately, only about 30% of them often integrates this into their design.

In particular, this limits energy-efficiency projects in commercial facilities known to be largely driven mostly by profit making. This is problematic as most commercial facilities are huge energy consumers. Professionals are key role-players in eco- friendly projects as such, they must be empowered with the right levels of expertise, decision-making ability along with energy-

efficiency targets and sustainability issues embedded in their projects to ensure sustainable built environment in Nigeria.

The study also revealed that non-integration of eco-friendliness into the design and construction of shopping mall is partly depended on the ownership type, underlying investment objectives, resource capacity and the available capital (client interest) perceived to influence environmental sustainability initiatives of the project. The ownership type was said to depend on the client, either as individual, private organization or government/public ownership. The ownership type is equally strongly related to the investment objectives. The two aforementioned factors are also directly influenced by the client resource capacity. The available capital perceived to influence environmental sustainability initiatives of the project often serves as hindrance to the Architects to integrate eco-friendliness into the design of shopping malls in full; instead it was done partly and at varying degrees.

CONCLUSION

The study investigated GB related challenges in terms of integration ofeco-friendly and energy efficiency in shopping malls design in Minna, Nigeria. The findings indicate that there is a lack of knowledge and understanding of 'what the GB approach' entails in Minna, especially among the respondents of the study. There appears that the majority of the shopping centre owners do not undertake green initiatives such as reducing energy consumption, although at a varying degree. This can partly be explained by the ownership type of the owner and their underlying investment objective (client interest). In other words, the extent of their environmental commitment depends on whether or not the owner has a long-term or short-term interest in the building. Moreover, organizational factors such as the resource capacity and available capital are believed to influence the initiatives. Also, the shopping centre as an asset implies comparatively complex management due to for instance the number of tenants and most often the big size and volume of the building. Consequently, these issues need to be addressed in order to gain insight and knowledge on how to green the shopping centres as well.

RECOMMENDATIONS

Eco-design requires the designer to use green materials and assemblies of materials, and components that facilitate reuse, recycling and reintegration for temporal integration with the ecological systems. Others may include,

i. Massive public enlightenment campaign as well as creating a behavioural awareness on the issue of energy conservation should be encouraged by built environment professionals and Government.

ii. Emphases should be laid on training and re-training of Architects on eco-friendly designs.

iii. Curriculum on sustainability should be included in schools of environmental studies.

iv. Legislative laws should be in place, both at local and National levels on Green building guidelines.

v. A ministry on green technology should be created in order to fill the gap on the issue of sustainability and scale up level of adaptability.

REFERENCES

Achyuthan, A. and Balagopal, T. S. (2007) Green - Architecture Traditional and Modern. *The Institution of engineers (India)* 88, 3-5

Adams, W. N. (2006). The Future of Sustainability: Rethink Environmrnt and Development In The 21st Century, UK: Cambridge University Press.

Aminu, D. Y., Kandar, M. Z. And Ossen, D. R. (2010). Evolking The Green-Shift In The Building Industry For Sustainable Development In Nigeria, West Africa Built Environment Research (WABER) Conference Proceedings, Vol. II, Accra, Ghana.

Bonde, M., Lind, H. And Zalejska-Johnsson, A. (2009). *The Economics of Green Buildings*

Bulmer, M. and Warwick, D.P. (eds.) (1993). Social Research in Developing Countries: Surveys and Censuses in the Third World. London: UCL Press.

Creative Research Systems (2003). The survey system, http://www.surveysystem.com/sscalc.htm (accessed February 2013)

Czaja, R. and Blair, J., 1996. Designing surveys: a guide to decisions and procedures, Thousand Oaks, California; London, Pine Forge Press.

De Francesco, A. J. and Levy, D. (2008). The impact of sustainability on the investment environment, Journal of European Real Estate Research, Vol. 1 Issue: 1, pp.72-87, doi: 10.1108/17539260810891505

Department of Environmental Affairs ans Tourism. (2009). *Green building in South Africa: Emerging Trends.* Pretoria: CSIR.

Eichholtz, P., Kok, N. and Chegut, A. (2009). A Green Corporate Headquarters And The Use Of Green Space In General, inMetzger, J., and Olsson, A. R. (Ed.) Sustainable Stockholm: Exploring Urban Sustainability in Europe's Greenest City, Royal Institution of Chartered Surveyors Research Report, March

Ellison, L., and Sayce, S. (2007). Assessing Sustainability in the Existing Commercial Property Stock. Property Management, 25(3), 287-304.

Emuze, F. A., Shakantu, W. M. And Ntsihlele, K. (2012). A Case For Construction Of Green Buildings In Lesotho: A Pilot Study, 4th West Africa Built Environment Research (WABER) Conference Proceedings, Vol. I, Abuja, Nigeria.

Fink, A., 1995. How to Sample in Surveys Thousand Oaks, CA: SAGE Publications

Foster, K., Stelmack, A., and Hindman, D. (2007: 69). *Sustainable residential interiors.* New Jersey: Wiley and Sons Inc. *Institution of engineers (India)* 88, 3-5

Hara, T. and Sakaguchi, Y. (2005). Approach To "Eco-Store" –Eco-Friendly Shopping Centers. In proceeding of the *World Sustainable Building Conference*, Tokyo, 27-29 September (SB05Tokyo)

Hinnells, M., Bright, S., Langley, A., Woodford, L., Schiellerup, P., & Bosteels, T. (2008). The Greening of Commercial Leases. Journal of Property Investment & Finance, 26(6), 541-551.

Kats, G. H. (2003). Green Building Costs and Financial Benefits, Environmental Business Council of New England, Inc., Western Massachusetts AIA.

Kibert, J. C. (2005). *Sustainable construcion.*New Jersey: John Wiley and Sons, inc.

Llandysul, SA44 5ZA: The green building press.

Low, N. et al. (2007). *The green city*. Routledge UNSW press pp. 15

Maneekum, F. (2010). Green Shopping Centers: A Survey of Stockholm's Shopping Center Market and its Environmental Commitment. An unpublished Master of Thesis submitted to the Department of Real Estate & Construction Management, Division of Building and Real Estate Economics, KTH Royal Institute of Technology, Stockholm, Sweden.

Nelson, A. (2008). Estimated Travel Time To The Nearest Cityo F 50,000 Or More People In Year 2000. Global Environment Monitoring Unit - Joint Research Centre of the European

Nunnally, J.C. (1978). Psychometric Theory, McGraw- Hill, New York, NY.

Oladokun, T.T. (2016). Effects of climate change on commercial properties in Lagos state, Nigeria. African Journal of Built Environment Research. Vol.1 issue 1 August.

Pivo, G. and McNamara, P. (2005). Responsible Property Investing. International Real Estate Review 8: 128–143.

Potbhare, V., Syal, M., Arif, M., Khalfan, M.M.A and Egbu, C. (2009). Emergence of green building guidelines in developed countries and their impact on India. *Journal of Engineering, Design and Technology*, Vol. 7 No. 1, pp. 99-121.

Snelling, J. F. (2009). Sustainable Design: Green building. *Archnet discussion forum top level.* www.archnet.org.

Wilkinson, S. J. and Reed, R. G. (2008). The Business Case for incorporating Sustainability in Office Buildings: the Adaptive Reuse of Existing Buildings, 14th Annual Pacific Rim Real Estate Conference, Kuala Lumpur, Malaysia

World Commission on Environment and Development, (1987). From One Earth to One World: An Overview, Oxford University Press. Retrieved from http://www.public.esu.edu/susdev/WCED87.html on 4/3/2017

Yuldelson, J. (2008). *The green building revolution*. 1718 Connecticut Ave. NW, suite 300, Washington DC 20009 Island press pp. 1, 3 and 13.

KEY ELEMENTS FOR SUSTAINABLE INFRASTRUCTURE DESIGN IN DEVELOPING COUNTRIES

Denamo A. Nuramo[1], Theodore C. Haupt[2]
[1]*Ethiopian Institute of Architecture, Building Construction and City Development, Addis Ababa University, P. O. Box 518, Addis Ababa, Ethiopia*
[2] *Mangosuthu Univesity of Technology, Durban, 4026, South Africa*

Infrastructure makes available the physical structures needed to provide the commodities and services essential to enable, sustain and enhance societal living. Investment in infrastructure in developing countries is essential for poverty reduction and it positively and significantly correlates with economic growth. Infrastructure provision has considerable impacts on resource utilization, quality of the environment and overall quality of life. This research recognizes the fact that infrastructure provision process should meet performance requirements in terms of economic, ecological and social aspects and that the design approach has to be in a way to harness technologies and meet human needs by working with nature, instead of solving problems at nature's expense. The objective of this study was to identify key design elements for sustainable infrastructure design in developing countries. Systematic literature review was employed to identify the key elements. The key elements were further refined by Delphi research technique that involved internationally recognized experts in the areas of sustainable infrastructure provision. The refined key elements are outlined under eight categories namely material selection, economic considerations, social considerations, environmental considerations, technical considerations, policy and regulations, design and project management and design professionals and the design process. The results of the study would help primarily design professionals in developing countries in designing sustainable infrastructure.

Keywords: design, developing countries, key elements, sustainable infrastructure

INTRODUCTION

Infrastructure is envisaged to be the life blood of prosperity and economic confidence across the globe in the 21st century (Miller, 2013). Infrastructure makes available the physical structures including roads, railways, runways, ports, water supply and sewerage systems, power generation and

[1] denamo.addissie@eiabc.edu.et
[2] theo.haupt@mut.ac.za

Nuramo, D. A. and Haupt, T. C. (2017) Key elements for sustainable infrastructure design in developing countries *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 994-1008.

distribution systems, telecommunication networks and buildings needed to provide the commodities and services essential to enable, sustain and enhance societal living (Agyefi-Mensah et al., 2012).

Investment in infrastructure in a developing country is essential for poverty reduction (Fay et al., 2011) and it positively and significantly correlates with economic growth (Myres, 2013). Despite irregularity (Romp & Haan, 2005; Straub et al., 2009; Briceño-Garmendia et al., 2004; Prud'homme, 2005; Srinivasu & Rao, 2013), particularly about the magnitude of the effect, literature support the notion that infrastructure has an impact on economic growth. Studies suggest that the impact of infrastructure on economic growth and productivity seems higher at a lower level of income (Romp & Haan, 2005; Briceño-Garmendia et al., 2004; Estache, 2008).

CIB (1999) emphasizes that the whole construction industry has a meaningful impact, directly and indirectly, on achieving Sustainable Development. According to Willoughby (Willoughby, 2004) infrastructure plays a vital role in achieving all Millennium Development Goals (MDGs).

Infrastructure development is a highly resource consuming endeavour. The fact that infrastructure installations have long life spans signifies their impact on resource utilization, the quality of the environment and overall quality of life (Agyefi-Mensah et al., 2012). This necessitates that they meet performance requirements in terms of economic, ecological and social aspects (Ibid) and that their design has to be in a way to harness technologies and meet human needs by working with nature, instead of solving problems at nature's expense (Sarte, 2010). Predictions indicate that population growth and the corresponding need for infrastructure are expected to continue with an alarming rate that the urgency of the matter can never be underestimated. This calls for an urgent intervention to ensure, accessible, affordable, or in the general sense sustainable infrastructure.

There are several but distinct and highly interrelated stages in infrastructure provision. As the decision made on one stage has a significant influence on the subsequent activities, it is important to make a closer follow-up at all stages to make sure that initial objectives of the project are met at the end. Particularly, planning and design stages play a notable role to make informed decisions at the early stage. The designer's ability to make the biggest impact on a project comes at its beginning, when assumptions are laid out, goals are established, and limitations are imposed (Sarte, 2010).

Customarily or rather traditionally, the main concern among design professionals had been functionality, aesthetics, safety, reliability and in some instances economic viability of infrastructure. Recently there is a notable paradigm shift where the issue of sustainability has begun to become a substantial component of designs. Sustainable design is the philosophy of designing physical objects, the built environment, and services to comply with the principles of social, economic, and ecological sustainability (McLennan, 2004). This signifies the importance of

identifying key elements for sustainable infrastructure design in developing countries.

The research question that this study attempts to address was "what are the key design stage elements/indicators that are perceived to be assist the Architecture, Engineering and Construction (AEC) industry in developing countries to deliver sustainable infrastructure?". The corresponding objective of the research was "identifying key design stage elements for sustainable infrastructure deliver in developing countries."

The research is important as it contributes to the existing body of knowledge by identifying key aspects to be considered at a design stage towards sustainable infrastructure in developing countries. The research is limited to hard or economic infrastructure including transportation and communication systems, water supply systems, waste disposal and drainage systems, industrial facilities, power generation and transmission systems. The findings of the study are limited to the context of developing countries.

LITERATURE REVIEW

Preliminary and detailed designs are vital in achieving cost efficiency, in improving performance of infrastructure systems, in reducing negative social and environmental impacts of infrastructure facilities. Design of infrastructure facilities needs to consider not only construction stage aspects but also post-construction impacts.

A little more effort during design stage would potentially have significant influence in improving construction and operation stage performance and impacts on infrastructures. As shown in Figure 1, design phase of infrastructure projects presents paramount opportunity to influence their lifetime performance.

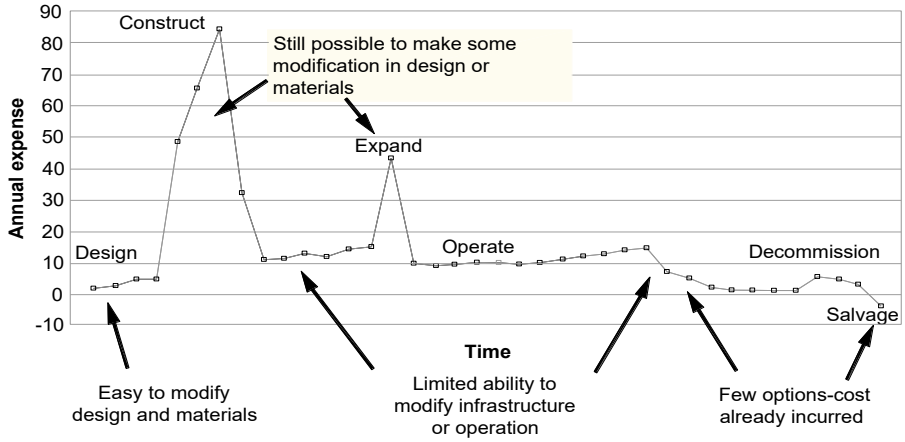


Fig 1 Opportunities for Reducing Cost are Greatest at the Outset, adopted from (Martland, 2012)

According to Martland (Martland, 2012) the drive to consider sustainability in infrastructure systems may originate from the following:

- Excessive reliance upon fossil fuels including coal, peat, petroleum, and natural gas;
- The increase in the world's temperature and associated climate change;
- Concerns in relation to equality and social justice;
- Unrest in different societies due to economic crisis, internal conflicts, and absence of prospects;
- Concerns of overcrowding and pollution within the largest cities;
- Breakthrough in automobile culture which resulted in devotion of huge amount of resource to vehicles and roads, excessive use of fossil fuel, escalated vehicle accidents, urban vehicle overcrowding which causes waste of time and resources; and
- Intensified ecological imbalance including rapid extinction of species, grave threat to the habitat, contamination of water supply with toxic chemicals and erosion.

While notable progress have been made with respect to development and assessment of 'green buildings', literature underscore that so far less attention has been paid to issues of sustainable infrastructure (Huang & Yeh, 2008). It is argued that attaining sustainable development should take into account the construction industry and the built environment as two of its key areas (CIB, 1999).

DFID (DFID, 2002) outlined the following six aspects as ways through which investment in infrastructure can contribute to sustainable development.

- Reducing transaction costs and facilitating trade flows;
- Enabling economic actors to respond to new types of demand in different places;
- Lowering the costs of inputs;
- Creating employment;
- Enhancing human capital; and
- Improving environmental conditions.

Due to their low level of physical development, developing countries will increasingly become arena for infrastructural development where this development provides the opportunity to direct the infrastructure development along a more sustainable path (Du Plessis, 2007). Willetts, et al. (2010) stress that early involvement of engineers is mandatory to fulfill sustainability aspiration of developments. Being unable to engage the right stakeholders at the early stage of projects might result in a compromise in sustainability targets and it can also be a reason for failure of projects. In this respect, design stage is considered as crucial as most decisions that dictate performance of the built environment are made at this stage (Bragança et al., 2014).

Sarte (2010) emphasized that the early stage is the point where engineers have the ability to make the biggest impact on projects. According to a report by FIDIC (FIDIC, 2012), sustainability should be a major early stage consideration. Bragança, et al. (2014) stressed that more sustainability is

achieved if project goals are defined and new criteria are integrated at the very early stage of projects.

Bruen et al. (2013) identified the following common barriers and challenges of sustainable construction in developing countries. The outlined barriers and challenges are associated with and can be addressed by planning and design stage considerations.

- Environmental aspect of sustainability is often considered as a low priority;
- Low level of acceptance by the people in respect to uses of alternative construction materials;
- Knowledge and skill gap in sustainable design and construction;
- Limited access to information about sustainable design and development;
- Inadequate support from government in terms of planning and policy making;
- Lack of appropriate guidelines, codes, standards and implementation strategies;
- Inadequate research and development; and
- Unsuitable procurement systems.

When compared to conventional design, additional criteria and items are required for sustainable design (Azapagic & Collett, 2006). It is cl aimed that apart from requiring more time and consideration during the design process, more sustainable design is often no more expensive (Shealy et al., 2016). According to Williams (2007) sustainable design " ... creates solutions that solve the economic, social, and environmental challenges of the project simultaneously, and these solutions are powered by sustainable energies."

Sarte (2010) argues that sustainable frameworks are not used in the standard design process resulting in fragmented, highly unsustainable and vulnerable infrastructure. He outlines the following as design drivers for sustainable infrastructure systems.

- Identification and comprehension of the project drivers
- Establishing project values and setting goals
- Establishing desired outcomes and metrics for success
- Creating frameworks and action plans that organize the approach
- Identifying concrete, measurable design strategies to achieve the above items

Williams (2007) recommends the following three aspects to be taken in to account in the early stage of design development:

1. Connectivity: Strengthening the link between the project, the project area, the neighbourhood and the ecology.
2. Indigenous: Capitalizing on what is existing and sustainable for long in the project area.
3. Long life, loose fit: Design for the future while reflecting the past; in concise term flexibility.

William McDonough (1992) has outlined the following nine principles of sustainable design also known as Hannover Principles:

1. Insist on rights of humanity and nature to coexist in a healthy, supportive, diverse and sustainable condition.
2. Recognize interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale.
3. Consider all aspects of human settlement including community, dwelling, industry, and trade in terms of existing and evolving connections between spiritual and material consciousness.
4. Accept responsibility for consequences of design decisions upon human well-being, the viability of natural systems, and their rights to coexist.
5. Create safe objects of long-term value.
6. Eliminate the concept of waste. Evaluate and optimize the full life cycle of products and processes, to approach the state of natural systems, in which there is no waste.
7. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.
8. Understand the limitation of design. Treat nature as a model and a mentor, not an inconvenience to be evaded or controlled.
9. Seek constant improvement by the sharing of knowledge.

METHODOLOGY

To identify the key design stage factors that significantly influence delivery of sustainable infrastructure, a systematic literature review was conducted. The systematic literature review attempted to address the research question by identifying, evaluating and integrating the findings of all relevant individual studies addressing the research question. While more than 200 relevant literatures were considered in the literature review, to avoid repetition of ideas only 24 seminal works were selected to extract the key elements for sustainable infrastructure design. The literature review involved extraction of relevant information from published journal articles, books, peer review conference proceedings, reports, infrastructure sustainability rating documents, guidelines and related documents. The literature was identified using the Internet and Google Scholar search engine by browsing the following key terms interchangeably: Sustainable infrastructure design, sustainable design, and sustainable infrastructure. As a result, 71 indicators were identified and categorized under eight leading factors. Table 4. 1 shows the leading factors and indicators with corresponding literature source citation. The Identified key elements were further refined using Delphi research technique.

Table 4. 2 Leading factors and indicators for sustainable infrastructure design

Leading factor	Indicator	Source
Material selection (Lin	Prescribing low energy materials	(Kibert, 2013)
& Yang, 2006; John et	Prescribing innovative construction materials	(Kibert, 2013)
al., 2005)	Utilizing potential of non-conventional materials	(Systems, 2016)
	Use of locally available materials	(Beyene, 2016)
	Use of durable/high-performance materials	(Kibert, 2013)
	Use of materials with low health risk and pollution	(Vallero & Brasier, 2008)
	Modulation/ harmonization with standardized materials	(Bennett, 2003)
	Prefabrication/off-site production of materials	(Ugwu & Haupt, 2007; Bennett, 2003)
	Material reuse	(Kibert, 2013; Systems, 2016; Ugwu & Haupt, 2007)
Economic considerations (Akadir	Cost/benefit analysis	(Willetts et al., 2010; Sahely et al., 2005; Shen et al., 2011)
& Olomolaiye, 2012)	Life cycle analysis	(Kibert, 2013; Shen et al., 2011; Myres, 2013)
	Cost efficiency	(Sahely et al., 2005)
	Bankability	(Willetts et al., 2010; Shen et al., 2011)
Social considerations	Public/beneficiaries participation	(Kibert, 2013; Systems, 2016)
(Valdes-Vasquez &	Client participation	(FIDIC, 2012; Systems, 2016)
Klotz, 2013)	Provision of employment opportunities	(Fourie, 2006; Ugwu & Haupt, 2007)
	Accessibility of the infrastructure to the public including people with specific needs	(Kibert, 2013; Lim & Yang, 2006)
	Health and safety consideration for construction workers and the public during construction and operation stages	(Willetts et al., 2010; Lim & Yang, 2006; Martland, 2012)
	Security consideration during construction and use	(Martland, 2012)
	Satisfaction of the public	(Kibert, 2013; Willetts et al., 2010)
	Protection of cultural heritage	(Lim & Yang, 2006; Systems, 2016)
	Protection of landscape, historical areas and archaeological sites	(Ugwu & Haupt, 2007)
	Risk analysis and disaster mitigation	(Martland, 2012)
Leading factor	Indicator	Source
Environmental considerations	Mitigating effects of natural disasters and climate change	(FIDIC, 2012)
(Brophy & Lewis, 2011)	Climate resiliency (resistant to climate change)	(Willetts et al., 2010; Systems, 2016)
	Reducing effects on soil and the biodiversity	(Systems, 2016)
	Reducing water, air and noise pollution caused by construction and operation of infrastructure	(Kibert, 2013; Willetts et al., 2010; Lim & Yang, 2006; CIB, 1999)
	Use of renewable energy sources both during construction and operation phases	(McDonough & Braungart, 2003; Systems, 2016)
	Ensuring efficient energy utilization both during construction and operation phases	(Kibert, 2013; Willetts et al., 2010; CIB, 1999)
	Optimizing uses of natural resources	(CIB, 1999; Kibert, 2013; Willetts et al., 2010)
	Provision of green infrastructure	(Systems, 2016)
	Optimizing site potentials (land use)	(Willetts et al., 2010; Kibert, 2013; UNCED, 1992; Lim & Yang, 2006)
	Uses of less energy during construction and operation	(Willetts et al., 2010)
	Waste minimization/ design optimization	(Willetts et al., 2010; McDonough & Braungart, 2003; CIB, 1999)
Technical considerations	Exhaustive site survey and ground investigation	(CIB, 1999)
(Azapagic & Collett, 2006)	Considering alternatives prior to proposing a solution	(Sarte, 2010; Vallero & Brasier, 2008)
	Multi-disciplinary integrated design team beginning from feasibility study stage	(Bragança et al., 2014)
	Uses of Building Information Modelling (BIM)	(CIB, 1999)
	Multi-stage design procedure	(Bragança et al., 2014)
	Provisions for phased construction	(Bennett, 2003)
	Aesthetics	(Sarte, 2010)
	Room for phased construction	(Bennett, 2003)
	Integrating design with delivery and operation stages	(Bragança et al., 2014)
	Synergy with other infrastructure projects	(Sarte, 2010)

Table 4. 3 con't: Leading factors and indicators for sustainable infrastructure design

	Meeting functional requirements and users comfort	(Willetts et al., 2010; Vallero & Brasier, 2008)
	Robustness and less maintenance products	(Sarte, 2010)
	Completeness and clarity of design documents	(Sarte, 2010)
	Value engineering	(Sarte, 2010)
	Harmony with the surrounding environment	(Ugwu & Haupt, 2007)
	Production of operation and maintenance manual	(Sarte, 2010)
	Research, development and innovation in design	(Bruen et al., 2013)
Leading factor	Indicator	Source
Policy and regulations (Bruen et al., 2013; Liu & Nederveen, 2015)	Presence of design sustainability regulatory requirements	(Bruen et al., 2013; Liu & Nederveen, 2015)
	Presence of sustainability rating systems	(Bruen et al., 2013; Papadopoulos & Giama, 2009; Shealy et al., 2016; Liu & Nederveen, 2015)
	Inclusion of sustainability requirements in public project briefs	(Bruen et al., 2013; Ugwu & Haupt, 2007)
Design and project management related (Willetts et al., 2010; Lechner, 2015)	Early contractors' involvement at design stage	(FIDIC, 2012; Ugwu & Haupt, 2007)
	Early suppliers' involvement at design stage	(FIDIC, 2012; Ugwu & Haupt, 2007)
	Selection of appropriate contract/project delivery type	(Lim & Yang, 2006; Bruen et al., 2013; Systems, 2016; Ugwu & Haupt, 2007)
	Inclusion of sustainability related clauses in contract documents	(Ugwu & Haupt, 2007)
	Flexible designs to accommodate on-site changes	(Sarte, 2010)
	Proper construction quality control procedure	(Lim & Yang, 2006; Ugwu & Haupt, 2007)
	Producing clear and workable construction methodology	(Lim & Yang, 2006)
	Labour intensive vs Machines intensive project implementation strategies specific to the projec	(CIB & UNEP-IETC, 2002)
Design professionals and the design proces (Sarte, 2010; Johı et al., 2005)	Awareness of clients about sustainability	(Bruen et al., 2013)
	Awareness of designers about sustainability	(Sarte, 2010; Vallero & Brasier, 2008)
	Knowledge and experience of designers	(Bruen et al., 2013)
	Skill of designers	(Kibert, 2013)
	Appropriating adequate time for design	(Shealy et al., 2016)
	Reasonable financial compensation for design work	(CIB, 1999)
	Presence of design guidelines/procedures for sustainable infrastructure	(Bruen et al., 2013)
	Proper coordination among designers from different disciplines	(Sarte, 2010)
	Willingness of designers to implement sustainability design concept and practices in their designs	(Sarte, 2010; John et al., 2005)

RESULTS AND DISCUSSION

The key elements, which had been identified through systematic literature review, were further refined using Delphi research technique. Delphi is a widely accepted research technique (Dalkey, 1963; Graham et al., 2003). The underlying assumption of the technique is that 'group judgments' are more reliable than individuals and it is used with a general intention of getting the most reliable group opinion (Giannarou & Zervas, 2014). The topic is intricate and requires experts' input and consensus. In order to arrive at a refined list of sustainable infrastructure design stage considerations the Delphi method was employed in this research. This research involved 11 international experts in all its three rounds to arrive at consensus. Selection criteria of the Delphi panel of experts were based on educational background, research and/or industry experience and exposure to sustainable infrastructure design in the context of developing countries.

Due to geographical location of the Delphi member and the researcher, the data collection was conducted via email communication. The form of data collection was structured questionnaire where a 10- point Likert type scale was used. Simple descriptive statistical analysis was employed to analyze collected data. To measure consensus, the research used the following criteria:

- Scale: median 7, 8, 9, 10 and at least 50% of the respondents rating the element from 7 to 10.

According to Adler & Ziglio (1996) most Delphi applications aim at reliable and creative exploration of ideas or the production of appropriate information for the purpose of decision-making. While there is no evidence of reliability of the Delphi technique, (Hasson et al., 2000). Landeta (2005) claims that the scientific community has accepted Delphi technique as another research technique with present-day validity and use. The assumption that group opinions are more reliable than individual opinion, and the fact that decisions are supported by reasoned argument ensured validity of the research technique (Hasson et al., 2000). The study was conducted in three rounds with experienced experts and other experts with different specialty reviewed the survey instrument. This ensured validity of the research instrument. The scales used in the survey instrument demonstrated internal consistency.

The results of the Delphi study validated and assisted to refine the identified key design elements which were found to be important toward delivery of sustainable infrastructure in the context of developing countries. This shows that the study has answered the research questions formulated at the outset. Below are outlined refined 50 key elements and corresponding factors for sustainable infrastructure design.

Factor 1: Material Selection	Factor 4: Social Considerations
Prescribing low energy materials	Public/beneficiaries participation
Use of locally available materials	Client participation
Use of durable/high-performance materials	Accessibility of the infrastructure to the
Use of materials with low health risk and	public including people with specific needs
pollution	Health and safety consideration for
Material reuse	construction workers and the public
Factor 3: Economic Considerations	during construction and operation stages
Cost/benefit analysis	Security consideration during
Life cycle analysis	construction and use
Cost efficiency	Satisfaction of the public
Bankability	Protection of cultural heritage
Factor 4: Policy and Regulations	Protection of landscape, historical areas
Presence of design sustainability regulatory	and archaeological sites
requirements	Risk analysis and disaster mitigation
Presence of sustainability rating systems	
Inclusion of sustainability requirements in	
public project briefs	

Factor 5: Design and Project Management	Factor 7: Environmental Considerations
Early contractors' involvement at design stage	Mitigating effects of natural disasters and climate change
Early suppliers' involvement at design stage	Climate resiliency (resistant to climate change)
Selection of appropriate contract/project delivery type	Ensuring efficient energy utilization both during construction and operation phases
Inclusion of sustainability related clauses in contract documents	Optimizing uses of natural resources
	Optimizing site potentials (land use)
Proper construction quality control procedure	Uses of less energy during construction and operation
	Waste minimization/ design optimization
Factor 6: Technical Considerations	Factor 8: Design Professionals and the Design Process
Exhaustive site survey and ground investigation	Awareness of clients about sustainability
	Awareness of designers about sustainability
Considering alternatives prior to proposing a solution	Knowledge and experience of designers
	Skill of designers
Multi-disciplinary integrated design team beginning from feasibility study stage	Appropriating adequate time for design
Meeting functional requirements and user comfort	Reasonable financial compensation for design work
Robustness and less maintenance products	Presence of design guidelines/procedures for sustainable infrastructure
Completeness and clarity of design documents	Proper coordination among designers from different disciplines
Value engineering	
Harmony with the surrounding environment	Willingness of designers to implement sustainability design concept and practices in their designs

CONCLUSIONS AND RECOMMENDATIONS

Traditionally, the main concern among design professionals had been functionality, aesthetics, safety, reliability and in some instances economic viability of infrastructure. Recent global developments called for a notable paradigm shift to make the issue of sustainability a substantial component of designs. Sustainable design is the philosophy of designing physical objects, the built environment, and services to comply with the principles of social, economic, and ecological sustainability. This signifies the importance of identifying key elements for sustainable infrastructure design in developing countries. This study has identified and refined key elements to be considered in the design of sustainable infrastructure in developing countries. These key elements are presented under eight categories namely material selection, economic considerations, social considerations, environmental considerations, technical considerations, policy and regulations, design and project management and design professionals and the design process. It is recommended that designers take into account these elements in their designs in order to achieve sustainable infrastructure in developing countries.

REFERENCES

Azapagic, A. & Collett, A.M.a.A., 2006. A Methodology for Integrating Sustianability Considerations into Process Design. Chemical Engineering Research and Design, A6(84), pp.439-52.

Agyefi-Mensah, S. et al., 2012. Towards sustainable infrastructure development in Africa: design principles and strategies for lifespan-based building performance. Kumasi, 2012. Proceedings of the 1st International Conference on Infrastructure Development in Africa (ICIDA 2012).

Akadiri, P.O. & Olomolaiye, P.O., 2012. Development of sustainable assessment criteria for building materials selection. Engineering, Construction and Architectural Management, 19(6), pp.666-87.

Beyene, H., 2016. Sanitation infrastructure sustainability: Experiences, challenges, and innovations. In P. Bongartz, N. Vernon & J. Fox, eds. Sustainable Sanitation for All. Warwickshire: Practical Action Publishing. p.328.

Bennett, F.L., 2003. The Management of Construction: A Project Life Cycle Approach. 1st ed. Oxford: Butterworth-Heinemann.

Blizzard, J.L. & Klotz, L.E., 2012. A framework for sustainable whole systems design. Design Studies, 33(5), pp.456-79.

Bruen, J., Hadjri, K. & Meding, J.v., 2013. Design Drivers for Affordable and Sustainable Housing in Developing Countries. Journal of Civil Engineering and Architecture, 7(10), pp.1220-28.

Bragança, L., Vieira, S. & Andrade, a.J.B., 2014. Early Stage Design Decisions: The Way to Achieve Sustainable Buildings at Lower Costs. The Scientific World Journal, 2014, pp.1-8.

Briceño-Garmendia, C., Estache, A. & Shafik, N., 2004. Infrastructure Services in Developing Countries: Access, Quality, Costs and Policy Reform. Washington DC: World Bank Policy Research Working Paper 3468.

Brophy, V. & Lewis, J.O., 2011. A Green Vitruvius – Principles and Practice of Sustainable Architectural Design. 2nd ed. London: Earthscan Ltd.

CIB & UNEP-IETC, 2002. Agenda 21 for Sustainable Construction in Developing Countries: A discussion document. Pretoria: CSIR Building and Construction Technology.

CIB, 1999. ISBN 90-6363-015-8 Agenda 21 on sustainable construction: CIB Report Publication 237. Rotterdam: CIB.

Estache, A., 2008. Infrastructure and Development: A Survey of Recent and Upcoming Issues. In F. Bourguignon & B. Pleskovic, eds. Rethinking Infrastructure for Development. Washington DC: The World Bank. pp.47-82.

Du Plessis, C., 2007. A strategic framework for sustainable construction in developing countries. Construction Management and Economics, 25(1), pp.67-76.

DFID, 2002. Making the Connections: Infrastructure for Poverty Reduction. London.

Fay, M., Toman, M., Benitez, D. & Csordas, S., 2011. Infrastructure and Sustainable Development. In S. Fardoust, Y. Kim & C. Sepúlveda, eds. POSTCRISIS GROWTH AND DEVELOPMENT; A Development Agenda for the G-20. Washington DC: The World Bank. pp.329-82.

FIDIC, 2012. State of the World 2012 Report 'Sustainable Infrastructure'. FIDIC.

Fourie, J., 2006. Economic Infrastructure: A Review of Definitions, Theory and Emperics. South African Journal of Economics, 74:3, pp.530-56.

Huang, R. & Yeh, C., 2008. Development of an assessment framework for green highway construction. Journal of the Chinese Institute of Engineers, 31(4), pp.573-85.

John, G., Clements-Croome, D. & Jeronimidis, G., 2005. Sustainable building solutions: a review oflessons from the natural world. Building and Environment, 40, pp.319-28.

Kibert, C.J., 2013. Sustainable Construction: Green Building Design and Delivery. 3rd ed. New Jersey: John Wiley & Sons, Inc.

Kohler, N. & Moffatt, S., 2003. Life-cycle analysis of the built environment. United Nations Environment Programme Division of Technology, Industry and Economics Publication, UNEP Industry and Environment.

Lechner, N., 2015. HEATING, COOLING, LIGHTING: Sustainable Design Methods for Architects. 4th ed. New Jersey: John Wiley & Sons, Inc.

Liu, Y. & Nederveen, S.v., 2015. Sustainable Infrastructure Design Approach through Integration of Rating Systems and BIM Tools. In Proc. of the 32nd CIB W78 Conference 2015. Eindhoven, 2015.

Lim, S. & Yang, J., 2006. Understanding the need of project stakeholders for improving sustainability outcomes in infrastructure projects. In Proceedings of Joint CIB Conference: Performance and Knowledge Management. Australia, 2006.

Miller, J.D., 2013. Infrastructure 2013: Global Priorities, Global Insights. Washington: Urban Land Institute.

Papadopoulos, A.M. & Giama, E., 2009. Rating systems for counting buildings' environmental performance. International Journal of Sustainable Energy, 28(1–3), pp.29–43.

Prud'homme, R., 2005. INFRASTRUCTURE AND DEVELOPMENT. Washington, 2005. The World Bank and Oxford University Press.

Sustainable Infrastructure Systems, 2016. [Online] Available at: http://www.sustainableinfrastructure.org [Accessed 10 May 2016].

Sahely, H.R., Kennedy, C.A. & Adams, a.B.J., 2005. Developing sustainability criteria for urban infrastructure systems1. Canadian Journal of Civil Engineering, 32(2005), pp.72-85.

Sarte, S.B., 2010. Sustainable Infrastructure: The Guide to Green Engineering and Design. New Jersey: John Wiley & Sons, Inc.

Shealy, T. et al., 2016. Using Framing Effects to Inform More Sustainable Infrastructure Design Decisions. Journal of Construction Engineering and Management, [Online]. [Accessed April 2016].

Shen, L., Wu, Y. & Zhang, X., 2011. Key Assessment Indicators for the Sustainability of Infrastructure Projects. Journal of Construction Engineering and Management, 137(6), pp.441-51.

Srinivasu, B. & Rao, P.S., 2013. Infrastructure Development and Economic growth: Prospects and Perspective. Journal of Business Management & Social Sciences Research (JBM&SSR), II (1), pp.91-91.

Straub, S., Um, P.N. & Vellutini, C., 2009. Infrastructure and Economic Growth in the Middle East and North Africa. The World Bank.

Romp, W. & Haan, J.d., 2005. Public capital and economic growth: a critical survey. In A. Rless, ed. EIB PAPERS. Farrah Baut-Carlier EIB Graphic Shop. pp.40-70.

Myers, D., 2004. Construction economics: a new approach. 1st ed. New York: Spon Press.

Myres, D., 2013. Construction Economics: a new approach. 3rd ed. London, Newyork: Routledge.

Martland, C.D., 2012. Toward More Sustainable Infrastructure: Project Evaluation for Planners and Engineers. Cambridge, Massachusetts: John Wiley & Sons.

McDonough, W., 1992. The Hannover Principles, Design for sustainability. Hannover, Germany.

McDonough, W. & Braungart, M., 2003. The Hannover Principles: Design for Sustainability. 10th ed. New York: William McDonough & Partners.

McLennan, J.F., 2004. The philosophy of sustainable design: the future of architecture. Kansas: Ecotone Publishing.

Ugwu, O.O. & Haupt, T.C., 2007. Key performance indicators and assessment methods for infrastructure sustainability—a South African construction industry perspective. Building and Environment, 2007(42), pp.665–80.

UNCED, 1992. AGENDA 21. Rio de Janerio.

Willetts, R., Burdon, J., Glass, J. & Frost, M., 2010. Fostering sustainability in infrastructure development schemes. In Proceedings of the Institution of Civil Engineers, Engineering Sustainability 163., 2010.

Williams, D.E., 2007. Sustainable Design: Ecology,Architecture, and Planning. New Jersey: John Wiley & Sons, Inc.

Valdes-Vasquez, R. & Klotz, L.E., 2013. Social Sustainability Considerations during Planning and Design: Framework of Processes for Construction Projects. Journal of Construction Engineering and Management, 139(1), pp.80-89.

Vallero, D. & Brasier, C., 2008. Sustainable Design: The Science of Sustainability and Green Engineering. New Jersey: John Wiley & Sons, Inc.

LESSONS LEARNT FROM THE 2012 FLOOD DISASTER: IMPLICATIONS FOR BUILDING DESIGN AND CONSTRUCTION IN HIGH-RISK FLOOD PRONE AREAS OF BAYELSA STATE, NIGERIA

Warebi Gabriel Brisibe[1]

[1]*Department of Architecture, Rivers State University, Nkpolu-Oroworukwo, Port-Harcourt, Nigeria*

Studies have shown that most parts of Yenagoa, the Bayelsa State capital fall within the high-risk flood zone of Nigeria and are susceptible to annual flooding. However, the 2012 flood was unusual in magnitude and led to the inundation of entire communities, the destruction of lives and property especially buildings and infrastructure. Over three years have elapsed since the floods and new construction projects have resumed in some of the hardest hit areas of Yenagoa. This paper draws on data from a survey of 400 new residential dwellings around areas hardest hit by the flood in Yenagoa. The survey involved interviews with home owners, private developers and architects in the area, to investigate possible lessons learnt in design, material use and construction to enhance resilience against future extreme floods in the region. The results of the survey show the percentage of developers who took precautionary measures in increasing flood resilience and those who did not; the role of the architects in developing flood resilient buildings; and the factors that have influenced these decisions and level of professional involvement.

Keywords: adaptability, architectural design, building construction, flooding, lessons learnt, resilience

INTRODUCTION

Bayelsa State is subject to perennial flooding as a result of low terrain levels, high rainfall intensities, high tidal levels, dam failures and overflow of the River Niger and its tributaries. In addition to the above factors, flooding in Yenagoa which is the capital city is accentuated by sedimentation and urbanisation activities such as construction of roads, erection of buildings and ineffective drainage and waste management systems. Like most flood prone areas, it experiences frequent floods in various magnitudes, ranging from minor to extreme flood events.

[1] briswares@yahoo.com; brisibe.warebi@ust.edu.ng

Brisibe, W. G. (2017) Lessons learnt from the 2012 flood disaster: implications for building design and construction in high-risk flood prone areas of Bayelsa State, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1009-1026

The 2012 flood was one of such extreme flood event and it occurred as a result of a dam release. Pent up flood waters were released from the Lagdo dam in Cameroun and the resulting deluge affected most downstream communities along the River Niger, its main tributary which is the Benue River as well as its main discharge outlet the Niger Delta. High-risk flood zones in the Niger Delta like Yenagoa, the Bayelsa State capital was adversely affected with considerable damage to buildings and infrastructure.

The consensus amongst most scholars and experts in the area of flooding is that, the best strategy to avoid flood damage is to avoid flood prone areas, since absolute flood protection is impossible (Hooijer et al, 2004; Roy et al 2003). But in cases like Yenagoa, where settlements already existed before extreme flood events are experienced and new building developments continue with increased urbanization, Kreibich et al (2005) states that flood damage must be kept as low as possible. New developments, especially residential buildings are springing up each day as the city experiences increased growth.

As such, the aim of this study is to investigate if there have been lessons learnt from the 2012 flood by examining if precautionary measures were taken by recent developers to make the buildings more resilient or adaptable to flooding. To achieve this aim, this study examines two pertinent questions;

1. Have there been any lessons learned to make subsequent new buildings more flood resilient or adaptable?
2. If so, what are these lessons learned and how are they reflected in the architectural designs and construction techniques in these new buildings?

LITERATURE REVIEW

The idea of lessons learned is to undertake a review of past performances and be better prepared in the event of another extreme flood. Kreibirch et al (2005) explained that preparedness consisted of preventive, precautionary and preparative measures. The concept of Building-Back-Better (BBB) is also an aspect of lessons learnt as precautionary measures are taken in reconstruction or rebuilding to make the building more resilient than it was before. Smith (1981) had earlier shown from a survey of 140 households in a flood prone area of Australia that precautionary measures taken by residents in the building of their houses had helped reduce actual damage by 52.4%. Similarly, Grothmann and Reusswig (2006) undertook a study on why some residents take precautionary measures in building against floods and why others do not. They developed a socio-psychological model based on what they referred to as protection motivation theory (PMT). Their study tried to analyse precautionary measure behaviours of residents based on;

- Perceptions of previous flood experiences

- Risk of future floods
- Reliability of public flood protection measures

This study tows a similar line in assessing precautionary measure behaviours of home builders but in addition also examines flood knowledge levels of architects that reside and practice within high risk flood prone areas of Yenagoa respectively. However, the difference is that this analysis is based on;

- Personal and others, perception of previous flood experiences
- Architects' or other building professionals' advice
- Sensitization campaigns by government agencies on eminent future floods

This study also examines the types of precautionary measures taken where available to ensure building resilience against future extreme flood events. With regards to resilience, Rogers et al (2015) showed in a study in New Zealand that future damage to buildings could be reduced by adopting appropriate building and foundation construction that are more resilient. Also, Balmforth (2016) in his work on flood resilient cities, highlighted the fact that based on lessons learnt from past floods, the way conventional buildings are currently constructed makes them highly vulnerable to destruction by floods waters. Studies on the assessment of building resilience, vulnerability of buildings and resilience of different existing building types to floods were conducted such as (Naumann et al 2010, Naumann et al 2009, Cutter et al 2010, Nikolowski et al 2013) alongside studies on how to make buildings more resilient to flooding in all aspects were undertaken. These include; improving the resilience of building materials and material technologies (Escarameia et al 2012, Golz et al 2015, Lawson 2011); innovations in architectural designs for enhanced flood resilience (Kolarevic and Parlac 2015, Watson and Adams 2011, Anh and Phong 2014, English 2009); assessing and upgrading planning regulations and building codes to cover extreme flood events and climate change (Aerts and Wouter Botzen 2011, Rogers et al 2015); and even the role of building professionals in developing a flood resilient society (Haigh and Amaratunga 2010).

All these studies emphasized a need to rethink building designs and assess the knowledge levels of architects in flood prone areas towards a more resilient and adaptable approach. In the course of this study two terms were constantly resurfacing, the understanding of which is pivotal to this research and discussions in this field as a whole. These are 'Resilience' and 'Adaptability'. In this field of study, the possibility of interchangeably using these terms is a regular occurrence. As such, there is a need to clearly define these key terms to form the basis for discussion in this study.

Definition of Terms

Majority of the definitions used are those borrowed from reviews done by scholars that bear direct relevance to this study as well as a few which I have attempted to define based on the study context. The terms 'Resilience'

and 'Adaptability' as used in this paper are discussed in relation to flooding and building design.

Walker et al (2004) rightly observed that there are different interpretations of what is meant by resilience. More so, it is sometimes used interchangeably with adaptability since these two-form part of the related attributes of social ecological systems (SESs) yet they differ distinctively. This distinction is made evident in what constitutes flood resilient designs and flood adaptable designs. As such, it is has become necessary to assess these terms on their own right as well as in relation to flooding and buildings.

Resilience

Resilience as defined by Walker et al (2004) is the "capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks". In relation to disaster, the International Strategy for Disaster Reduction (ISDR) defines resilience as;

The capacity of a system, community, or society potentially exposed to hazards to adapt by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures. (ISDR 2009)

With regards to design, resilience involves creating buildings, communities and regions that mitigate threats of extreme weather and climate change by engineering buildings for severe wind and wave impacts and using materials that are waterproof or otherwise impermeable to water damage (Watson and Adams 2011).

For the purpose of this study, resilience will be examined in relation to design against floods. As such, the data collected on resilient design measures would include; the use of waterproofing materials, waterproofing building products and flood protection methods such as barriers and defenses. This does not include the use of Damp Proof Membranes (DPM) which is a regular building feature that serves as a barrier for rising damp and other capillary actions. But it includes the use of waterproof cement admixtures, chemicals, asphalt or bitumen based linings, rubber or plastic sheet layers and other applications that increase resilience. Escarameia et al (2012) suggest that flood resilience of properties can be achieved by the use of adequate building materials, construction techniques and flood protection products amongst other measures.

Adaptability

Walker et al (2004) defines adaptability as the capacity of actors in a system to influence resilience. This can be done by altering how the threshold affects the system and vice versa. Where adaptability differs from resilience is that it may not require measures that resist or stop flood waters but allows buildings function in spite of the floods. In terms of design, it requires designs to be more adjustable to users and functions in the event of floods.

Kronenburg (2015) analyzed adaptable designs in the discussion on flexible architecture. He suggests that for a building to adapt or be adaptable it ought to adjust to different functions, users and climates or even change in climate.

For this study, the data collected on design adaptability include; adaptable floor levels including buildings that float with increased flood levels, fortified foundations, adaptable building services and components including emergency escape hatches amongst others.

Study location

Bayelsa State is located in the Niger Delta area which lies in the southern part of Nigeria and is a mixture of tropical rain forests and mangrove swamps. It has a total land area of 9,059 sq. km and the capital city Yenagoa, is one of eight Local government areas that make up its administrative structure. The climatic disposition of this region is tropical. It lies just above the Equator with an annual mean temperature range of 23.9°C – 29.5°C. The mean maximum temperature rarely exceeds 35°C. Relative humidity is high and it increases as progression is made towards the coast.

The terrain is scarred by a network of tributaries, creeks and rivers, depositing their load into the Atlantic Ocean. There are 10 channels from which the waters of the River Niger are emptied into the Atlantic Ocean and 8 of these rivers run through Bayelsa State. The average rainfall experienced in this region is between 2000-2500mm per annum or between 290-360 days of rainfall annually, culminating in floods.

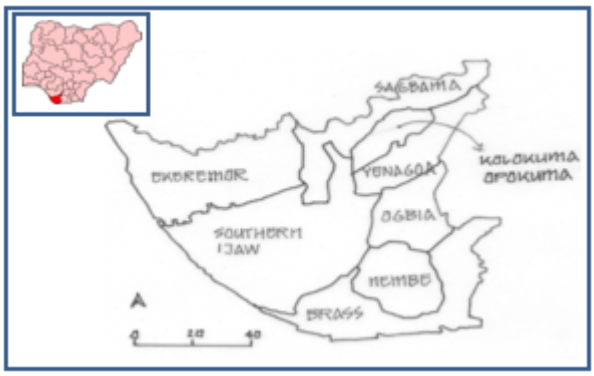


Fig 1 Map of Bayelsa State showing the eight Local Government Areas (LGAs) and the capital Yenagoa

The areas within the study locations in Yenagoa the Bayelsa State capital where newly built dwellings were identified include; Biogbolo, Okaka, Kpansia, Edepie, Etegwe and Akenfa. These locations were selected for two reasons. Firstly, they fall within the high flood risk zones which are areas prone to flooding and were badly affected by the floods that occurred in 2012. Secondly, over the last 5 years they have opened up for new residential developments for the middle and upper middle class more than any other locations in Yenagoa.

METHODOLOGY

The study area involved communities that lie along some major creeks and their tributaries in Yenagoa; the Epie creek on the north which has a total of about 59 tributaries along its 30km length feeding off it. The tributaries include the Akenfa creek, Agudama creek, Edepie creek and Okutukutu creek which runs southwards and joins up with the Ogbuko and Alagada creeks at Amarata. Buildings developed in areas along these creeks from 2013 to 2016 after the 2012 floods were targeted as survey samples. Data for this study was obtained as part of a larger study of building designs in flood prone areas of Yenagoa, Bayelsa State. Fieldwork for the study spanned about eight months between July 2016 and February 2017 with a team of four persons made up of the author and three field assistants. Each team member was assigned to communities along one of the four tributaries in the study area.

The survey adopted a semi-structured interview approach, with each interview lasting approximately 20mins. Four hundred residents were asked about their experiences of the flood as it affected their buildings or buildings of other people known to them; levels of damage to the buildings; if precautionary measures were taken in constructing their new buildings to make them more flood resilient; and if so, what these specific measures are. Information provided by the respondents were recorded in field notes at the point of interview and later collated. Data obtained from the survey were converted into tables from which percentages were obtained for each action undertaken by the respondents in response to questions asked. Discussions on precautionary measures for both residents and architects were based on percentage outcomes.

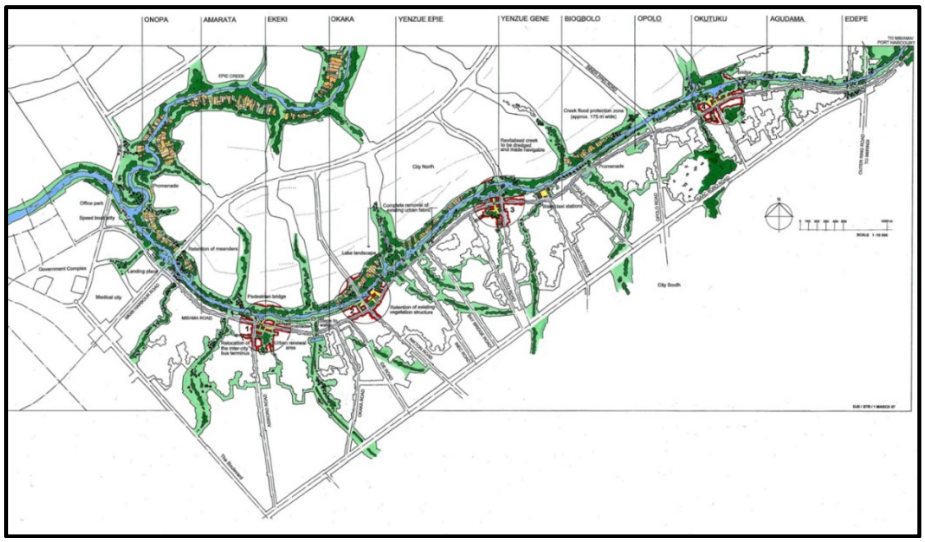


Fig 1 Map showing Epie creek and its tributaries in the study area (Courtesy: Albert Speer & Partners)

However, there were some limitations identified in the course of this study especially during data collection. Firstly, there was paucity of data on architects' advice on precautionary measures due to the limited engagement of professional architects for the design of buildings by private developers

in Yenagoa. Secondly, the scope and robustness of the data on architects' awareness of floods and precautionary measures was limited due to the small number of architects practicing in Yenagoa.

In addition, a survey was conducted among professional architects practicing in Bayelsa State. The study adopted a phone interview technique with the names and phone numbers of architects drawn from a directory obtained from the Bayelsa State chapter of the Nigerian Institute of Architects (NIA). From a list of about 30 architects in the Bayelsa branch of the institute, 20 semi-structured interviews were conducted over the phone with each lasting an average of 15mins, during which some fundamental questions were asked in addition to other follow up questions depending on the responses obtained. The questions include:

1. If the architects had previous experiences of the flood whether personal or otherwise?
2. If they had designed and supervised building projects anywhere within the study areas or other flood prone areas in Yenagoa after the 2012 floods?
3. If yes, did they include any design features in the building(s) to make it more resilient or adaptable to flood waters in event of extreme floods?
4. If so, what specifically was done to make the buildings more resilient or adaptable in the area of vertical spatial design, specification of waterproof materials for construction, specification of flood adaptable fittings, as well as flood adapted building services and components?

These questions were designed to ascertain the level of knowledge architects practicing in these flood prone areas have about flood behaviour, mitigation methods and resilience. The survey also helps to determine the level of professional guidance architects in these flood prone regions give to their clients when consulted on building developments based on knowledge and lessons learned.

IMPACT OF THE 2012 FLOODS ON BUILDINGS IN YENAGOA

After the 2012 floods, the Bayelsa state government set up an Infrastructure Advisory Committee (IAC) and a Post Flood Management Committee (PFMC). The aim was to assess the level of damage to buildings and infrastructure and advice on control and mitigation measures in the event of any future extreme floods. Part of the committees' report was that most of the existing buildings were ill-designed for flood resilience, hence the large extent of damage incurred.

Based on the official report by the Post Flood Management Committee PFMC (2013), certain degrees of human fatalities and displacement of persons and communities were recorded. Some communities were either fully or partially inundated with flood heights ranging from 0.80m to 2.5m

especially at the back swamps. It was also observed that most of the flooding resulted from overflow of nearby rivers, creeks, streams and other natural/artificial canals. The comprehensive Post Disaster Needs Assessment conducted from November 2012 to March 2013 on the flood induced damage in Nigeria's Niger Delta with the support of the World Bank, United Nations and other agencies estimated the total value of infrastructure, physical and durable assets loss at $9.6bn (Soriwei, 2013).

However, the report from the PFMC did not specify the extent of damage to buildings in Yenagoa or the exact number of displaced persons but it observed that buildings in several communities incurred different types and levels of damage due to the different levels of inundation they suffered. However, some of the main conclusions deduced were the obvious facts that the level of damage incurred was directly proportional to the length of time the flood waters were sustained in the buildings. Also, the trend of building designs and construction within Yenagoa allowed for the possibility of several openings for ingress of flood waters into buildings. The report revealed that the avenues for flood water ingress into buildings include;

1. Backflow of sewage from overflooded septic tanks, soakaway pits and sewers bringing return discharge into buildings through sanitary appliances
2. Ingress through cracks in the walls
3. Doorways and windows
4. Seepage through unrendered external walls
5. Capillary action through hollow sandcrete blocks where no damp proof membrane was used.

Blanco and Schanze (2012) opine that flood impact on buildings can be described by the degree of experienced harm of its materials and structures and the deterioration of its physical functions. The damaging effects of floods on buildings have been described by a number of scholars. Nikolowski et al (2013) listed damage types as;

- Saturation of building components
- Destruction of water-sensitive building components
- Destruction of building components through hydrostatic pressure
- Damage to building services

While Naumann et al (2009) classified the damage types as;

- Moisture/ water damages
- Structural damages
- Contamination damages

However, the different types of direct damage incurred by buildings during the floods as specified by the PFMC report (2013) include:

1. Weakened or failed foundations

2. Caving-in of ground floors due to erosion of filling material such as mud or sand from under the foundation
3. Destruction of most timber based building products from doors to roof members depending on level of inundation or flood depth and duration of flood waters in contact with building
4. Damaged wall render and paint due to prolonged contact with floodwater
5. Damaged electrical wiring and fittings due to surface wiring technique widely used
6. Contamination of property with sewage, drains and chemicals from garages

In effect, one of the crucial lessons learnt was that the conventional way buildings in this region have been designed and built over the years makes them vulnerable to damage by flood waters in so many areas.

DATA ANALYSIS

The areas within the study locations in Yenagoa the Bayelsa State capital where newly built dwellings were identified include; Okaka, Biogbolo, Kpansia, Edepie, Etegwe and Akenfa. These locations were selected for two reasons. Firstly, they fall within the high flood risk zones which are areas prone to flooding and were badly affected by the floods that occurred in 2012. Secondly, over the last 4 years they have opened up for new residential developments for the middle and upper middle class more than any other locations in Yenagoa. Out of 400 residential buildings developed between 2013 and 2017 that were surveyed, 288 developers adopted one form of precautionary measure or the other against flooding. The remaining 112 developers did not adopt any precautionary measures against flooding to their buildings.

From the survey of 400 new buildings, table 1 above reveals reasons why some developers took precautionary measures and the various flood resilient and adaptable methods used, as well as reasons why others did not take such measures. The data indicates that 72% of developers and home owners in the study area took one form of precautionary measure or the other, as against 28% who did not. Of the number of developers who took precautionary measures, about 12.8% based their decision on the advice of either an architect or other building professional; 27.1% took precautionary measures based on previous personal experiences during the 2012 floods; 58.7% was based on past experiences of others during the flood; while just 1.4% based their decisions on information from campaigns disseminated by Government agencies on flood precautionary measures.

For the developers and home owners who did not take any precautionary measures, 8% blamed it on the fact that they had no architect/professional advice; 69.6% did not take measures because of the cost involved in implementing such resilient or adaptable measures; a further 8% blamed

their actions on a lack of sensitization and information dissemination on the part of government agencies responsible; 5.4% do not believe a flood of that magnitude is likely to reoccur; and 9% did not take precautionary actions for faith-based reasons.

Table I data from survey of 400 new building developments in flood prone areas of Yenagoa

1	Flood resilient measures used	Water proofing	Water proof building products	Water barrier and defenses	Others	Use of regular Damp Proo Membrane
	No. of Persons out of 288	2 (0.7%)	3 (1.04%)	Nil	Nil	278 (96.5%)
2	Flood adaptable measures used	Elevated floo levels	Flood adapted spaces	Flood adapted interior fittings	Flood adapted building services	Fortified foundation
	No. of Persons out of 288	268 (93%)	Nil	12 (4.2%)	6 (2.1%)	179 (62.2%)
3	Reason for taking precautionary measures	Architects' /Professional advice	Previous personal experience	Sensitization campaign from Government or other agencies	Previous experiences of others	Other reasons
	No. of Persons out of 288	37 (12.8%)	78 (27.1%)	4 (1.4%)	169 (58.7%)	Nil
4	Reasons for not taking precautionary measures	No architects' professional advice	Cost of implementing precautionary measures	No sensitization campaign from Government or other agencies	Do not believe extreme flood event will reoccur	Other reasons
	No. of Persons out of 112	9 (8%)	78 (69.6%)	9 (8%)	6 (5.4%)	10 (9%)

Amongst developers and home owners who took flood resilient measures, 278 persons (96.5%) only two persons (0.7%) out of the reported 288 actually adopted water proofing techniques with the use of waterproof cement admixtures. In addition, just three developers (1.04%) employed the use of some water proofing building products, with specific reference to waterproof electrical fittings, but there was no record of anyone employing the use of wet proofing techniques, dry proofing or water barrier defenses. Also, the data indicates that there were no other measures taken to curtail ingress of flood waters through cracks or openings which was one of the main problems experienced during the past flood.

For flood adaptable measures, 268 persons making up about 93% of developers and home owners employed the use of elevated floor levels beyond the levels used prior to the floods. Within this number, 62.2% also fortified these elevated foundation walls and weakening caused by flood

waters, with reinforced concrete. A total of six persons, making up just 2.1% of the developers used flood adaptable building services as a means of reducing damage by backflow of sewage from overflooded septic tanks, soakaway pits and sewers. The use of appliances such as back-flow stop valves or one-way gate valves stops return discharge into buildings from overflooded pits.

Table II data from interview of 20 architects practicing in Yenagoa since 2012

1	No. of buildings designed/ supervised after 2012 floods	1 – 2	3 – 5	6 – 10	11 – 15	Over 15
	Out of 20 persons	11 (55%)	6 (30%)	2 (10%)	Nil	Nil
2	Extent of Architect/ professionals' knowledge of flood resilience, mitigation and adaptation	Raised floor levels and reinforced foundations	Use of water proofing techniques	Use of waterproof building materials	Use of adaptable spaces and services	Others
	Out of 20 persons	20 (100%)	2 (10%)	Nil	Nil	Nil
3	Architectural features added as precautionary measures against floods	Raised floor levels	Use of water proofing techniques	Use of waterproof building materials	Creation of emergency exits and escape routes	Others
	Out of 20 persons	20 (100%)	2 (10%)	Nil	Nil	6 (30%)
4	Height to which ground floor levels were raised above previous levels	0 – 0.6m	0.6 – 0.9m	1.0 – 1.5m	1.6 – 2.0m	Over 2.1m
	Out of 20 persons	1 (5%)	1 (5%)	10 (50%)	6 (30%)	2 (10%)
5	Design type for raised ground floor levels	Use of stilts	Creating water pathway under building	Complete filling of raised floor	Introduction o basement under raised floor	Others
	Out of 20 persons	Nil	1 (5%)	18 (90%)	1 (5%)	Nil
6	How height of raised ground floor levels was determined	Reference from official datum point	Reference from nearest main access road	From previous flooc water mark on neighboring fence or building	No reference point used to determine floo height	Others
	Out of 20 persons	Nil	5 (25%)	12 (60%)	3 (15%)	Nil

From the data shown in table II over 50% of architects interviewed had designed or supervised to completion at least one building in a flood prone area in Yenagoa since 2012. 10% of the architects interviewed had designed/ supervised at least six buildings from that period till date and just 0.5% had not designed or supervised any building in a flood prone area during this time.

When asked about their level of knowledge regarding flood resilient or adaptation measures, the data revealed that all 20 of them were conversant with raising the ground floor level as an effective precautionary measure. However, only two architects making up just 10% of the number interviewed had any knowledge about water proofing techniques in addition to raised floor levels. Water proofing techniques include the use of cement admixtures, chemicals, linings, wet and dry proofing techniques, sheet layers and other applications that increase resilience. When asked what architectural features each added as precautionary measures for escape or emergency evacuation in event of floods, no architect included escape routes or emergency exits in their design. However, six of them stated that they recommended structural reinforcements for foundation walls of bungalow structures built in flood prone areas that were raised above 1m height.

On the issue of raised floor levels, all 19 architects who had designed or supervised buildings in flood prone areas had recommended building floors to be raised to a minimum of 600mm above previous local standards. 50% of them designed ground floor levels between 1.0 to 1.5m in height, 10% had designed ground floor levels to be over 2.1m while 30% used between 1.6 to 2.0m as ground floor level height. However, one of the added data revealed by the study was how the architects determined the height of the raised ground floor levels on each of their projects. For this information, the data shows that no reference was taken from official datum points or established flood levels given by the Bayelsa State Geographical Information Services (BGIS) which is the government agency responsible for setting such standards and planning regulations. Rather, 60% determined their floor level heights from previous flood water marks on neighboring fences or buildings; a further 25% of the architects obtained their floor heights using the nearest major access roads as reference points; while about 15% did not use any reference point to determine their floor heights.

Finally, when asked how the raised ground floor levels were designed, 90% of the architects interviewed said the raised floor levels were designed as fully covered foundation walls and filled with earth before over site concrete was poured. None of the architects adopted the use of stilts, although just one created a pathway for water under a building using a concrete box culvert technique while another created a basement space under the raised floor level.

DISCUSSION

The study reveals that majority of architects interviewed are acquainted with the effects of flood waters on buildings and have been opportune to design or supervise the construction of buildings in flood prone areas. However, for most, the extent of their professional knowledge is still limited to the basic precautionary measure of raised floor levels and even at that there are little or no innovative, efficient and adaptable designs being employed to these raised floors. Some scholars have recommended raising buildings unto stilts or platforms as well as designing smart buildings that

respond to varying levels of rising water (Balmforth 2016, Kolarevic and Parlac 2015, English 2009). Also, the studies show the architects have little or no knowledge of current flood resilient technologies (FReT) as proposed by Lawson (2011) and discussed by Golz et al (2013) in reducing flood damage.

In addition, the level of paucity of knowledge by architects in the area on designing flood resilient buildings was also revealed in the inclusion of a basement floor as indicated in row 5 of table 2. Building designs with cellars or basements are not recommended in flood prone areas (Kreibich et al 2005). This supports the ICPR (2002) study in Germany which states that buildings without cellars can help reduce flood loss in the residential sector by 3000-6000 EUR.

The data also showed that none of the architects interviewed included emergency exits or escape hatches in their designs as a means by which survivors can escape to elevated positions and await rescue. This issue was discussed in detail as a design feature in buildings in flood prone areas that has been known to contribute to the rescue of lives in several flood events in the world. Its absence is also seen as a major design flaw in building designs in Bayelsa State (Brisibe and Pepple 2016).

The survey indicated that a larger percentage of people who had direct previous experience of flood damage or who knew people with previous experience of flood damage took precautionary measures to make their buildings more resilient or adaptable to flooding. This agrees with the study by DEFRA (2010) which states that people with some experience of household flooding are more than 6-times more likely to take resilience or protection measures than those with no experience.

The study also revealed that 69.6% of home owners and developers cited the issue of cost as one of the major factors why precautionary measures were not taken to increase building resilience against floods. However, Escarameia et al (2012) who examined cost-benefit analysis justified the use of flood resilient building materials for the reduction of flood damage. The economic value of flood damage was estimated by rebuilding/ replacement costs, while damage reduction assessment or value is estimated by various options such as choice of resilient building materials and construction methods e.g. elevated structures. Rogers et al (2015) in a similar study showed that future damage to buildings could be reduced by adopting appropriate building and foundation construction. However, they observed that the cost of building the recommended liquefaction resilient foundation was more costly than other housing foundation types but has been described as critical to building damage reduction.

There are also those who did not take precautionary measures citing faith-based reasons. These made up about 9% of the 112 persons. Their reasons were based on faith in the supernatural for protection over life and property and as such do not feel they need to take extra precautionary measures which in their opinion may only temporarily resist flood waters at best. Similarly, there are those who believe that since the 2012 floods was due to

dam release, the likelihood of an extreme flood event repeating itself could only occur if such dam release were to happen again. Although, there were no facts or studies presented to back this claim, 5.4% of those who did not take precautionary measures, based their decisions on this notion.

Furthermore, the study revealed that the paucity of knowledge by architects about flooding and the reason why some developers did not take precautionary measures was, based on the fact that the building codes/ planning regulations contained no information on flood resilience and adaptation measures to act as guidelines in professional practice. Escamareia et al (2012) observed that for an effective uptake of resilience, there should be regulations to that effect backed up by legislation to make them enforceable. Only few countries in Europe namely; UK, Czech, Poland and Germany have current building regulations covering the use of flood resilient building materials. Although Norway has no specifications with regards to resilient materials, yet there are recommendations on building layout or adaptable designs such as elevation of buildings above certain levels (Escarameia et al 2012).

But it is the US and Australia that currently leads in this study of resilient building materials. The US has standardized building codes updated every 3years that specifically covers the use of flood-damage resistant materials for all structures in flood hazard areas. They have also provided documentation identifying some such materials based on ability to withstand direct and prolonged contact with water, without sustaining damage that requires more than cosmetic repairs. The US has also gone further to propose future standards that use certain methods to determine flood damage resistance ratings of materials, as well as materials that can withstand contaminants carried by flood waters (Escarameia et al 2012).

Lastly, an aspect of flood resilient technologies (FReT) is the building aperture technology which ensures temporary watertight closure of façade openings such as doors and windows, keeping flood waters out to a defined design level. This type of technology can be adopted to aid in reducing damage by flood water ingress through apertures and openings, which is one of the major sources of damage to buildings experienced during the 2012 floods as observed by the post flood management committee (PFMC) in Bayelsa State.

CONCLUSIONS AND RECOMMENDATIONS

With extreme flood events occurring on an ever increasing scale due to the adverse effects of climate change, there is a need to re-evaluate and ultimately redefine the roles of professionals in the built environment. The redefining process puts the responsibility of offering sound advice on built environment professionals like architects, which can preserve huge financial investments in the built environment and potentially save lives. Such advice is based on current knowledge obtained through cutting-edge research and training. For instance, following the increased rate of earthquakes in seismic regions like Japan and China and sweepers in

tornado prone regions in the US over the last two decades, architects in those regions have invested in research into adaptive innovations in buildings for increased resilience to such natural disasters. Immense changes and innovations had to be made not only in material technology but also in design and this was achieved through an evaluation of the previous knowledge and skill set vis-à-vis the current technical know-how required to address such issues.

One of the observations from the study conducted by Anh & Phong (2014) on lessons learnt for disaster resilient shelters in Vietnam was the inadequate level of skills of local builders to construct resilient buildings to combat the enhanced threat of extreme flood events in that region. This study acts as an evaluation of the current knowledge level of architects in flood prone regions like Yenagoa and recommends the need for upgrade in their knowledge of flood resilient technologies (FReT) and flood resilient designs through enhanced training programmes.

The study also reveals that part of the blame no matter how small, for developers not taking precautionary measures lies with the built environment professionals such as architects. With architects being the first point of call in designing flood resilient buildings, their invaluable expertise where it exits plays a key role in the development of society's resilience to disasters like floods. This supports Haigh and Amaratunga's (2010) review on the role of built environment professionals. However, there is a flip side to this issue which is a lack of consultation with professionals in the built environment in developing countries as majority of housing construction is still undertaking on owner-builder basis as observed by Anh and Phong (2014). As such, there is a need for legislation on the inclusion of a registered built environment professional when building in disaster prone areas both at the design and construction stage.

With regards to building codes, besides the countries in Europe listed above and some others in South-east Asia not listed, there seems to be a general lack of building codes and regulations related to disaster risk reduction (DRR) in developing countries. As such, a risk-based building regulation with legal backing to create resilient structures in flood prone areas where development is predominantly owner-built is highly recommended.

Another recommendation that cannot be overemphasized is the setting, implementation and use of code specified flood levels for Yenagoa. This has been used to great effect for cities like New York (Aerts and Wouter Botzen 2011) and Christchurch, New Zealand where current buildings are required to have floor heights above the 200-year flood level including allowance for climate change and sea level rise (Rogers et al 2015). Similarly, after the Katrina floods, the state of Louisiana passed new building codes for floors to be raised to a minimum of 3ft above the highest existing adjacent grade or the local base flood elevation for new or substantially rebuilt houses (FEMA 2006). In Yenagoa, the Bayelsa State Geographical Information Systems (BGIS) have set code specified flood levels for buildings based on post 2012 flood studies which should be adopted for structures in this region.

In conclusion, the study revealed that there have been lessons learnt in post-flood building design and construction, amongst most private developers and home owners as well as professionals in the building industry. However, the factors that have warranted the decisions to either take precautionary measures or not are worth studying for more holistic flood resilience in the built environment to be achieved.

REFERENCES

Aerts, J.C.H and Wouter Botzen, W.J. (2011) Flood-resilient waterfront development in New York City: Bridging flood insurance, building codes, and flood zoning, *Annals of the New York Academy of Science*, 1227, pp. 1-82

Anh, T.T and Phong, T.V.G. (2014) Opportunities to Build Disaster-Resilient Shelter and Settlements: Lessons Learnt from a Housing Architectural Design Competition. *Journal of Civil Engineering and Architectural Research* 1(1) pp. 24 – 31

Balmforth, D. (2016) Flood resilient cities, Proceedings of the ICE HKA Annual Seminar, Sustainable and Resilient Coastal Development

Blanco, A. and Schanze, J. (2012) Conceptual and methodological frameworks for large scale and high resolution analysis of the physical flood vulnerability of buildings – In Klijn, F and Schweckendiek, T (Eds.) Comprehensive flood risk management: research for policy and practice. Proceedings of the 2nd European Conference on flood risk management, FLOODrisk2012, Rotterdam, The Netherlands, 19-23 November, Boca raton: CRC press. pp. 148-150

Brisibe, W. G. and Pepple, T. D. (2016) Attic Habitable: The study of residential roof designs in flood prone areas of Bayelsa State, Nigeria, International Journal of Research in Civil Engineering, Architecture and Design Vol. 4(4), pp. 12-21

Cutter, S.L, Burton, C.G and Enrich, C.T. (2010) Disaster resilient indicators for benchmarking baseline conditions, Journal of Homeland Security and Emergency Management, vol. 6(4), pp. 332 - 344

English, E. (2009) Amphibious foundations and the buoyant foundation project: Innovative strategies for flood-resilient housing, – in Pasche, E, Evelpidou, N, Zevenbergen, C, Ashley, R and Garvin, S. (Eds.) Road map towards a flood resilient urban environment – Proceedings of the COST Action C22 Urban Flood Management in cooperation with UNESCO – IHP, Paris, France.

Federal Emergency Management Agency (FEMA) 2006, Flood Recovery Guidance: Advisory Base Flood Elevations for Orleans Parish Louisiana. Washington: FEMA

Golz, S, Schinke, R, Naumann, T, Garvin, S and White, I. (2013) Assessing the effects of flood resilient technologies – Proceedings of the International conference on flood resilience: experiences in Asia and Europe, 5-7 September, Exeter, United Kingdom.

Grothmann, T. and Reusswig, F. (2006) People at risk of flooding: Why some residents take precautionary action while others do not, Natural Hazards vol 38(1-2), pp. 101-120

Haigh, R. and Amaratunga, D. (2010) An Intergrative review of the built environment disciplines' role in the development of society's resilience to disasters, International Journal of Disaster Resilience in the Built Environment, Vol 1(1) pp. 11-24

Hooijer, A., Klijn, F., Pedroli, G.B.M, and Van Os, A.G. (2004) Towards sustainable flood risk management in the Rhine and Meuse river basins: Synopsis of the indings of IRMA-SPONGE*, River Research Application*, Vol. 20, pp. 343-357

ICPR (2002) International Commission for the Protection of the Rhine, Non Structural Flood Plain Management – Measures and their effectiveness, ICPR, Koblenz

Kolarevic, B. (2015) Towards architecture of Change – in Kolarevic, B and Parlac, V (Eds.) Building Dynamics: Exploring Architecture of Change, Routledge: New York. pp. 9-31

Kreibich, H, Thieken, A.H, Petrow, T.H, Muller, M. and Merz, B. (2005) Flood loss reduction of private households due to building precautionary measures – lessons learned from the Elbe flood in August 2002, *Natural Hazards and Earth System sciences* Vol. 5, pp. 117-126

Kronenburg, R. (2015) Flexible Architecture: Continuous and Developing – In in Kolarevic, B and Parlac, V (Eds.) Building Dynamics: Exploring Architecture of Change, Routledge: New York. pp. 47-66.

Lawson, N, (2011) Glossary of the EU-FP7 research project 'Smart Resilient Technology, Systems and Tools' (SMARTeST)

Naumann, T, Nikolowski, J, Golz, S. (2009) Synthetic depth-damage functions: A detailed tool for analyzing flood resilience of building types – in Pasche, E, Evelpidou, N, Zevenbergen, C, Ashley, R and Garvin, S. (Eds.) Road map towards a flood resilient urban environment – Proceedings of the COST Action C22 Urban Flood Management in cooperation with UNESCO – IHP, Paris, France.

Nikolowski, J, Goldberg, V, Zumm, J and Naumann, T. (2013) Analysing the vulnerability of buildings to climate change: Summer heat and flooding, *Meteoroloische Zeitschrift*, vol. 22(2), pp. 145-153

Rogers, N, Van Ballegooy, S, Williams, K, Johnson, L. (2015) Considering Post-Disaster Damage to Residential Building Construction – Is our Modern Building Construction Resilient? 6th International Conference on Earthquake and Geotechnical Engineering 1-4th Nov. Christchurch, New Zealand

Roy, E., Rouselle, J. and Lacroix, J. (2003) Flood damage reduction program (FDRP) in Quebec: Case study of the Chaudiere River, *Natural Hazards*, Vol. 28, pp. 387-405

Smith, D.I. (1981) Actual and potential flood damage: a case for urban Lismore, NSW, Austrailia, *Applied Geography*, Vol.1, pp. 31-39

Soriwei, F (2013) 2012 flood disaster cost - NEMA retrieved from http://www.punchng.com/news/2012-flood-disaster-cost-nigeria-n2.6th-nema/

Walker, B, Holling, C.S, Carpenter, S. R, Kinzig, A. (2004) Resilience, Adaptability and Transformability in Social-ecological Systems, *Ecology and Society* 9(2)

Watson, D and Adams, M. (2011) Design for Flooding: Architecture, Landscape, and Urban Design for Resilience to Flooding and Climate Change. John Wiley & Sons, Inc. New Jersey

MARKET FIRES AND RISK ACCUMULATION IN GHANA'S BUILT ENVIRONMENT

Ebenezer Owusu-Sekyere[1], Elvis Attakora-Amaniampong[2], Robert Adjuik Yakubu[3]

[1]*Department of Development Studies, University for Development Studies, Wa, Ghana*
[2]*Department of Real Estate and Land Management, University for Development Studies, Wa, Ghana*
[3]*Department of Social, Political and Historical Studies, University for Development Studies, Wa, Ghana*

In the last two decades, traditional open-air markets which serve as centres for livelihood activities in Ghana have also become the ill-fated amphitheatre of incessant fire disasters. The disasters are often blamed on unseen risk accumulation processes. This study examines the risk accumulation processes responsible for the unending fire disasters in the Kumasi Central Market regarded as the largest open-air-market in Ghana. By engaging with some fire (non) victims in the Central Market, through a multi-directional methodological approach, traders' limited understanding of the risk accumulation arising out of their (in) actions is revealed. It is shaped by complex socioeconomic factors, unsustainable planning and development practices and poor management framework, all of which have worked together to add to the risk in the market. Till date, these factors have been poorly understood and documented and therefore traders are reluctant to adopt mitigating measures required to reduce such fire disasters. The study concludes by suggesting a continuous debate on building a resilient market place where all key stakeholders are involved rather than government investment in infrastructure enrichment of this busy public gathering place.

Keywords: central market, disaster, Kumasi, risk accumulation, urbanization

INTRODUCTION

There has never been a time in human history where the urban built environment has been under attack than the turn of the new millennium. This attack is due to rapid and unprescedented urbanization in the past few decades (Owusu, 2011). With over 3.5 billion of the global population living

[1] oseturbo@yahoo.com
[2] osekyere@uds.edu.gh
[3] eattak@uds.edu.gh

Owusu-Sekyere, E., Attakora-Amaniampong, E. and Yakubu, R. A. (2017) Market fires and risk accumulation in Ghana's built environment *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1027-1047.

in cities (UN-Habitat, 2012), the demographic shift has accelerated mainly in countries in the global South through natural increase and rural-urban migration (Oteng-Ababio, 2013). Discourse on the urbanization process in sub-Sahara Africa in particular has focused on the need to develop proper urban policy and planning regimes in order to take advantage of the benefits. In theory, large scale urbanization presents opportunities for innovations to generate wealth, enhance quality of life and accommodate more people within a smaller footprint at lower per capita resource use and emissions than any other settlement patterns as opined by (Satterthwaite, 2011). The same process if not properly managed, can also present serious challenges for proper urban planning. The provision of adequate basic infrastructure commensurate with the growth process can also disproportionately generate and accumulate risk factors in the urban space. It also creates other occupational and environmental conditions which are more vulnerable to both natural and anthropogenic hazards.

In Ghana, the urbanization process is characterised by the increasing scale of risk accumulation. Risk accumulation refers to all the risk factors that can lead to large aggregate losses from a single disaster event (UNISDR, 2011). The continuous accumulation of risk has resulted in losses from catastrophic anthropogenic disasters. Their effects are manifested by the number of lives and property lost as well as the perpetual destruction of vital livelihood support systems. Additionally, the basic arrangement for the smooth functioning of the urban systems are sometimes severely destroyed. The after-effects weigh heavily on the urban poor, whose daily lives are characterized by hard labour with little rewards. Eventually, the resources needed desperately for development to escape the excruciating poverty are then diverted (Pelling, 2010) a situation which can be viewed as the ill symptom of the social pathology (UNISDR, 2011). As Ghana's urbanization process engenders unemployment and social exclusion, the urban population has taken traditional market places (open-air markets) as assets for livelihoods as there are no entry restrictions (Owusu-Sekyere et al., 2016). These markets have been described by Monteith (Undated:1) as having dual significance; "on one hand, they offer opportunities for the forging of new relationships, or 'fictive kin', beyond the confines of consanguinity and affinity. On the other hand, they are intensely competitive places in which strangers skilfully intrude into one's life. Succeeding in the market therefore requires the striking of a skilful balance between accumulation and redistribution, disclosure and concealment". A third dimension of market place is that they have become centres of intense risk accumulation resulting in extensive fire disasters.

In the past ten years or more, the incidence of market fires has attracted both academic and policy attention as evidenced by available literature (see (Daily Graphic, 2013; GNFS, 2013; Oteng-Ababio et al., 2015). These interests have tended to concentrate on perceived causes and mitigation practices especially from the institutional and political perspectives. However, how the social organization of the market and how the activities of traders have fuel the risk accumulation and contributed to the frequent

fire out breaks in the markets have not attracted research and policy attention. Search for literature on the subject matter, to the best of our ability did not yield much evidence. Motivated by the general lack of research, this paper examines fire risk accumulation in the Kumasi Central Market. The study employs a non-lineal approach, looking at both local conditions and internal forces and how they interact to create vulnerability in the Market. The study has become necessary because traditional markets in Ghana do not exist as stand-alone entities. They are all part and parcel of often shared geographical, social, environmental and political contexts. For that reason, any calamity that affects the markets affects the entire nation. It is for this reason that the study intends to stimulate local and national debate in order to re-imagine shared approaches to capture the most effective fire risk interventions to facilitate building sustainable cities. The rest of the paper is divided into five sections. The next section discusses the theoretical foundations of the study. It is followed by the literature review while the next section concentrates on the research methodology. The results and discussions is presented in section four. We present the conclusions and recommendations in section five.

FIRE DISASTERS IN GHANA: LITERATURE PERSPECTIVE

Table 1 Number of Fire Outbreaks in Ghana and their Estimated Cost (2000-2011)

Year	Total No. of Fire Outbreaks	Estimated Cost of Damage GHS
2000	2,214	789,721.41
2001	2,432	1,459,203.30
2002	2,721	1,249,933.91
2003	2,647	2,039,229.20
2004	2,418	1,430,306.03
2005	2,436	5,061,077.90
2006	2,606	2,896,460.35
2007	3,199	751.927976
2008	3,249	795.857075
2009	2,858	698.829252
2010	2,587	35,998.21
2011	1,335	199.380808

Source: Ghana National Fire Service Headquarters Database, Accra (GNFS, 2013).

Fire disasters represent the dominant hindrance to Ghana's forward march to poverty alleviation. While there are historical accounts of fire disasters even during the pre-colonial and post-colonial period, the most significant of all fire disaster was that of 1983 (Sam-Okyere, 2010). This monumental disaster took the entire country hostage and triggered crisis of all forms,

none that has ever happened in Ghana in recent past (Sam-Okyere, 2010). Available data from the Ghana National Fire Service (GNFS, 2013) further shows an increasing trend of fire incidence in Ghana since the turn of the new millennium (see table 1). Not only have fire disasters increase overtime, the cost implication is also a source of worry, (table 1). What this means is that if fire disasters are not controlled, resources needed for other investments for the total development of the nation will be affected.

Besides economic cost, deaths and injuries due to fire disasters also show a worrying trend. For example, Addai et al. (2016), reports that both injuries and mortality rates resulting from fire disasters from 2007 to 2013 showed an upwardly unacceptable trend (figure 1). In 2012, over 375 deaths occurred from 4,995 fire disasters while over 379 people lost their lives from 5,489 fire disasters across the country (Addai et al., 2016).

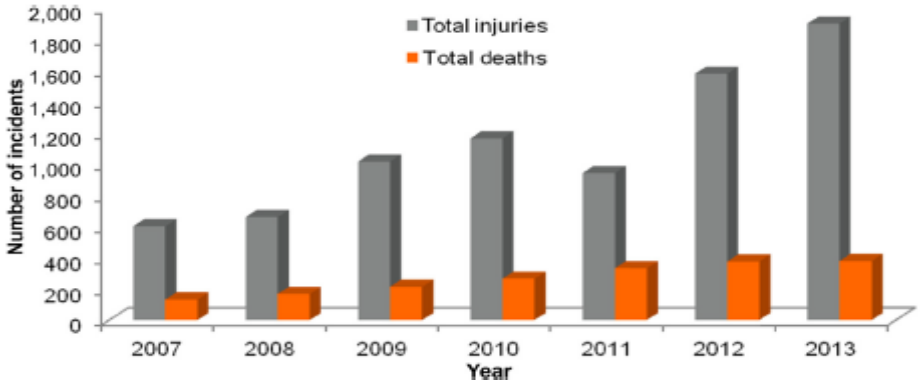


Figure 1 Injuries and Mortality Cases Due to Fire Disasters from 2007 to 2013
Source: Addai et al., 2016

In terms of market fire disasters, its cumulative effects threaten the sustainability of the urban centers as enginge of growth (Oteng-Ababio, 2011). It also poses a great challenge to the institutional and urban governance structures, which have tended in most cases, to deal with the problem in a reactive, adhoc and often ambiguous manner (Owusu-Sekyere et al., 2017). The city authorities appear clueless and helpless due to their failure to consciously engage in any systematic data collection and analysis to aid policy formulation for sustained intervention. Indeed, how the current land use planning, governance structure and policies have helped create and facilitate the current risk accumulation within the open-air markets have not been expolored. This study intends to fill this yawning gap using the Disaster Crunch Model (OXFAM, 2012).

THEORETICAL FRAMEWORK

The study adopted the Disaster Crunch Model. The model, also called the Disaster Pressure and Release Model helps practitioners to understand and react to people's vulnerability to disasters. The Model was first introduced into disaster management by Blaikie, Wisner et al., in 1994. The model has

two main dimensions: hazards and vulnerability, both of which influences disaster risk (figure 2).



Figure2: The Disaster Crunch Model
Source: OXFAM, 2012

The Model states that disaster occurs when trigger events (hazards) and unsafe conditions (vulnerability) work together. The level of disaster risk therefore depends on the magnitude of the hazard and degree of vulnerability of the people. From that perspective, without hazards meeting vulnerabilities, disaster will not occur. "A natural phenomenon by itself is not a disaster; similarly, a population maybe vulnerable for many years, yet without the "trigger event", there is no disaster" (OXFAM, 2012:5). The causes of vulnerability is in the socio-economic and political processes. These processes must be addressed in order prevent disasters from occurring.

Globally, human systems are under considerable strain from mega-disasters on an almost unheard of scale (CRED, 2007; FAO, 2008). While natural disasters present significant risk to humanity, human-made disasters such as road traffic accidents, wars, invasions, massacres, riots and terrorism also continue to put society at risk (Archer & Somsook, 2010). With mounting national and international concern at the rising frequency and severity of the impact of disasters, there has been a shift in disaster management strategies of the 1990s which focused primarily on post disaster activities. Disaster management is now approached from risk reduction perspective (UNISDR, 2011). Countries are therefore required to put in place legal, institutional, policy frameworks, administrative mechanisms and procedures in order to reduce the destructive effects of disasters on the lives and livelihoods of individuals and communities. We adopted this model because it can help policy makers understand the effects of disasters in order to build sustainable cities and translate their understanding of the effects of disasters into appropriate practices.

MATERIALS AND METHODS

Historically, the Kumasi Central Market is believed to have started as a small converging point for traders in the latter parts of the sixteenth century (Mensah, 2014). The "Great Market of Kumasi" as it was called extended in geographical space during the peak of the Ashanti Empire in

the seventeenth and eighteenth centuries, when travellers from Northern and Southern Ghana and the neighbouring kingdoms came to trade in Kumasi (Mensah, 2014). In 1936, the Manhyia Palace (the seat of Ashanti Kingdom) moved the market to the Subin constituency, a political demarcation regarded as the centre of Kumasi in order to increase socio-economic activity (KMA, 2014). The geographical centrality has catapulted it to grow to become the major centre for the exchange of both locally produced and imported commodities from other African countries, and some countries of the global system. It is also home to some migrants who are struggling to access accommodation in the already congested city. Figure 3 presents the current structure of the Kumasi Central Market. The Market initially covered 25 hectares and had about 119 original blocks of stalls and stores, laid out in back-to-back rows during the initial development (Boateng, 2013). Currently, it covers more than 40 hectares of land with over 5000 stalls many of which are illegal makeshift structures. The UN-Habitat describe the structures as "derived from village prototypes but are modified by the requirements of space and the availability of materials - plastic, tin, bits of cloth, wood and bricks, which draw on past and present materials" (UN-Habitat, 2008: 69). About seventy percent are without legal electricity connectivity (KMA, 2014). Conservatively, it is estimated that over five million people engage in commercial activity in the market everyday (ibid).

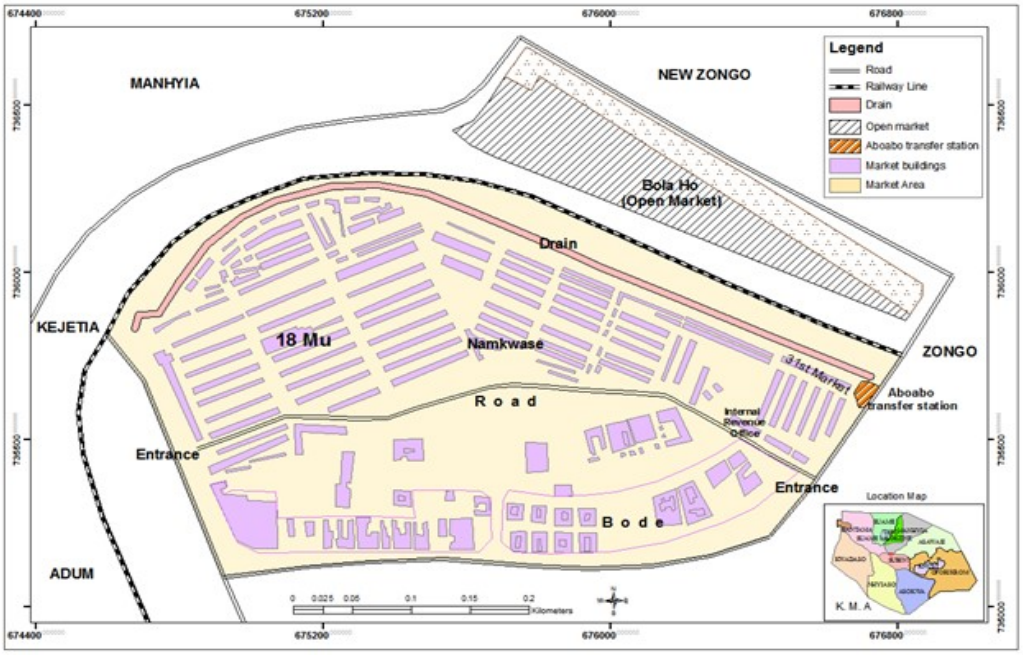


Figure 3 Structure of the Kumasi Central Market
Source: KMA, 2014

DATA COLLECTION

The multistage sampling technique was adopted. The systematic random sampling was first used to select 500 participants of both victims and non-victims of fire disasters in the Market drawn equally from ten zones of

identical items sold. The ten zones were used because the market structure is already laid out according to commodity sectors. Though suffice to say that in most cases such segmentations according to commodities become indistinct and completely jumbled up as many more people congregate into the market and capture every available space. Within each zone, 50 respondents were randomly selected and one trained research assistant was assigned to assist the participants to complete the questionnaire. The questionnaire was divided into three sections. Section one was on participants' bio-data. Section two, and perhaps the most important explored respondents" knowledge on the risk accumulation process in the market, the role in averting some of the perceived risk, their expectation of city authorities in averting the risks and the losses they incur in some of the fire disasters. The last section offered respondents the opportunity to state some the mitigation processes at both local and national levels and prescribed some recommendations.

Beyond the survey, in-depth interviews were held with 10 representatives (market Queens and Kings) of the ten zones selected for the study. The market Queens and Kings liaise between the traders and city authorities on all issues concerning the management of the market and were also in charge of the welfare of the traders, an important aspect of the social arrangements in the market. They were therefore in a position to identify the potentially vulnerable groups (areas) within the market; the level of fire risks; the general impacts of fire disasters and coping strategies. In order to obtain a more balance perspective, an additional 5 in-depth interviews were conducted with the regional heads of the National Fire Service, Ghana Police Service, National Disaster Management Organization and the Kumasi Metropolitan Assembly. The questions sought their views and perception about the fire risk accumulation process in the market, trend of fire disasters in the market, the mitigation measures put in place and future strategic plan for the market. In order to appreciate the extent and magnitude of the problem series of site observations were done.

The third set of data collection involved three different focus group discussions with some fire victims. The discussants were recruited during the reconnaissance survey. The purpose of the FGD was to explore some of the issues in greater depth. Each group had nine participants. Among the issues that were explored included their understanding of incessant cause of fire outbreaks in the market; the response from GNFS, their losses, the extent of venerability of the market, the range of options for reducing fire risk and the need for fire insurance. In order to help fill the missing link and also validate and cross-check the primary data non-participant observation approach was adopted to provide insights into risk accumulation process in the market. The data from the survey were computed and analysed with the Statistical Package of Social Sciences (SPSS 17). The data from the interviews and FGD were organized into themes and used to complement the survey research results. The results were conceptualized through data interpretation based on the real areas of analysis.

RESULTS AND DISCUSSIONS

Management syntax of the Kumasi Central Market

The management of the Kumasi Central Market, like any other market in Ghana, is the responsibility of the Ministry of Local Government and Rural Development and is governed by the Local Government Act 462. The Ministry performs this responsibility with the assistance of other allied ministries (see table 2).

In line with the law, the MLGRD has ceded the responsibility of open market management to the various Metropolitan, Municipal and District Assemblies (MMDAs). Consequently, the KMA has put together a management team in charge of the Central Market headed by a manager. The team is made up of officials from the security agencies including the GNFS, the Metropolitan Assembly and the market representatives among others. The understanding is that each member of the team will bring their expert knowledge to bear towards building a sustainable market place. The manager, who is the representative of the local authority is responsible for the day-to-day management of the facility including the provision of security and sanitation, as well as for the orderly operation of trading activities (KMA, 2014). The manager and his team are also to ensure that all rules regarding the management of public spaces including the Central Market are adhered to. This in principle means that the market ought to have a police station, a clinic, and a fire station and so on. A key informant revealed that it is in line with this thinking that led to the establishment of the Zongo and the Manhyia fire service stations. He further explained that the Manhyia Hospital (state-owned) and the numerous private clinics were given the licence to operate due to their proximity to the market.

Table 2 Management Arrangement of the Central Market

Institution	Functions
MLGRD	-Responsible for the general management of markets and supervise the MMDAs. By the loca government Act, Act 462, local authorities are mandated to establish, develop, manage an maintain markets -The Act gives MLGRD three responsibilities to policy and planning; legislation on market management; and regulation, monitoring, and enforcement of market activities.
MEST (EPA	-Through EPA, the guiding ministry accountable for formulating environmental laws an quality standards for the general management of markets
MOH	- Guiding institutions of the health sector have the regulatory authority that includes th sanitary aspects related markets management, in which they intervene through regulator activities and sanitary control. -They are in charge of issues pertaining to public and occupational health, hygiene an sanitary surveillance related to markets management
MoI	- The Ministry of Interior through the respective security agencies such as the National Fir Service, the Police Service, the Military and so on set some standards for fire disaste prevention and also respond to emergency situations. The MOI through GNFS provid technical advice for building plans with regards to machinery and structural layouts in orde to reduce the impact of fire disasters should they occur. They also offer rescue and evacuatio services to those trapped by fire and other emergencies and undertake any other function incidental to fire disaster profile of the state.

Source: MLGRD (2002).

The Zongo fire station and the Zongo police station which originally seemed a bit distant away from the market have now been embedded into the market due to the rapid expansion. While firefighting facilities at the station were described by our key informant as inadequate, it was still sufficient to provide a first stop shop for fire prevention. He explained in an interview:

"What we do is that we try to put out fire that will start in the market and where the magnitude of the fire was beyond our ability, we call for re-inforcement from the Manhyia and other nearby fire stations".

He further explained that beyond firefighting, they also make sure risks related to fires are reduced to the barest minimum through protecting fire hydrants, public education and sometimes free distribution of fire extinguishers. Apart from the officially constituted management board, the study found another management team that was born out of the social arrangement of the traders - Market Associations. The market associations are made up of the various market Queens and Kings who represent their colleagues who deal in similar commodities. The leaders of the market associations in short, represent commodity associations. The research revealed that there were over forty commodity associations including Wax Dealers Association, Second Hand Clothes Dealers Association, Tomatoes Sellers Association, Beef Sellers Association and the list is endless. The rationale is predicated upon social support and is represented by informal networks within the market such as family and friendship relationships that build support mechanisms (Sherrieb et al., 2010).

One underlying principle of the market associations is to foster social relationships which is perhaps one of the clearest expressions of the importance of cooperation and collective action. In most cases, these commodity associations were voluntary associations which provided economic and social benefits for their members. The leaders of the individual associations regulated businesses in their sector by ensuring fair play in business transactions and settling disputes among members. They also undertake external negotiations with other associations and with the external regulatory and policy environment, especially local government agencies. Some also provide financial assistance to members to sustain or expand their businesses. This system serves as a more useful and practical alternative to private money lenders and established financial institutions, which charge exorbitant and prohibitive loan interests (Oteng-Ababio et al., 2015). While the informal associations have been accepted as part of the management structure of the market though without government remunerations, very often each entity, tends to claim their superiority over their space of jurisdiction and has tended to create turf wars due to lack of clearly defined roles and responsibilities especially issues on tax, dues and a laison role with higher political authority at the national level. Irrespective of the source of conflicts, one purpose unites them all – building a risk-free market where people can engage in their rightful economic activity.

Kumasi Central Market fire disasters in retrospect

Table 3 Incidence of fire disasters in the Kumasi central market

Date	Year	Magnitude of the Disaster
30th June	1993	several shops were destroyed
18th July	1994	several shops were destroyed leading to market closure
14th November	1994	several shops were destroyed leading to market closure
11th October	1995	several shops were destroyed leading to market closure
11th January	1996	Over 25 shops were destroyed
16th April	1996	Over 705 shops were destroyed
17th December	1996	Over 60 shops were destroyed
12th November	1997	less than 15 shops were destroyed
1st January	1998	less than 12 shops were destroyed
2nd September	1998	less than 10 shops were destroyed
11th December	1998	less than 7 shops were destroyed
8th January	1999	less than 12 shops were destroyed
31st January	1999	less than 11 shops were destroyed
22nd October	1999	Over 55 shops were destroyed
29th October	2000	Over 290 shops were destroyed leading to market closure
21st November	2000	less than 5 shops were destroyed
4th July	2001	less than 7 shops were destroyed
11th November	2001	less than 9 shops were destroyed
5th April	2002	less than 5 shops were destroyed
14th June	2002	less than 19 shops were destroyed
22nd February	2005	Over 200 shops were destroyed leading to market closure
9th March	2007	over 608 shops were destroyed leading to market closure
28th May	2009	Over 679 shops and their content were destroyed
2nd January	2010	Major 360 shops and their content were burnt
16th April	2012	Over 234 shops and their content were destroyed
19th April	2012	Over 321 shops and their content were destroyed
30th December	2012	Over 233 shops and their content were destroyed
9th February	2013	less than 12 shops were destroyed
22nd March	2013	less than 11 shops were destroyed
2nd June	2013	less than 6 shops were destroyed
16th June	2013	Over 620 shops and their content were destroyed
26th February	2014	Over 150 shops were destroyed
13th March	2014	less than 11 shops were destroyed
11th May	2014	Over 40 shops were destroyed
21st May	2014	Over 330 were destroyed
28th June	2014	Less than 3 shops were affected
17th July	2014	Over 2000 shops were destroyed
24th August	2014	Less than 7 shops were affected
24th November	2014	Less than 7 shops were affected
6th January	2015	Less than 11 shops were affected
4th February	2015	Less than 9 shops were affected
14th October	2015	Less than 8 shops were affected
29th December	2015	Less than 9 shops were affected
7th January	2016	Over 99 shops were destroyed
21st July	2016	Less than 5 shops were affected
30th September	2016	Less than 3 shops were affected

Source: GNFS, 2017

The Central Market has suffered several worse fire calamities over the years (table 3). However, the worst disaster hit the market on 28th May 2009 when fire broke out at the "French line" occupied mostly by dealers in used clothing. According to officials of the National Fire Service, it took the fire officers about six (6) hours to bring the fire under control after deploying eight (8) fire tenders to the scene. The cost of that outbreak was estimated at GHS 5,242,030.00. This excludes the 430 traders whose loses could not be estimated immediately. Beyond this monumental fire disaster, the market has over years suffer series of fire disasters of different magnitude (see table 3).

This list though not exhaustive, shows the extent of vulnerability of the market. This calls for the need to investigate what constitute risk accumulation in the market.

Risk accumulation in the Central Market

Risk accumulation as used in this context refers to the set of actions or factors that are likely to cause fire disasters. This section of our fieldwork explored the traders understanding of the risk accumulation and the causes of the incessant fire disasters in the Central Market from the perspectives of both traders and disaster management institutions. The field survey revealed varied results on the traders understanding of what constitute risk accumulation process in the market (see table 4).

Table 4 Traders' Understanding of Risk Accumulation

Risk Accumulation	Contribution to Fire Disasters
Electrical fault	Poorly repaired electrical faults and unattended to electrical problems affects functioning of electrical systems and these serve as source of fire outbreaks
Fluctuation and irregular power supply	Fluctuations and irregular power supply often leads to surge in voltage and this often leads to fire disasters
Arson	Traders deliberately set their stores on fire in order to outwit financial institutions and other lenders
Spiritual factors	When source of fires are blamed on superstition where traders who are believed to have sought spiritual help for the growth of their business fail to pay back the spiritual price

A more nuance analysis of the traders' responses shows that traders are not aware of the specific factors that are responsible for the continuous outbreak of fire disasters. This also in a way may affect the prevention strategies that ought to be in place. This is because as noted by Pyles (2007), knowing the cause of a disaster event helps in building short, medium and long-term preventive strategies. Respondents gave reasons for their understanding of what has been causing fire disasters in the market. For example, a respondent explained that the irregular power supply commonly called 'Dumsor' in Ghana was the result of the fire outbreaks. She explained further:

"sometimes the Electricity Company of Ghana can put the light out many times and in the process, some of us will leave our gadgets on and go home so when power is restored, the occaisional surge results in the electrical connections catching fire. If they want the fire to stop, they must also stop the Dumsor", she concluded.

While many other participants agreed that Dumsor constituted risk accumulation, arson and superstition also featured prominently in the field survey. A trader at the Kente line explained:

"People who go for loan and know they cannot payback deliberately set their shops on fire so that their creditors will write-off the loan. I have been in this market for more 30 years and I know what I am talking about", she ended emphatically.

On her part, a 56 year old second-hand cloth dealer believes that the set of spiritual factors constitute serious risk in the market. According her, there is a general notion that many traders seek the assistance of magico-spiritual leaders in order for their business to grow.

"This help comes with a price that must be paid but many a time, these traders fail to pay back after things start to work positively. In this case the spiritual people will punish them for not honouring their promises. I have this believe because with many of the fire disasters, investigations by so called expert have not been able unravel the cause of the fire events. If it is not spiritual, then what else", she asked.

These sentiments represent the general thinking in Ghana on the role of magico-spiritual factors in disaster events (NADMO, 2015). It also presents a challenge to disaster managers on how to proceed in reducing the risk accumulation in the market. This is because issues with spiritual connotations lack empirical evidential proofs even in Ghana's courts of law. While traders believed that the risk accumulation were purely socio-religious, officialdom in disaster management thought otherwise (see table 5).

A comparative analysis of the responses from both official and the traders' perspectives shows a common trend- electrical problem. The results show that the Electricity Company of Ghana (ECG), an agency responsible for the provision of electricity does not have office in the market. In the event, prospective clients rely on unqualified way-side electricians for connections to the national grid. Explaining why they (traders) do not follow the laid down procedure to be connected to the national grid, various reasons such as long bureaucratic procedures, high cost of connections and some legalistic terms of engagement were given. Supporting this claim, a 42 year old Kente (Royal cloth) seller indicated:

"Sometimes, it takes even more than three weeks to complete just application forms. After the completion of the forms, you have to pay a lot of money before they will come and connect".

Table 5 Officials" perspective on risk accumulation in the Central Market

Risk Accumulation	Contribution to Fire Disasters
Old wiring system	Insulated materials are removed and therefore easily catches fire
Overloaded sockets	Overloaded sockets easily exceed the capacity of socket and
Naked fire from gas cookers	the easily gets heated up can catches fire
Water heaters	Unattended to Gas stoves gets heated till the gas cylinder explodes
Illegal wiring systems	Water heaters are left in bowls unattended to and wen wate runs dry, the heater explodes and catches fire
	Illegal means of connection by unqualified electricians has heightened the risk of fire in market

Analysis of ECG documents shows that the company follows strict compliance rules in connecting customers to the national grid. Explaining further the public relations officer outlined the procedure of getting connected:

"Before one gets connected to electricity, one has to present the site plan or any legal title to the facility before getting connected to the national grid. However, many of the structures are illegal and because the ECG does not recognize these structures as formal, the traders have resorted to illegal mode of electricity connections within the market by hooking wires to electricity poles to connect electricity to their structures. This illegal means of connection has heightened the risk of fire in the market", he concluded.

Personal observations revealed that electricity connections constituted two sets of risk.

While the first set of risk, i.e. poorly wired illegal structures have been amply explained, another set of risks was where legally connected structures have hanging wires and poorly fixed switch boards (example figure 4).



Figure 4 Poorly Wired Structure in the Kumasi Central Market

Physical observations and confirmed by an ECG official shows that this situation further heightened the risk accumulation processes.

Managing Fires Disasters in the Kumasi Central Market

In theory, the management of any form of disasters including fire is done at two different levels (GNFS, 2011). The first level is the preventive stage where resilient and risk reduction measures are put in place to prevent the disaster from occurring or even when they occur, the impact might be less (Guyiri, 2014). The second level of fire management involves activities of dousing the fire ones it has started. The success of any of the levels requires collective efforts from all stakeholders. In the case of the Kumasi Central Market, two key stakeholders are very critical in that direction – the traders on one hand and legally mandated disaster management institutions on the other hand. These institutions play major roles in fire management in the areas of prevention, control, rescue and assisting victims of fire outbreaks (Local Economic Development for Africa, 2014). An examination of existing documents from the GNFS and supported by our field interviews show that they use a variety of approaches to educate traders against fire disasters (table 6).

Table 6 Risk Communication Approach adopted by GNFS in Kumasi

Before Disaster	Action	Activities
Empowerment	Community development: resourcing and facilitating traders for self-reliance	Resourcing emergency organisations, i.e. fire service, ambulance and police
Collaboration	Community education: fire risk problem solving at all level, multi-faceted approach	Reconstruction advisory committee: collaborative disaster committee (MDPC)
Consultation	Community Education: problem solving individual or small group(two-way), face-to-face	Workshops, demonstration simulation, small public meeting on training, fire etc
Information	Public awareness, one-way	Information line: radio education, drills etc. What to do/not to, how to escape in the face of fire, e.g. run out and call fire service
Manipulation/ therapy	Social marketing, one- way persuasion, house to house, face-to face education, texting of safety messages to phone etc	Advertising campaign through radio, TV etc.
Non-participation	Emergency announcement	Warning of fire incidents, use of fake electrical materials, creating the awareness of possible causes of fire

Source: GNFS, 2017

The approaches they use are interactive processes of sharing information and opinions between stakeholders regarding the nature and associated risks of a hazard on the individual or community and the appropriate

responses to minimise the risks (O'Neill, 2004). The approach was designed to change people's perception of the risk and to increase their willingness to manage the risk. Each of the six components presented in table 6 postulate different important messages at different stages of the risk prevention process. It is important to state here that in risk prevent education, Information that talks about risk magnitude may be most important in making people aware of risks they have never heard of, while information about personal susceptibility may matter more in the transition from awareness to the decision to act (Sandman, 1994). For this reason, each stage of the information process requires different messages because of the changing perceptions of risk. One of the keys to this approach is the use of the warning time. During the warning period people's perception of the risk becomes more realistic, the costs of action goes down and the benefits increase.

The head of communications at the Ashanti Region GNFS observed that the overall intention of adopting these approaches was to make traders aware of what constitute risk accumulation so that the incidence of rampant fire disasters in the market will be reduced. The study unmasked the key challenge with this approach. The nature of trading activities afforded the traders little time to participate in the programmes designed for fire prevention. A situation that also defeats United Nations International Strategy for Disaster Reduction (UNISDR) which is premised on building resilient cities through disaster risk reduction (UNISDR, 2010). As part of market fire prevention activities, traders are required to have basic fire prevention gadgets including fire extinguishers, smoke detectors and fire alarm systems in their facilities. These gadgets are expected to be used to douse fire events or detect potential fire risk at the early stages before the GNFS is called to action. The field observations and survey indicate that not only are these gadgets absent from the shops, where some are present, traders were not aware of their functions or how to operate them. Table 7 shows the availability or otherwise of fire prevention gadgets in shops in the Central market.

Table 7 Traders' fire disaster prevention

	Extinguisher	Fire Alarm	Smoke Detector	Sand
Stalls	x	x	x	x
Stores	√	x	x	x
Supermarket	√	x	√	x
Warehouse	√	x	√	√

√ - available
X – not available

One insightful finding was that with the exception of fire extinguishers that were available in almost all the contacted facilities but for a stall, none of the shops had fire alarm systems. The research further showed that bigger shops were conscious of having fire prevention facilities that smaller shops.

A twenty-seven year old warehouse attendant displayed his ignorance about the purpose of the fire alarm system in his shop when he opined:

"I came to this shop to meet it and I have not asked my madam what it is used for. In fact, I have not asked because it is not part of my duty to ask what it is".

Personal examination of some of the gadgets indicates that perhaps, some of the gadgets were as old as the building facility and have become outdated. The dust and cobweb at the site of these gadgets pointed to the fact that for a long time, they had seized working. Apart from lack of knowledge on the functioning of the fire prevention gadgets, majority of the traders who participated in the study were not aware of emergency telephone numbers disaster management organization (see table 8).

Table 8 Traders' Knowledge about Emergency Numbers in Percentages

Institution	Yes	No	Total
Fire service	33	77	100
Police Service	35	75	100
Ambulance	25	85	100
Radio Station	47	53	100

For over 77 percent of the participants, knowledge of emergency numbers the GNFS, the most important fire disaster management agency was not a priority. For Ambulance services 85 percent of respondents did not know how to reach them via telephone. Obviously for such traders, calling disaster manage organizations in times of difficulties was not an option. The in-depth interviews showed that the lack knowledge of emergency numbers was due to the literacy level of the traders. On average over 65 percent of traders in Ghana (GSS, 2010) cannot read or write but are ironically able to do financial transactions with no difficulty. For some of the traders however, keeping the numbers in their head was not important because as, a 34 year old wax dealer explained:

"Even when you call them (referring to GNFS) they will not come early and sometimes too when they come, they easily run out of water and therefore are unable to save the situation".

A key respondent also explained that instead of keeping all the different emergency numbers, what they do is to call radio stations in times of fire disasters so that a broadcast is made. For many in Kumasi in general, relying on radio stations for emergency announcements have become the norm. This may perhaps be the confidence and the credibility the media had built over the years. Beyond prevention, responding to fire disasters with promptness was also observed to be the greatest challenge in fire management in the Kumasi Central Market. A key informant at the regional GNFS in an in-depth interview enumerated some of the major challenge. Congestion in the market leading to near inaccessibility was very key. Our personal observation shows that illegal structures have taken over

the pavements and other relatively bigger lanes for vehicles with impunity. Similarly, the paved floors had been taken over by street traders. Additionally, shop extensions have also added to the encroachment (see figure 5).



Figure 5 Congested Kumasi Central Market

Our key informant at GNFS explained further:

"The indiscriminate placement of containers by the traders at the extreme end of the market from the Aboabo station has rendered the lane inaccessible for vehicles. Anytime there is fire outbreak, our men will have to push away many of the unauthorized structures, a process that further limits the firefighting ability of the GNFS to quench the fire promptly".

Available statistics from the GNFS indicated the Central Market has a total of sixteen fire hydrants out of which ten were functional as the time of our study. The field observation highlighted the poor state of the functional fire hydrants. A greater majority of the functioning hydrants had been obstructed by unauthorized structures (tables, wares etc.) and this made their location difficult. All the hydrants were the screwed down type installed in pits below ground level. We observed instances where the screws had entirely been covered with refuse, a situation that made their location inaccessible. As our key informant noted:

"But the for congestion and limited number of fire hydrants, fighting in the market should not be a problem". He concluded.

Contrary, a key informant (trader) blamed the market managers for the congestion in the market. He explained further:

"If they (referring to managers) were up to the task by ensuring that all rules were followed, the market will not have been congested. It is their duty to make sure that all unauthorized structures, those who sell in front of shops and those who sell on pavements and walkways are removed. This they don't do and even take revenue from them. How can you take revenue from someone who is trading illegally"? He asked.

In principle, legally sanctioned in-filling of dilapidated structures and empty spaces to create more shopping spaces as a means absorbing the increasing numbers of traders though acceptable, these new structures were sometimes put up in zones of instability in connivance with the market managers without recourse to sound architectural design and fire safety considerations. Such structures often sat across covered or buried utility facilities service networks from drains; power, water, communication cables to hydrants. A situation that further added to fire risk in the market.

CONCLUSION

From all indications, the growth of cities will be the single largest influence on development in the 21st century. This urban growth presents both possible opportunities and potential constraints. As already indicated, the growth of cities in theory, may increase average incomes. On the opposite side, the massive urbanization will also increase urban poverty faster than can be anticipated. This study focused on how massive urbanization in Kumasi has led to the concentration of people in the Central Market and how such congregation of people has contributed to fire risk accumulation in that limited geographical space. The trigger events and the state of vulnerability were real. Our analysis shows that the configuration of the Market and the seemingly unregulated trading activities had been the main contributing factor to the risk accumulation process within the Market. The trigger events such as overloaded electrical installations, poor application of electrical appliances, exposure to naked fires among others have all been contributing to risk accumulation in the market. Similarly, vulnerabilities such as congestion, the use of prohibitive building materials and inaccessibility to fire hydrants as exposed by the disaster crunch model all contributed to the increasing risk accumulation. While the risks were generated at the individual level, the overall aggregated effects on the sub-national and the national economy were dire. We further observed that while fire risk was real and visible in the Market, traders were unaware of how the fire risk accumulation was due to their (in)actions and therefore were reluctant to put in place preventive measures.

There is every possible indication that the Central Market is not going cease expanding. With the predictable expansion of trading activities in the face limited availability of land and capital for the development of modern open-air markets, city authorities need to step their game up in reducing the fire risk accumulation process. While the Ghana National Fire Service Act of 1997 (Act 537) enjoins the service to be responsible for preventing and managing undesired fires including fire safety, backing the rhetoric with concrete action on the ground is the most important. So far, the study suggests that the Market has become a free for all arena. No rules work. Traders have become masters to themselves as the overriding profit motives have tended to overshadow risk aversion responsibilities. Again, the Metropolitan Assembly's unbridled appetite for revenue have also overshadowed the need to build a disaster free market place. The reality is that the safety of the market cannot be guaranteed in the face of haphazard

development. It is for this reason that the all hands – on - deck approach is being suggested beyond government investment in massive infrastructure enrichment of this busy public gathering place. This approach is suggested because the research has shown that in all the fire disasters, livelihoods were perpetually destroyed, government revenue needed for national development were affected and in some cases lives were lost. Again, we make this suggestion against the background that fire victims, after counting the cost realize that the disaster could have been averted or its impact reduced if they had understood the fire risk accumulation in the market.

REFERENCES

Addai, E., K., Tulashie, S., K., Annan, J., S., Yeboah, I. (2016). Trend of Fire Outbreaks in Ghana and Ways to Prevent These Incidents, Safety and Health at Work, 7, 284-292

ADPC, (2004). Reducing Fire Threat to Homes: Piloting Community-Based Fire Risk Assessment in Ban Hatsady Village.

Archer, D. & Somsook. (2010). Seeing a disaster as an opportunity; harnessing the energy of disaster survivors for change, Environment and Urbanization, 23(2)

Blaikie, P., Cannon, T., Davis I. and Wisner, B. (1994). At Risk: Natural Hazards, People's Vulnerability and Disasters. London and New York: Routledge (new edn 2004).

Boateng, W. (2013). Electricity Company of Ghana Explains Causes of Fire Outbreaks. Ghanaian Times, Thursday, 24th January.

CRED. (2007). EM-DAT: The OFDA/CRED International disaster database. Centre for Research on the Epidemiology of Disasters, [Geo-2-330].

Daily Graphic (2013). Ghana records 265 fires in two weeks of 2013 Daily Graphic; Saturday June 15, 2013. 2

FAO. (2008). Disaster risk management systems analysis: A guide book, Viale delle Terme di Caracalla, 00153 Rome, Italy

Ghana National Fire Service (2011). Ghana National Fire Service Act, 1997. Retrieved January 6, 2016 from: http://www.epa.gov.gh/Ghanalex/Acts/GhanaNationalFireServiceAct,1997

Ghana National Fire Service (GNFS) (2013). Ghana National Fire Service Annual Report. Accra Ghana.

Ghana National Fire Service (2017). Incidences on Fire Outbreaks in the Kumasi Central Market: An Annual report.

Ghana Statistical Service. (2010). 2010 Population and Housing Census.

Guyiri, B.J. (2014). Makola Market on Fire. Retrieved March 16, 2015 from:

http://www.ghananewsagency.org/social/fire-outbreak-at-makola-no-2-market-

KMA, (2014). Kumasi Metropolitan Assembly: Data for purposes of planning waste management intervention programmes. Kumasi, Ghana.

Local Economic Development for Africa (2014). Market Fires and their Implication for Local Economic Development in Ghana. Retrieved April 1, 2015 from: http://ledna.org/blog

MLGRD (2002). Government and Rural Development (MLGRD). Ghana: The Local government system. Accra: Ministry of Local Government and Rural Development.

Mensah, P.A. (2014). Fire Renders 500 Jobless at Kumasi Central Market. Retrieved April 6, 2015 from:http://graphic.com.gh/news/general-news/18404-fire-renders-500-jobless-at-kumasi-central-market.html

Marjanovic, P. & Nimpuno, K. (2002). Disaster Management: Living with Risk-towards Effective Disaster Management Training in Africa. Retrieved September 20, 2014 from: http://www.tt.fhkoeln.de/semester projects_extern/disaster_managment/data_lit/Disaster _Management/DM_living_with_risk.pdf.

Monteith, w. (undated). Showing 'Heart' While Making Money: Twenty-Four Hours in a Ugandan Marketplace, Retrieved February 16, 2017 from: misr.mak.ac.ug

NADMO [2015). National Disaster Management Organization Amended Act, 2015. Accra, Ghana

O'Neill, P. (2004), Public Communication Program Framework. Wollongong: State Emergency Service (unpublished).

Oteng-Ababio M., Ohene Sarfo K., Owusu-Sekyere E. (2015). Exploring the realities of resilience: Case study of Kantamanto Market fire in Accra, Ghana. International Journal of Disaster Risk Reduction 12 (2015) 311–318

Oteng-Ababio, M. (2011). Neglected vulnerabilities in a rapidly urbanizing city: reflections on earthquake risks in Accra. Journal of Housing and the Built Environment, 27(2), 187-205

Oteng-Ababio, M. (2013). Prevention is better than cure: Assessing Ghana's preparedness (Capacity) for disaster management. Jàmbá: Journal of Disaster Risk Studies, 5(2), 1-11

Owusu, G. (2011). Urban Growth, Globalization and Access to Housing in Ghana"s Largest Metropolitan Area, Accra. A Paper Presented at the 4th European Conference on African Studies (ECAS4), Uppsala, Sweden.

Owusu-Sekyere, E., Yakubu A., R., Wedam, E. (2017). The Central Medical Store Fire Disaster: A Test for Institutional Compliance in Disaster Prevention in Ghana, SAGE Open, 1–10.

Owusu-Sekyere, E., Twumasi,S. A., Teng-Zeng, F. (2016). Tug of war: street trading and city governance in Kumasi, Ghana, Development in Practice, 26:7, 906-919

OXFAM (2012). The Disaster Crunch Model: Guidelines for a Gendered Approach, Retrieved January 1, 2017 from: www.oxfam.org.uk

Pelling, M. (2010). Urban governance and disaster risk reduction in the Caribbean: The experiences of Oxfam GB. Environment and Urbanization, 23(2)

Pelling,M. and Wisner, B. (Eds.). 2008. Disaster Risk Reduction: Cases from Urban Africa, Earthscan Publication, London.

Pyles, L. (2007). Community organizing for post-disaster social development. International Social Work, 50(3), 321-333.

Sam-Okyere E (2010). Infernos in our offices; demystifying the facts. The Chronicle. 2010 February, 25; p. 3.

Satterthwaite, D. (2011). What role for low-income communities in urban areas in disaster risk reduction? Global Assessment Report (GAR) (Paper prepared for (ISDR) World Bank, IIED)

Sherrieb, K., Norris, F.H. and Galea, S. (2010), "Measuring capacities for community resilience", Social Indicators Research, Vol. 99 No. 2, pp. 227-247.

UN-HABITAT (2008). State of African cities 2008: A framework for addressing urban challenge in Africa. Nairobi, Kenya

UN-HABITAT (2010). The State of African Cities: Governance, Inequality and Urban Land Markets, Nairobi, UNEP

UNISDR (2011). Global assessment report on disaster risk reduction: Revealing risk, redefining development. Summary and main Findings. Retrieved June 3, 2012, from www.undp.org.bd/info/pub/GAR%20Exe%20Summary.pdf

MATERIAL WASTE CAUSES AND THEIR IMPLICATIONS ON COST OVERRUNS IN ABUJA, NIGERIA: A MATERIALS-PROCUREMENT STAGE PERSPECTIVE

Ibrahim Saidu[1], Winston MW Shakantu[2], Kabir Ibrahim[3]
[1,2,3]*Department of Construction Management, the Nelson Mandela Metropolitan University, Eastern Cape, Port Elizabeth, South Africa*

Material wastage and cost overruns are global problems affecting construction projects. These problems occur at different stages of a project, from planning, design, estimating, materials procurement and construction stage of a project. The purpose of this paper is to examine the material waste causes and control measures that have effects on project-cost overruns at the materials procurement stage of a project. The study covers building-construction professionals in Abuja, Nigeria, from which a purposive sample of 30 professionals was drawn. Interviews were conducted with the sampled professionals; and in the process, quantitative data were generated by using a tick-box questionnaire. The tick-box questionnaire contained literature based information, which was personally perused by the researcher – when the respondents mentioned any of the issues contained in the tick-box. The results from the tick-box were the only data utilised in this research. The data were analysed by using the descriptive and inferential methods. The research found that the material waste causes that have 'very high effects' on cost overruns with respect to materials procurement stage are: procuring items not in compliance with specification, inexperienced personnel in estimation and procurement, mistakes in quantity surveys (poor estimate for procurement), and damage of materials during transportation. Conversely, difficulties of vehicles in accessing site and errors in shipping among others were identified to have 'very little effects' on cost overruns. Analysis of variance revealed a none significant difference in the views of the professionals on these issues. The study concludes that effective management of the identified material waste causes would translate into reduction in the amount of cost overruns with respect to procurement stage of a building project.

Keywords: control measures, cost overruns, material waste, procurement stage

[1] saidu.ibr@futminna.edu.ng
[2] Winston.shakantu@nmmu.ac.za
[3] s216719380@nmmu.ac.za

Saidu, I., Shakantu, W. M. W. and Ibrahim, K. (2017) Material waste causes and their implications on cost overruns in Abuja, Nigeria: a materials-procurement stage perspective *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1048-1062

INTRODUCTION

The construction industry plays a leading role in improving the quality of the built environment, but faced with the problems of time overrun, cost overrun and material waste (Osmani et *al.,* 2008; Saidu and Shakantu, 2016a). Cost overrun and material waste are global problems which make it difficult for many construction projects to be completed within their budget (Saidu and Shakantu, 2015; Ameh and Itodo, 2013; Abdul-Rahman *et al.,* 2013; Nagapan *et al.,* 2012a). Material waste from the construction industry represents a relatively large percentage of the production costs, thus, poor management of materials and waste leads to an increase in the total cost of building projects (Ameh and Itodo, 2013). The problems of material waste and cost overrun are occasioned by several causes at different stages of projects. These include: the planning stage, estimating stage, design stage, material procurement stage and the construction stage. Identification of these causes at different stages and the application of relevant control measures to minimise their occurrence is a step towards alleviating the consequences (Mou, 2008; Oladiran, 2009; Nagapan *et al.,* 2012a; Saidu and Shakantu, 2015).

Material waste is a problem requiring urgent attention in the construction industry; it is a contributing source of municipal solid waste in megacities around the world; and frequently accounting for 10% to 40% of the total waste sent to landfills (Li and Zhang, 2013; Begum, 2009). For instance, the US generates 164million ton of construction waste annually representing 30-40% of the country's Municipal Solid Waste (MSW) (Osmani, 2011). China alone generates 30% of the world's MSW, out of which construction and demolition waste represents 40% of the country's MSW (Lu and Yuan, 2010). In Hong Kong, construction waste consists of 30% to 40% of the total waste sent to landfills (Li and Zhang, 2013). 28.34% of the total waste sent to landfills in Malaysia originates from construction activities (Begum 2009). 10% of the materials delivered to sites in the UK construction industry end up as waste that may not be accounted for (Osmani, 2011). Ameh and Itodo (2013) noted that for every 100 houses built in Nigeria, there is sufficient waste material to build another 10 houses.

Cost overrun is a problem which plague the construction industry for decades; and the argument on how to reduce or totally remove it from projects has been ongoing among the built environment professionals, project owners and the users for the past seventy years (Apolot *et al.*, 2010; Allahaim and Liu, 2012), but there is no substantial improvement nor significant solution in mitigating its detrimental effects (Allahaim and Liu, 2012). Flyvbjerg *et al.* (2004) conducted a global study on cost overruns and concluded that cost overruns were found across twenty (20) nations and five (5) continents of the world. Cost overruns are a problem, which affects 90 percent of completed projects (Flyvbjerg *et al.*, 2004; Memon, 2013; Abdul-Rahman *et al.,* 2013). Moreover, most developing countries experience overruns exceeding 100 percent of the initial budget (Memon *et al.,* 2013).

Consequently, Ameh and Itodo (2013) believed that building material wastage on construction sites accounts for cost overruns. And this is as a result of the fact that, most managers of construction projects pay little attention to the effects of generated material waste on cost overruns. Many studies have been conducted in this field, for instance, Tam *et al.* (2007) assessed the levels of material wastage affected by sub-contracting relationships and projects types with their correlations on construction site; Ameh and Itodo (2013) assessed professionals' views of material wastage and cost overruns, as well as the most wasteful materials on construction sites. Saidu and Shakantu (2015) examined the relationship between quality of estimating, construction material waste generation and cost overruns in Abuja, Nigeria; Saidu and Shakantu (2016a) examined the relationship between material waste and cost overrun in the construction industry using literature based methodology and recommended further empirical investigations. Moreover, Saidu and Shakantu (2016b) developed a framework and an equaion for managing construction-material waste and cost overruns. Saidu and Shakantu (2016c) also determined the contributions of material waste to project cost overrun in Abuja, Nigeria. None of the above-mentioned research clearly identified the materials waste causes that have effects on cost overruns at the materials procurement stage. These therefore, provides the need for a research that provides a holistic assessment of the effects of material waste causes and their control measures on cost overruns at the materials procurement stage of a construction project. Hence, the aim of this paper is to examine the material waste causes and control measures that have effects on cost overruns with respect to materials procurement stage of a building project. To achieve this aim, the following objectives are formulated: To examine the material waste causes that have effects on cost overrun; to examine the material waste control measures that have effects on cost overruns; and to compare the views of professionals on the material-waste causes and control measures that have effects on cost overruns, all with respect to materials procurement stage of project

MATERIAL WASTE AND COST OVERRUN

Construction waste is a global challenge facing construction professionals; It has a significant impact on time, cost, quality and sustainability (Nagapan *et al.,* 2012a). Construction waste is generally classified into two main classes, namely: the physical and the non-physical waste (Nagapan *et al.,* 2012b). The physical construction waste is the waste from construction, renovation activities, including civil and building construction, and demolition activities. It is, however, referred by some directly as solid waste (Saidu and Shakantu, 2015). This type of waste consists of material waste for recovery (re-use and recycling) or complete loss of materials for landfill disposal (Saidu, 2016).

The non-physical waste normally occurs during the construction process. In contrast to the physical or material waste, non-physical waste relates to time overruns and cost overruns for construction projects (Nagapan *et al.,*

2012b; Saidu, 2016). Similarly, Ma (2011) defines waste as not only associated with wastage of materials, but also to other activities such as delays due to repair, waiting time, among others. Besides that, waste can be considered as any inefficiency that results in the use of equipment, materials, labour, and money in the construction process (Ma, 2011). In other words, waste in construction is not only focused on the quantity of materials wasted onsite, but also covers issues like overproduction, waiting time, material handling, inventories, and unnecessary movement of workers (Nagapan *et al.*, 2012a).

Saidu and Shakantu (2015) emphasised that since the term 'construction waste' entails both the physical and the non-physical waste, there is a relationship between material waste originating from physical waste and cost overruns from the non-physical waste, since they both emanate from the same waste family. This classification is shown in Figure 2.1.

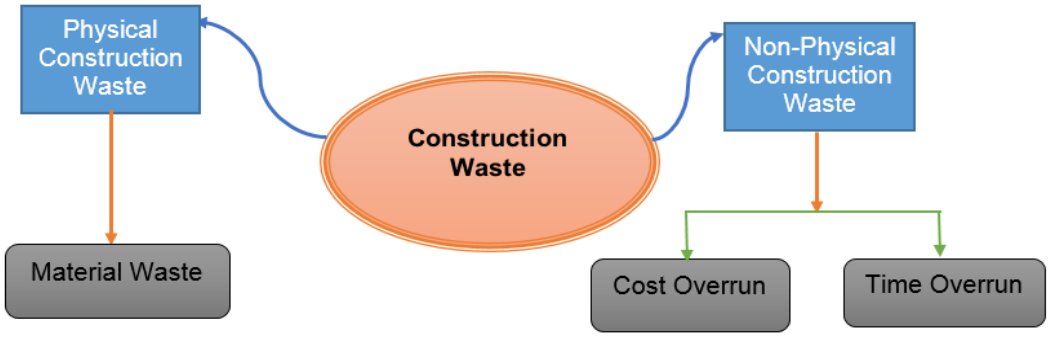


Figure 1: Classification of construction waste

Linking material waste to cost overruns, Ameh and Itodo (2013) assert that material wastage on site leads to an increase in the final cost of the building project. Teo *et al.* (2009) believe that as materials are wasted, more are procured and this thereby affects the estimated cost. Studies from different parts of the world revealed that poor management of materials and waste leads to an increase in the total cost of building projects (Ameh and Itodo, 2013; Saidu, 2016). Saidu and Shakantu (2016a) concluded through a desktop research that all the causative factors of material waste also cause cost overruns at the pre-contract and post-contract stages of a project. However, 96.88% and 81.81% of the causes of cost overruns also cause material waste at the pre-contract and post-contract stages respectively (Saidu and Shakantu, 2016a). Averagely, an overlap of 86.74% existed between the causes of material waste and those of cost overruns at all stages of a project. Other causes which are not related are mostly the micro-economic and macro-economic factors. Table 1 shows the causes of material waste that are linked to causes of cost overruns at the materials procurement stage of a project.

Table 1: Material waste causes related to the causes of cost overruns with respect to material procurement management stage of a project

Causes of material waste related to the causes of cost overruns	Material Waste		Cost overruns	
	Author & date	Location	Author & date	Location
Procurement & Transportation				
Errors/mistakes in material ordering/procurement	Nagapan *et al.* (2012a)	Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Procuring items not in compliance with specification	Adewuyi and Otali (2013); Osmani, *et al.* (2008)	Rivers, Nigeria; UK	Allahaim and Liu (2012)	Saudi Arabia
Errors in shipping/supply	Osmani, *et al.* (2008); Nagapan *et al.* (2012a)	UK; Malasia	Nega (2008)	Ethiopia
Lack of experience	Nagapan *et al.* (2012a)	Batu, Malaysia	Abdul Rahman *et al.* (2013); Ameh *et al.* (2010)	Malaysia; Nigeria
Mistakes in quantity surveys: Poor estimate for procurement (over procuring)	Nagapan *et al.* (2012a)	Malaysia	Aziz (2012); Allahaim and Liu (2012)	Egypt; Saudi Arabi
Wrong material delivery procedures	Nagapan *et al.* (2012a)	Malaysia	Aziz (2012)	Egypt
Delivery of substandard materials	Nagapan *et al.* (2012a)	Malaysia	Nega (2008)	Ethiopia
Damage of material during transportation	Osmani *et al.* (2008)	UK	Nega (2008)	Ethiopia
Late delivery /Inadequate delivery schedule	Nguyen, Gupta and Faniran (nd)	Geelong, Australia	Al-Najjar (2008); Abdul Rahman *et al.* (2013)	Gaza Strip; Malaysia
Poor material handling	Osmani *et al.* (2008)); Nagapan *et al.* (2012a)	UK; Malaysia	Ameh *et al.* (2010	Nigeria
Poor protection of materials and damage during transportation	Osmani *et al.* (2008); Aiyetan and Smallwood (2013)	UK; Lagos, Nigeria	Nega (2008)	Ethiopia
Over allowance (difficulties in ordering less)	Osmani *et al.* (2008); Nagapan *et al.* (2012a)	UK; Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Frequent variation orders	Nguyen, Gupta and Faniran (nd)	Geelong, Australia	Aziz (2012); Baloyi and Bekker (2011)	Egypt; South Africa
Poor product knowledge	Nagapan *et al.* (2012b)	Malaysia	Jackson (2002)	Reading
Difficulties of vehicles in accessing site	Osmani *et al.* (2008); Nagapan *et al.* (2012b)	UK; Batu, Malaysia	Allahaim and Liu (2012); Zewdu an Aregaw (2015)	Saudi Arabia; Ethiopia
Manufacturers				
Poor quality of materials	Adewuyi and Otali (2013)	Nigeria	Ameh *et al.* (2010	Nigeria
Non-standard sizes of materials	Osmani (2011)	UK	Lee-Hoai *et al.* (2008)	Vietnam
Poor product information	Nagapan *et al.* (2012)	Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Lack of awareness	Al-Hajj and Hamani (2011)	UAE	Ameh *et al.* (2010	Nigeria
Suppliers				
Poor supply chain management	Al-Hajj and Hamani (2011)	UAE	Ameh *et al.* (2010	Nigeria
Supplier errors	Odusanmi, Oladiran and Ibrahim (2012)	Nigeria	Nega (2008)	Ethiopia
Poor product incentive	Nagapan *et al.* (2012)	Malaysia	Allahaim and Liu (2012)	Saudi Arabia
Poor handling of supplied materials	Osmani, etal (2008); Ameh and Itodo (2013)	UK; Nigeria	Ameh and Itodo (2013)	Nigeria
Poor methods of unloading materials supplied in loose form	Adewuyi and Otali (2013)	Nigeria	Nega (2008)	Ethiopia

RESEARCH METHODOLOGY

The study covers building construction projects within Abuja, the Federal Capital Territory of Nigeria. Abuja was selected because it is one of the metropolitan cities of Nigeria that has the highest population of professionals within the built environment and has many on-going construction projects.

Interviews were conducted with construction professionals using purposive sampling techniques. Purposive sampling technique was used, because only building-construction professionals handling projects that are worth 1.6 billion Naira/R100 million and above were consulted/interviewed. This is because building projects of such value/amount are likely to generate more waste and are likely to be handled by more experienced professionals, who might be more familiar with the issues leading to material waste and cost overruns than the projects of lesser value. Furthermore, Leedy and Ormrod (2014) believe that the size of a purposive sampling technique ranges between 5 and 25 participants. For this research, thirty (30) professionals were interviewed (15 Project Managers {PMs}, 9 Quantity Surveyors {QSs}, 5 Site Engineers {SEs}, and 1 Senior Technical Officer {STO} of a waste management department). The interviews were on the issues relating to material waste and cost overruns at the materials-procurement stage of a construction project. All thirty (30) respondents identified in this research responded to all the questions presented for discussion.

The research method is quantitative which is in line with the positivist paradigm assumption. It is quantitative because in the course of the interviews, a tick-box structured questionnaire containing a list of literature based information (waste causes and control measures that relate to cost overruns) was ticked/marked by the interviewer/researcher as the respondents mentioned or commented on any of the issues in the tick-box. This was done to validate the literature based information by determining their frequencies and percentages of occurrence. The results of the tick-box questionnaire were the 'only research data' utilised in this study. The, study is therefore quantitative rather than qualitative or mixed method research.

The research employed the descriptive and the inferential analyses. The descriptive tool that was used to analyse the data (tick-box structure questionnaire) was the cross-tabulation method. The responses from the tick-box questionnaires are rated based on the cut-off points highlighted by Morenikeji (2006) in a five-point Likert scale; the material-waste causes and control measures that have a percentage of "90 to 100" are rated "Very High (VH) effect"; 70 to 89% are rated "High (H) effect"; 50 to 69% are rated "Moderate (M) effect"; 30 to 49% are rated "Little (L) effect"; and 1 to 29% are rated "Very Little (VL) effect" on cost overruns.

Inferentially, the analysis of variance (one-way ANOVA) was used to compare the means of the results/views of the different respondents /professionals, to determine if there is a statistically significant difference

by the respondents on the effects of material waste causes on cost overruns at the site management stage of a building construction project.

RESULTS AND DISCUSSION

Material waste causes that have effects on project cost-overrun with respect to materials procurement management stage of a project

Table 2 indicates that 100 percent of the respondents agreed that "procuring items not in compliance with project specifications" and "engaging inexperienced personnel in estimation and procurement" were the major material-waste causes that have a 'very high effect' on project-cost overruns at the materials-procurement stage of a project. These results confirm the findings of Abdul Rahman *et al.* (2013); Ameh *et al.* (2010) and Allahaim and Liu (2010) on the causes of cost overruns for projects identified in Table 1. The same results also corroborate the findings of Adewuyi and Otali (2013); Osmani *et al.* (2008) and Nagapan *et al.* (2012a) on the causes of material waste for projects.

The percentages of 76.7, 73.3,73.3 and 73.3 relative to "mistakes in quantity surveys (poor estimate for procurement)", "mistakes in material procurement", "procuring wrong quantities of materials", and "procurement and delivery of substandard materials", respectively, were the material waste causes considered by the respondents to have a 'high effect' in causing cost overruns; because they fall between 70 and 89 percent. The results corroborate the findings of Nagapan *et al.* (2012a) on the causes of material waste and those of Nega (2008); Aziz (2012); and Allahaim and Liu (2012) on the major causes of cost overruns for projects.

Additionally, percentages of 60, 56.7, 53.3, 53.3, 53.3, and 50, in relation to "wrong material delivery procedures", "lack of quality control/assurance for evaluation of procured product", poor material handling", "poor product knowledge", "poor supply-chain management" and "damage of material during transportation", respectively, were deemed by the respondents to have a 'moderate effect' on cost overruns.

Nevertheless, the material waste causes that have very little effects on cost overruns were: (a) errors in shipping; (b) damage of material during transportation; (c) poor market conditions; and (d) lack of awareness; because they fall between 1 and 29 percent. These results confirm some of the findings of Nagapan *et al.* (2012a); Osmani *et al.* (2008) on the causes of material waste for a project. The findings also corroborate the findings of Nega (2008) on the causes of cost overruns.

Table 2: Result of the effects of material-waste causes on cost overruns at the materials procurement management stage of a project

S/n	Causes material waste that have effect on the causes of cost overrun at materials procurement stage of a project	PM	QS	SE	STO	Total	Ranking	Decision
a	Procurement and transportation source							
1	Mistakes in material procurement	12	7	2	1	22 (73.3%)	4	High effect
2	Procuring items not in compliance with specification	15	9	5	1	30 (100%)	1	Very high
3	Errors in shipping	2	0	3	0	5(16.7%)	17	Very little
4	Mistakes in quantity surveys (poor estimate for procurement)	11	7	4	1	23 (76.7%)	3	High effect
5	Procurement and delivery of substandard materials	11	5	5	1	22 (73.3)	4	High effect
6	Damage of materials during transportation	12	6	3	1	22 (73.3%)	4	High effect
7	Inadequate delivery schedule	5	4	2	0	11 (36.7%)	13	Little effect
8	Poor market conditions	2	0	1	0	3(10%)	21	Very little
9	Poor handling of materials	7	6	3	0	16(53.3%)	10	Moderate
10	Waiting for replacement	0	0	0	0	0 (0%)	29	No response
11	Poor protection of materials during transportation	10	4	2	1	17 (56.7%)	8	Moderate
12	Over allowance	3	4	0	0	7(23.3%)	15	Very little
13	Frequent variation orders	0	0	0	0	0(0%)	29	No response
14	Poor product knowledge	7	4	4	0	15(50%)	12	Moderate
15	Difficulties of vehicles in accessing site	3	1	0	0	4(13.3%)	19	Very little
16	Inexperienced personnel in estimation and procurement	15	9	5	1	30 (100%)	1	Very high
17	Procuring wrong quantity of materials	11	5	5	1	22 (73.3%)	4	High effect
18	Lack of quality control assurance fo evaluation of procured product	9	5	3	0	17 (56.7%)	8	Moderate
19	Incompetent procurement management	3	2	4	0	9 (30%)	14	Little effect
20	Lack of professionalism and transparency in procurement	4	1	0	0	5 (16.7%)	17	Very little
21	Lack of early materials requisition	1	0	0	0	1 (3.3%)	24	Very little
b	Manufacturers' source							
22	Manufacture of poor quality materials	3	3	0	0	6(20%)	16	Very little
23	Poor product information	1	3	0	0	4(13.3%)	19	Very little
24	Poor projection for materials	0	0	0	0	0 (0%)	29	No response
c	Suppliers' source							
25	Poor supply chain management	10	3	2	1	16 (53.3%)	10	Moderate
26	Poor packaging	1	2	0	0	3(10%)	21	Very little
27	Supplier errors	1	1	0	0	2(6.7%)	23	Very little
28	Poor product incentive	0	0	0	0	0(0%)	29	No response
29	Poor handling of supplied materials	8	5	3	0	16(53.3)	8	Moderate

Material waste control measures that have effects on cost overrun with respect to materials procurement stage of a project

The material waste control measures that have a very high effect on controlling cost overrun with respect to quality of procurement management of a project are: (i) procuring in accordance with the specifications; and (ii) experienced personnel in estimation and procurement. These results confirm the findings of Abdul-Azis *et al.* (2013) who recommended the engagement of experienced personnel as a major control measure for project-cost overruns. The only cause of material waste that has a high effect on cost overrun is 'procuring the right quantity of materials at the right time'.

Table 3. Results of the effect of material waste control measures on cost overruns at materials procurement stage of a project

S/n	Control measures for material waste (Quality of Procurement management)	PM	QS	SE	STO	Total	Ranking	Decision
a	Procurement & transportation							
1	Better transportation of materials	3	0	1	0	4 (13.3%)	16	Very little
2	Enhanced construction materials handling by workers	7	6	3	0	16 (53.3%)	8	Moderate
3	Adopting good materials abstracting	1	2	1	0	4 (13.3%)	16	Very little
4	Provision of easy access road for vehicles delivery	3	1	0	0	4 (13.3%)	16	Very little
5	Adoption of unified methods of estimating for procurement	8	6	4	0	18 (60%)	6	Moderate
6	Ordering appropriate materials quantity	5	4	2	0	11 (36%)	11	Little
7	Timely delivery of materials	6	4	1	1	12(40%)	10	Little
8	Standard evaluation and comparing with specification	12	2	5	0	19 (63.3%)	4	Moderate
9	Procuring in accordance with specification	15	9	5	1	30 (100%)	1	Very high
10	Experienced personnel in estimation and procurement	14	9	5	1	29 (96.7%)	2	Very high
11	Insurance of the procured materials	1	1	1	0	3 (10%)	21	
12	Procuring the right quantity of materials at the right time	11	5	5	1	22 (73.3%)	3	High
13	Formation of a quality control unit for evaluation of procured product	9	5	3	0	17 (56.7%)	7	Moderate
14	Competent procurement management	3	2	4	0	9 (30%)	13	Little
15	Professionalism and transparency in procurement	4	1	0	0	5 (16.7%)	15	Very little
b	Manufacturers source							
16	Improved quality of materials	3	3	0	0	6(20%)	14	Very little
17	Materials should be manufactured in standard units	9	3	2	0	14 (46.7%)	9	Little
18	Knowledge of product to be manufactured	1	3	0	0	4 (13.3%)	16	Very little
c	Supplier source							
19	Better and improved supply chain management	5	4	2	0	11 (36.7%)	11	Little
20	Efficient methods of unloading materials supplied in loose form	11	5	3	0	19 (63.3%)	4	Moderate
21	Better materials delivery to site	1	2	0	0	3(10%)	21	Very little

Furthermore, percentages of 63.3, 60, 56.7, and 53.3 relative to standard evaluation and comparing with specification; efficient methods of unloading materials supplied in loose form; adoption of unified method of estimating for procurement; formation of a quality-control unit for evaluation of procured product; and enhanced construction material handling by workers, respectively, were considered to have a moderate effect in controlling cost overruns by the respondents because they fall between 50 and 69 percent.

The material waste control measures that have a very little effect on cost overrun with respect to materials procurement stage are: (a) better delivery of materials on-site; (b) adopting good materials abstracting; (c) provision of easy access road for vehicles delivery; and (d) knowledge of the product to be manufactured. These results support the findings of Osmani *et al.* (2008) on the control measures for material waste for projects.

Comparative views of respondents on the effects of material-waste causes and control measures on cost overruns with respect to materials procurement stage of project

Analyses of the differences in the professional views on the effects of material-waste causes and control measures on project-cost overruns reveal a non-statistically significant difference between the values of f-calculated (0.238 and 0.236) which are less than the value of f-tabulated (1.701) and the probability values of 0.790 and 0.792 are greater than the critical value of the 5 percent level of significance within the mean-squared groups of 1.81-7.59 and 1.16-4.92, respectively.

The evidence is not statistically significant. These imply that the respondents were of the same views on the effects of material waste causes and control measures on cost overruns with respect to materials procurement stage of a project. This is shown in Table 4.

Table 4: Test of difference in professional views on the effects of material-waste causes and control measures on cost overruns at materials procurement management stage of a project

S/n	Variables	Type of Analysis	Observation				Inferences
	*X*1 *X*2 *X*3 *X*4		Mean square within group	F-cal	F-tab	Probability value	Remark
1	PM QS SI STO Sources and causes	One-way ANOVA	1.81 7.59	0.238	1.701	0.790	Not statistically significant
2	PM QS SE STO Control measures	One-way ANOVA	1.16 4.92	0.236	1.701	0.792	Not statistically significant

CONCLUSION AND RECOMMENDATIONS

The construction industry plays a leading role in improving the quality of the built environment, but faced with the problems of cost overruns and material waste. These problems occur at different stages of a project, from planning, design, materials procurement and execution. Material waste

from the construction industry represents a relatively large percentage of the production costs, thus, poor management of materials and waste leads to an increase in the total cost of building projects. The purpose of this paper was to examine the material-waste causes and their control measures that have effects on cost overruns at the materials procurement stage of a construction project.

It was found that material waste causes and their control measures were identified to have significant (very-high, high, medium, low, and very-low) effects in causing/controlling cost overruns at the materials procurement stage of a project. Also, there was no statistically significant difference in the views of the respondents on these issues. The respondents have therefore the same views on the results of the effects of material-waste causes and control measures on cost overruns at materials procurement stage of a project.

It was also found that, in order to minimise the rate of material waste at the materials procurement stage of a project, materials must be procured in compliance with project specifications, experienced personnel must be engaged in procurement, proper estimation and ordering of appropriate materials quantity, formation of a quality control unit for evaluation of procured product, and enhanced means of handling the procured materials by workers.

Based on these findings, it can be concluded that effective management of material-waste causes on construction site would translate into a reduction in the level of cost overruns for projects.

The study recommends that management of material-waste causes at the procurement stage should be encouraged, as it has the potential to minimise cost overruns on projects. The management system should be revised based on the findings of this research as a reference document and included as part of the materials procurement planning process for a project.

REFERENCES

Abdul-Azis, A. A., Memonl, A. H., Abdul Rahman, I. and Abd Karim, A.T. (2013). Controlling Cost Overrun Factors in Construction Projects in Malaysia. *Research Journal of Applied Sciences, Engineering and Technology* 5 (8), 2621-2629.

Abdul-Rahman, I., Memon, A.H. and Abd. Karim, A.T. (2013). Significant Factors Causing Cost Overruns in Large Construction Projects in Malaysia. *Journal of Applied Sciences*,13(2), 286-293.

Adewuyi, T. O. and Otali, M. (2013). Evaluation of Causes of Construction Material Waste: Case of River State, Nigeria. *Ethiopian Journal of Environmental Studies and Management,* 6, 746-753.

Aiyetan, O. and Smallwood, J. (2013). Materials Management and Waste Minimisation on Construction Sites in Lagos State, Nigeria. *Proceedings of the 4th International Conference on Engineering, Project, and Production Management (EPPM),* October, 23-25, 2013, Suk sol, Bangkok, Thailand, 1161-1172.

Al-Najjar, J.M. (2008). *Factors Influencing Time and Cost Overruns on Construction Projects in the Gaza Strip*. Masters Dissertation, Gaza, 1-206.

Allahaim, F.S. and Liu, L. (2012). Cost Overrun Causes, the Framework in Infrastructure Projects: Toward a Typology. *37th Australian University Building Educators Association, International Conference (AUBEA, 2012) Sydney*, University of NSW (UNSW), 1-15.

Ameh, J. O. and Itodo, E. D. (2013). Professionals' Views of Material Wastage on Construction Sites. Organization, Technology and Management in Construction. *An International Journal,* 5(1), 747-757.

Ameh, O.J. Soyingbe, A.A. and Odusami. K.T. (2010). Significant Factors Causing Cost Overruns in Telecommunication Projects in Nigeria. *Journal of Construction in Developing Countries,* 15 (2), 49–67.

Apolot, R. Alinaitwe, H. and Tindiwensi, D. (2010). An Investigation into the Causes of Delay and Cost Overrun in Uganda's Public Sector Construction Projects: In, *Second International Conference on Advances in Engineering and Technology,* Uganda, 305-311.

Aziz, R.F. (2013). Factors Causing Cost Variation for Constructing Waste Water Projects in Egypt. *Alexandria Engineering Journal* 52, 51–66.

Baloyi, L. and Bekker, M. (2011). Causes of Construction Cost and Time Overruns: The 2010 FIFA World Cup Stadia in South Africa. *Acta Structilia*, 18 (1), 51-67.

Begum, R.A., Siwar, C. Pereira, J.J. and Jaafar, A. (2009). Attitude and Behavioural Factors in WasteManagement in the Construction Industry of Malaysia. *Resources, Conservation and Recycling* 53: 321–328.

Flyvbjerg, B. Holm, M.K. and Buhl, S.L. (2004). What Causes Cost Overrun in Transport Infrastructure Projects? *Transport Reviews*, 24 (1), 3–18.

Jackson, S. (2002). Project Cost Overruns and Risk Management. Paper, Whiteknights: School of Construction Management and Engineering, The University of Reading.

Leedy, P.D. and Ormrod, J.E. (2014). *Practical Research Planning and Design*. Tenth Edition. Edited by Pearson new international Edition. Edinburgh Gate, England: Pearson Education Limited.

Le-Hoai, L. Lee, Y.D. and Lee, J.Y. (2008). Delay and Cost Overrun in Vietnam, Large Construction Projects: A Comparison with Other Selected Countries. *KSCE Journal of Civil Engineering,* 12(6), 367-377.

Li, J., Zhang X. (2013). A Model for Estimating Construction Waste gGeneration Indexfor

Building Project in China. *Resources, Conservation and Recycling,* 74, 20– 26.

Lu, W. and Yuan, H. (2010). Exploring Critical Success Factors for Waste Management in Construction Projects of China. *Resources, Conservation and Recycling*, 55, 201–208. Ma, U. (2011). No Waste: Managing Sustainability in Construction. Surrey: Gower Publishing limited. 118-120

Ma, U. (2011). *No waste: Managing Sustainability in Construction*. Surrey: Gower Publishing Limited.

Memon, A.H. (2013). The way Forward in Sustainable Construction: Issues and Challenges. *International Journal of Advances in Applied Sciences (IJAAS,)* 2 (1), 1-8.

Memon, A.H. Abdul-Rahman, I. Zainun, N.Y. and Abd-Karim, A.T. (2013). Web-based Risk Assessment Technique for Time and Cost Overrun (WRATTCO)–A Framework. *Procedia-Social and Behavioural Sciences*, 129, 178 – 185.

Mou, K. (2008). *The Role of Government and Construction Waste*. Msc Dissertation, The Centre of Urban Planning & Environmental Management, University of Hong Kong, Hong Kong, 1-179.

Nagapan, S. Abdul-Rahman, I. and Asmi, A. (2012a). Factors Contributing to Physical and Non-Physical Waste Generation in Construction Industry. *International Journal of Advances in Applied Sciences (IJAAS),* 1 (1), 1-10.

Nagapan, S. Abdul-Rahman, I. Asmi, A. and Hameed, A. (2012b). Identifying the Causes of Construction Waste-Case of Central. *International Journal of Integrated Engineering*,

4(2), 22-28.

Nega, F. (2008). *Causes and Effects of Cost Overrun on Public Building Construction Projects in Ethiopia.* Msc Dissertation, Department of Civil Engineering, Addis Ababa University Ethiopia.

Nguyen, B. Gupta, H. and Faniran, S. (n.d). Waste Minimization Strategies in the Construction Industry-A Geelong Case Study." Geelong, 1-10.

Oladiran, O. J. (2009). Causes and Minimization Techniques of Materials Waste in Nigerian Construction Process, *Fifth International Conference on Construction in the 21st Century (CITC-V);* Collaboration and Integration in Engineering, Management and Technology, 20-22, May 2009, Istanbul, Turkey.

Osmani, M. (2011). *Construction Waste. Chap. 15 in Waste: A Handbook for Management*, by Letcher and Vallero, 1-565. San Diego: Academic Press.

Osmani, M. Glass, J. and Price, A.D.F. (2008). Architects' Perspectives on Construction Waste Reduction by Design. *Waste Management,* 28, 1147–1158.

Saidu, I. and Shakantu, W.M.W. (2015). A Relationship between Quality-of-Estimating, Construction Material Waste Generation and Cost Overrun in Abuja, Nigeria. *Fourth Construction Management Conference,* Nelson Mandela Metropolitan University, Port Elizabeth, South Africa. Edited Emuze, F.A.; 95-104, 30 November-1st December 2015.

Saidu, I. and Shakantu, W.M.W. (2016a). A Study of the Relationship between Material Waste and Cost Overrun in the Construction Industry. *The 9th cidb Postgraduate Conference Cape Town, South Africa*. "Emerging trends in construction organisational practices and project management knowledge area. Edited Windapo, A.O.,124-134, Feb 2-4, 2016.

Saidu, I. and Shakantu, W.M.W. (2016b). A Conceptual Framework and a Mathematical Equation for Managing Construction-Material Waste and Cost Overruns. World Academy of Science, Engineering & Technology. *International Journal of Social Behavioural, Educational, Economic, Business and Industrial Engineering*, 10 (2), 555-561.

Saidu, I. and Shakantu, W.MW. (2016c). The Contributions of Material Waste to Project Cost overrun in Abuja, Nigera. *Acta Structilia*, 23 (1), 99-113

Saidu, I. (2016). *Management of Material Waste and Cost Overrun in the Nigerian Construction Industry*. An Unpublished PhD Thesis, Department of Construction Management, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa.

Teo, S.P. Abdelnaser, O. and Abdul, H.K. (n.d.). Material Wastage in Malaysian Construction Industry. *International Conference on Economics and Administration*, Faculty of Administration, University of Bucharest Romania, 257-264.

Tam, V.W.Y. Shen, L.Y. Tam, C.M. (2007). Assessing the Levels of Material Wastage Affected by Sub-Contracting Relationships and Projects Types with their Correlations. *Building and Environment,* 42, 1471–1477.

Zewdu, Z.T. and G.T. Aregaw. (2015). Causes of Contractor Cost Overrun in Construction Projects: The Case of Ethiopian Construction Sector. *International Journal of Business and Economics Research* 4 (4), 180-191.

APPENDIX

In order to achieve the aim and objectives advanced in this research, the interview and the tick box questionnaire were designed to answer the following research questions:

1. What are the material waste causes that have effects on cost overruns with respect to materials procurement stage of a building project?
    a. Can you tell me about the quality of procurement management in your organization/industry?
    b. Does the quality of procurement management contribute to material wastage? What about cost overrun?
    c. How would you describe procuring or allowances for waste with respect to material waste and cost overrun?
    d. How would you relate the procurement of materials to material waste generation and cost overrun?

2. What are the material waste control measures that have effects in controlling cost overruns with respect to materials procurement stage of a building project?
    a. What strategies/ control measures does your firm use in minimizing material waste through procurement of materials for a project?

METHODS OF DURATION ESTIMATION AT THE RURAL ROAD AGENCY IN GHANA

Isaac Mensah[1], Theophilus Adjei-Kumi[2] and Gabriel Nani[3]
[1,2,3]Department of Building Technology, College of Art and Built Environment, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

The methods used in fixing contract duration is essential to both clients and contractors. The purpose of this paper is to determine the current practices or methods employed by the Department of Feeder Roads in estimating the duration of road and bridge construction projects. A questionnaire survey was administered to 66 professionals at the agency to indicate the techniques employed in estimating the duration of road and bridge construction projects. The results showed that 13.6% of the professionals arbitrarily fix contract durations with 68.2% indicating that they used similar experience on previous projects to fix duration. The results further showed that the duration fixed by construction professionals at the agency were different from that used by the contractors in executing contracts. It is recommended that the rural road agency adopts a scientific approach in the estimation of duration of their projects to prevent time overruns of future projects.

Keywords: bridges, contract duration, duration methods, rural roads, Ghana.

INTRODUCTION

Contract duration is considered as one of the major factors for a successful project, apart from the cost and quality that is required. This is partly because late completion of projects increases the cost of the works (Aibinu and Jagboro, 2002) and the client loses potential revenue. According to Lim and Mohamed (1999), clients, users, stakeholders and the general public usually look at project success from the macro point of view of completing projects early.

The fixing of contract duration by construction professionals at the Department of Feeder Roads in Ghana for construction projects binds on potential bidders once the contract is awarded and signed. The risk is that where the duration fixed by the agency is not reasonable; the selected contractor is likely to suffer from the deduction of liquidated and

[1] isaacfmensah@yahoo.com
[2] tadjeikumi@yahoo.com
[3] gabrielnani@yahoo.com

Mensah, I., Adjei-Kumi, T. and Nani, G. (2017) Methods of duration estimation at the rural road agency in Ghana *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1063-1078

ascertained damages (LAD) as penalties or construction disputes between the client and contractor are likely occurrence (Jin et al, 2016). In addition, time overruns, increased claims and substandard performance are the consequence of unrealistic contract duration. Where the duration fixed is however, overestimated, the employer/client loses potential revenue.

Duration overrun of projects is a major concern to stakeholders in the construction industry. Amoatey and Ankrah (2017) indicated that about 70% of road projects in Ghana go beyond their intended completion date by an average time overrun of 17 months up to 78 months. Also Asiedu et al, (2016) found out that the average time overrun of public school projects from 2010 to 2013 in Ghana was 106.45%. Aibinu and Jagboro (2002) revealed that the average time overrun of building projects in Nigeria ranges from 59.23% to 92.64%. Odusami and Olusanya (2000) found that most of the projects executed in the city of Lagos in Nigeria recorded an average delay of 51% of the planned duration. The study conducted by Kumaraswamy and Chan (1998) showed a mean percentage time overrun of 9% for Government projects and 17% for private buildings in Hong Kong. These findings are not different from that of the construction industry in Ghana as most of the rural roads and bridge construction projects completed in the country go beyond the intended or planned completion date. Variations between the initial and final contract durations have been a problem for construction professionals and other stakeholders involved in the construction industry in the country. One of the reasons for this variation are the methods used in fixing the duration of bridges and road construction projects at the Department of Feeder Roads in Ghana.

Determining an appropriate duration is important to all parties (client, contractor, consultants and other stakeholders) involved in a contract. A number of transportation departments around the world have developed tools for estimating the duration of their projects. For instance, the Federal Highway Administration (2002) i.e. U.S Department of Transportation, DOT) has provided procedures to be adopted by State Transportation Agencies (STAs) for determining contract time for construction projects. These procedures have been codified in Federal regulations in the United States. However, the professionals at the Department of Feeder Roads (rural road agency) do not have such systems in place. They fix the durations for potential bidders/ contractors which eventually binds on them after award of contract.

The purpose of this study is to ascertain the methods employed by the professionals at the Department of Feeder Roads in fixing contract duration for both roads and bridge construction projects with the view of answering the following questions.

(i) What are the current practices employed by the agency in contract duration determination?

(ii) What are the extent of variability between the initial (or planned/revised) contract duration and that of the final contract duration used by the contractors?

To answer these questions, the paper reviews past studies on methods employed by construction professionals and collects quantitative data to determine the extent of variability between the initial and final contract durations of past projects. It also discusses the research method employed and discusses the findings in the study. The paper ends with recommendations and conclusions.

LITERATURE REVIEW

There are project management techniques which are used to determine construction duration. These methods are categorized as planning techniques and include the Gantt/Bar Chart, Critical Path Methods (CPM), Program Evaluation and Review Technique (PERT). Others are categorised under planning algorithms and they include artificial intelligence such as neural networks and genetic algorithms. Statistical techniques such as regression analysis are also in use.

A number of studies have been conducted to determine the methods employed by various governmental agencies across the world in estimating the duration of construction projects. Most of these studies show that construction professionals employ various methods suitable to them in estimating durations.

The Federal Highway Administration (2002) i.e. U.S Department of Transportation, DOT) has provided procedures to be adopted by State Transportation Agencies (STAs) for determining contract time for construction projects. These procedures have been codified in Federal regulations in the United States.

The contract duration determination techniques used by the Department of Transportation in the U.S and codified in the Federal regulations are bar charts, CPM and Estimated cost. For the estimated cost technique, the contract duration is basically determined based solely on the amount of the engineer's estimate. This method can be likened to the methods or models developed by Czarnigowska and Sobotka (2013) and Chan (2001) just to mention a few. For non-complex projects and projects affecting small volumes of traffic, this procedure may be appropriate. The estimated cost method is usually not recommended for use on projects where completion time is a major factor. Many items influencing the duration of a project are not taken into account when applying this method. Any special features that are special to a specific project cannot easily be taken care of when using this very simplistic procedure (Federal Highway Administration, 2002).

Hancher et al (1992) developed a procedure for determining construction contract duration using a conceptual scheduling system for the Texas department of transportation (DOT) in the form of a Contract Time Determination System (CTDS). This included both a manual method and an automated or computerized system utilizing software packages of Lotus 123, Flash-Up and Super Project. Through that study by Hancher, methods such as bar charts and experienced engineer's judgement were the most

common methods used by various DOT's in contract duration estimation in the United States.

This developed system was based on Texas DOT's project classification system which consisted of 13 different classes of projects. The system developed eventually generated 13 different templates as shown in Table 1 with a fourteenth template added to take care of any project that did not fit into any of the thirteen.

Table 1: Texas DOT Project Template

Template 1	SC	Seal Coat
Template 2	OV	Overlay
Template 3	RER	Rehabilitate Existing Road
Template 4	CNF	Convert Non-Freeway to Freeway
Template 5	WF	Widen Freeway
Template 6	WNF	Widen Non-Freeway
Template 7	NLF	New Location Freeway
Template 8	NNF	New Location Non-Freeway
Template 9	INC	Interchange
Template 10	BWR	Bridge Widening/Rehabilitation
Template 11	BR	Bridge Replacement/ New Bridge
Template 12	UPG	Upgrade Freeway to Standards
Template 13	UGN	Upgrade Non-Freeway to Standards.
Template 14	MSC	Miscellaneous Construction

Source: Hancher et al (1992)

Following the method developed for Texas DOT, Hancher and Werkmeister (2000) developed a contract time estimation system for the Kentucky Transportation Cabinet. This system, built upon the Texas DOT concept, was called the Kentucky Contract Time Determination System (KyCTDS). This new system uses 6 project templates based on the classification of projects by the Kentucky Transportation Cabinet (see Table 2).

Table 2. Kentucky Department of Highway Project Templates

Project Template	Project Description
Reconstruction Limited Access	This is a project that utilizes the existing alignment but
Reconstruction Open Access	This is a project where a road is being rebuilt that has
New Route	This is a project being built from point "A" to point
Relocation	This is a project that a section of road is being rebuilt
Bridge Rehabilitation	This is a project that a lane on a bridge would be closed
Bridge Replacement	This project's main focus would be to build a new

Source: Hancher and Werkmeister (2000)

The study conducted by Atreya (2007) indicated that construction professionals at the DOT in the U.S use a combination of duration estimation methods in contract time estimation. The contract time methods used in his study were Engineer's Experience, Hand calculations,

Standardised Hand Written Templates and Computer Program such as Primavera, MS project and SureTrak. Atreya (2007) found that about 39.1% of the respondents at DOT use a combination of Engineer's Experience and Hand calculation in the computation of duration for highway road projects. 17.4% however, used a combination of Engineer's experience and computer program in their estimation of duration.

Seshie (2009) conducted a study at the Ministry of Water, Works and Housing in Ghana and found out that 67.5% of the respondents employ both past experience and scientific methods in determining contract duration. He also revealed that 27.5% and 5% of the respondents used only past experience and scientific methods respectively in determining contract duration for building projects. Seshie (2009) concluded that most of the construction professionals at the Works and Housing Ministry rely mostly on past experience of similar nature in determining contract duration.

A more recent study conducted in the UK by Olawale and Sun (2015) showed that 53.8% of responding consultants determine the duration of their construction activities by experience based methods only while just 16.7% of contractors base the method of determining duration on experience only. 35.7% of the contractors determine the duration of projects by techniques based on calculations with 11.5% of the consultants using this method. 35.7% of the contractors also indicated a combination of experience and calculations as the techniques employed in duration determination.

In the study conducted by Nkado et al (1999) using 42 firms who gave multiple responses, 71% indicated that they determine the duration of their projects based on experience with 31% using historical data approach. 10% and 7% used computerised systems and the programming techniques (Gantt chart) respectively in determining duration of projects. Therefore, in South Africa, experience is the foremost approach employed by construction professionals in contract duration determination.

RESEARCH METHODS

The questionnaires pertaining to the methods employed in construction duration were self – administered by mailing them to professionals at the Department of Feeder Roads. The department has a total number of 78 civil engineers and 47 quantity surveyors. This represents a total entire population of 125. To determine the sample size (n) to use for the distribution of the questionnaires, the following formula adapted by Ofori - Kuragu et al, (2016) was used;

$$n = \frac{N}{1+N(e^2)} \quad \ldots\ldots\ldots (1),$$

where N is the number of entire population and e is the significance level. For a confidence level of 95%, e = 0.05, N = 125. Substituting the values in equation 1, n = 125/1+125(0.05)^2. This gives n = 125/1.3125 =95.24, approximated to 95. To compensate for non – responses and non –returns of the questionnaires, add 5% of 95. This gives 4.75 which is approximately 5. Adding 95 to 5, the actual number of questionnaires to be distributed is 100.

The regional offices of the department are located within ten regions of the country with their Head Office in Accra. The Engineers and Quantity Surveyors were targeted since they are the professionals who are concerned with the designs and contract administration of road and bridge construction projects at the department. 100 questionnaires were therefore administered to professionals at the department (see Table 3). Out of the 100 questionnaires distributed, 55 were sent to Civil Engineers and the remaining 45 were distributed to Quantity Surveyors. 30 and 38 responses were received from Civil Engineers and Quantity Surveyors respectively. However, 2 of them were not fully completed by the respondents and were therefore not suitable for inclusion in the analysis. This represents a valid response rate of 66% which was considered to be very good as it was similar to the response rate of Amoatey et al (2015) with a reponse rate of 62% but higher than the response rate of Olawale and Sun (2015) which was 45%. Respondents were asked to numerically indicate the methods identified from literature that they employ in fixing contract duration for bridges and road construction projects.

Table 3: Questionnaire distribution and their responses in percentage

Profession	Questionnaire distributed	No of responses	No Rejected	No of valid responses	% of response
Civil Engineers	55	30	1	29	43.9
Quantity Surveyors	45	38	1	37	56.1
Total	100	68	2	66	100

These engineers and quantity surveyors are the ones in charge of the total road network in their respective regions and so the data obtained can be said to be reliable and can contribute immensely to the results of this research.

Collection of quantitative data

To determine the extent of variability between the initial and final contract durations, 30 and 40 completed bridge and road construction projects respectively were collected from the Department of Feeder Roads in nine regions. Table 4 shows the type of projects collected. The data collected for each project was the initial and final durations on completion. The following formula was used to determine time overrun or underrun of projects in Tables 13 and 14.

Time overrun = Final contract duration - initial contract duration x 100% ..... (1)

Initial contract duration

Table 4: Type of Projects

Project type	No. of projects	% of sample
Bridges	30	42.86
Surfacing	40	57.14
Total	70	100

Testing of hypothesis

Hypothesis 1

To test for any agreement on the methods of determining duration by the two professional respondents, the t-test or the p-value at 5% significance level was used to test the following hypothesis:

Null hypothesis H_o: There is no agreement on the methods of determining duration by the two professional group of respondents at the agency.

Alternative hypothesis H_1: There is agreement on the methods of determining duration by the two professional group of respondents at the agency.

Hypothesis 2

H_0: There is no significant difference between the initial (planned) mean of duration and the mean of final (actual) duration.

Alternative hypothesis H_1: There is significant difference between the initial (planned) mean of duration and the mean of final (actual) duration

If t-calculated is less than t-tabulated, accept H_o and reject H_1. Alternatively, if p-value is greater than 0.05, then accept H_0 and reject H_1. The opposite is true in both alternatives (i.e. reject H_o and accept H_1 if t-calculated is greater than t-tabulated or p-value is less than 0.05).

RESULTS AND DISCUSSION

Part 1 of the questionnaire was meant to gather information on the background information of the respondents at the Department of Feeder Roads. Tables 5 and 6 show that 43.9% of the respondents were Civil Engineers with 31% of them having experience of 10 – 15 years and 15 years or more. The quantity surveyors on the other hand, had a response rate of 56.1% with 48.6%% and 21.6% of them having experiences of '10 -15 years' and '15 years or more' respectively. In addition, only 18.2% of the professionals had qualifications below a first degree. This means that as much as 81.8% of the respondents had BSc, MSc and PhD with only 3% having other qualifications namely Masters in Business Administration (MBA) apart from their first degrees (Table 7) refers. This information confirms that the data provided by the respondents can be relied upon for the purposes of analysis.

Table 5: Profession of Respondents

Profession	No	%
Civil Engineers	29	43.9
Quantity Surveyors	37	56.1
Total	66	100.0

Table 6: Years of experience of respondents

Year	Civil Engineers		Quantity Surveyors	
	No	%	No	%
1 – 5	5	17.2	7	18.9
5 – 10	6	20.7	4	10.8
10 – 15	9	31.0	18	48.6
15 years or more	9	31.0	8	21.6
Total	29	100.0	37	100.0

Table 7: Qualification of Respondents

Qualification	No. of respondents	%
CTC/HND	12	18.2
BSc	30	45.5
MSc	20	30.3
PhD	2	3.0
Others (MBA)	2	3.0
Total	66	100.0

Part 2 of the questionnaires was designed to solicit information on the current methods employed in determining the duration for both road and bridge construction projects and to ascertain whether the agency (who normally act as consultants to Government) keeps a database for production rates of various construction activities. The methods indicated in the questionnaire were identified from literature and presented to the respondents to indicate the ones they actually use in determining the duration of their projects. Table 8 shows that 17.2% of the respondents who were civil engineers indicated that the Gantt chart technique is used in estimating the duration for their projects whereas 21.6% of the quantity surveyors indicated that they used the same technique for the purpose of estimating the duration. This supports the view of Nkado et al (1999) who found out that 7% of quantity surveyors in South Africa employ a computerised program (Gantt Chart) in estimating construction time. With respect to the usage of the PERT technique, 24.1% of civil engineers and 35.1% of quantity surveyors indicated that this technique is employed by them. This finding is comparable to that of Olawale and Sun (2015) who found out that 34% of consultants use the PERT technique for determining the duration of projects in the UK. The same percentages of civil engineers (24.1%) and quantity surveyors (35.1%) mentioned that none of these techniques are employed by them. This is because as shown in Table 9, 13.6% of the professionals at the agency arbitrarily fix contract durations whereas 68.2% use similar experience on previous projects in fixing duration of both bridge and road construction projects. The finding of 68.2% of the professionals at the agency using similar experience (or engineering

judgement) in fixing contract duration is comparable to that of the study conducted by Nkado et al (1999) who found out that 71% of the practitioners in South Africa also use similar experience in the estimation of duration. Only 1 civil engineer and quantity surveyor indicated the usage of a combination of Gant chart and CPM as well as CPM and PERT in fixing durations.

To ascertain whether there are agreements by the two professional groups of respondents on the traditional methods employed by them in determining duration, the paired sample test or the significance test at 5% level (Table 9) was employed on the percentages of each professional group. Using the SPSS version 17, the result of the test in Table 9 indicates that there are no agreements between civil engineers and quantity surveyors [t (6) = -0.003, $p>0.05$ since $p = 0.997$] on the traditional methods employed by them in fixing contract durations for both road and bridge construction projects. The possible reason for this disagreement among the two professional groups could be that most of them (i.e 68.2% use similar experience on previous projects in fixing duration whereas 13.6% arbitrarily fix duration of new projects, see Table 10). "Arbitrarily fixing duration" in this study refers to professionals fixing duration without any basis.

Table 8: Traditional Methods of duration determination

Method	Civil Engineers (CE)		Quantity Surveyors (QS)	
	No	Percentage	No	Percentage
Gant Chart	5	17.2	8	21.6
CPM	6	20.7	0	0.00
PERT	7	24.1	13	35.1
None	7	24.1	13	35.1
Others	2	6.9	1	2.7
Gantt chart and CPM	1	3.4	1	2.7
CPM and PERT	1	3.4	1	2.7
Total	29	100.0	37	100.0

The finding of 68.2% of the respondents using similar experience alone agrees with Olawale and Sun (2015) who discovered that 53.8% of consultants in the UK employ experience only in determining contract time. It is worthy to note that the usage of similar experience and arbitrariness alone by the professionals at the agency in fixing contract duration constitutes 81.8% of the 66 respondents. 7.6% of the respondents indicated that they use a combination of similar experience and arbitrary fixing of contract duration. Therefore, the use of fixing contract duration by similar experience, arbitrariness and a combination of experience and arbitrariness collectively sums up to 89.4% of the respondents. This honest admission of using similar experience on previous projects and arbitrariness in fixing contract durations suggests that the Gantt charts, CPM and PERT techniques are rarely used by them even though 38.8%, 20.7% and 59.2% of the respondents said that they use the Gantt chart, CPM and PERT techniques respectively in fixing contract durations (see Table 7). The predominant method of similar experience (68.2%) employed by the

professionals at the agency in fixing contract duration corroborates that of Seshie (2009) who found out that construction professionals, who manage public building projects in Ghana estimate durations based on experience and did not adopt any scientific method for fixing duration for building projects. The method of using similar experience on previous projects (68.2%) to fix contract duration at the agency has been adjudged subjective and thus unreliable (Hassan et al, 2015). This is possibly, the reason why as much as 92.4% of the respondents (see Table 12) in this study stated that they would like a model for duration estimation for road and bridge construction projects to be developed for them. The development of the models for both road and bridge construction projects have been published elsewhere (see Mensah et al, 2016a and Mensah et al, 2016b).

Table 8: Paired Sample Test for traditional methods of duration determination for respondents

		Paired Differences					
		Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pair 1	CE - QS	-.01429	10.86637	4.10710	-.003	6	.997

Table 9: Other Methods for determining duration

Other Methods	Frequency	Percent
Arbitrarily fixing	9	13.6
Similar experience	45	68.2
Regression techniques	2	3.0
Others	3	4.5
Arbitrarily fixing and similar experience	5	7.6
None	2	3.0
Total	66	100.0

Table 10 shows that 62.1% of the respondents use the computer software, MS project in determining duration whereas 18.2% indicated that they do not use any of the available computer softwares. The finding of 62.1% of the respondents using MS project is similar to that of Olawale and Sun (2015) who also found out that 57% of consultants in the UK employ this same software for time estimation purpose and time control. 16.2% however said that they use other software in duration determination.

Table 10: Computer softwares for duration determination

Computer softwares	Frequency	Percent
MS Project	41	62.1
Suretrak	0	0.00
Others	11	16.7
Primavera and MS Project	2	3.0
None	12	18.2
Total	66	100.0

With respect to whether the professionals at the agency have a database for production rates and how regularly they are updated, 62.1% responded that they do have a database for production rates for various activities

undertaken by them. A moderate percentage of the professionals (37.9%) said that they do not have such database at all and this is in line with Chong et al (2011) assertion that many departments of transportation simply do not have sufficient data in terms of production rates to apply computerised methods to improve the reliability of their estimates. Out of the 62.1% (Table 10) who said that production rates are available at the agency, 48.5% indicated that the production rates are regularly updated whereas 15.2% mentioned that the production rates are not updated regularly. 36.4% of the respondents, however, made no indication of whether the production rates are updated or not.

Table 11: Production rates availability and regular update

Response	Availability of Database for production rates?		Production rates updated regularly?	
	Frequency	Percent	Frequency	Percent
Yes	41	62.1	32	48.5
No	25	37.9	10	15.2
No indication	0	0.0	24.0	36.4
Total	66	100.0	100.0	100.0

Table 12: Professionals who want models to be developed for duration determination

Response	Frequency	Percent
Yes	61	92.4
No	5	7.6
Total	66	100.0

Variability in initial and final contract durations for bridge and road construction projects

Tables 13 and 14 show the summary characteristics of the selected bridge and road construction projects respectively. Table 13 shows that 22 of bridge projects representing 73.33% of the sample experienced a time overrun above 20%. This agrees with the study carried out by Amoatey and Ankrah (2017) who revealed that about 70% of road projects in Ghana go beyond their intended completion date by an average time overrun of 17 months up to 78 months. The finding is also in line with the study conducted by Asiedu et al, (2016) who found out that the average time overrun of public building projects in Ghana is 106.45%. The result reveals that there is a wide variability between the initial contract duration fixed by professionals at Department of Feeder Roads and the actual durations used by most of the contractors in completing the bridge construction projects. Table 13 furthers shows that only 3 of the projects were also completed before the intended or revised completion dates with only 2 projects experiencing a time overrun of between 5% and 20%. For road construction projects, Table 14 reveals that twenty – five (25) of the projects representing 62.50% of the sample

experienced a time overrun above 20%. Seven (7) of the projects were also completed before the intended or revised completion dates with seven (7) projects experiencing a time overrun of between 5% and 20%. This is in line with the findings of Asiedu et al, (2016) who found out that the average time overrun of public school projects in Ghana from 2010 to 2013 ranged from -45.05% to 559.91%. The findings also agrees with Aibinu and Jagboro (2002) who revealed that the average time overrun of building projects in Nigeria ranges from 59.23% to 92.64%.An important revelation that emerges from this analysis is that the estimated duration of bridge construction projects are often exceeded by contractors who execute such contracts. The possible reason for this development is the absence of the application of scientific methods in determining contract durations (see Table 9). From Table 9, 68.2% of the respondents indicated that they use similar experience to determine duration whereas 13.6% fix the duration arbitrarily and this method has been adjudged subjective and unreliable (Hassan et al, 2015).

Table 13: Summary characteristics of collected bridge projects

LOCATION	NO. OF PROJECTS	PERCENTAGE
Eastern	6	20.00
Northern	1	3.33
Upper East	5	16.67
Brong Ahafo	3	10.00
Western	4	13.33
Central	2	6.67
Greater Accra	1	3.33
Ashanti	8	26.67
Time overruns/underrun (T)		
T< 0	3	10.00
0≤ T ≤5%	3	10.00
5< T ≤20%	2	6.67
T >20%	22	73.33
Bridge span (m)		
20 - 30	21	70.00
31 - 40	6	20.00
41 - 55	3*	10.00
Donors / Funding Type		
Acrow	7	23.33
Dutch	16	53.33
Spanish	7	23.33

*2 of the projects contained two different steel bridges of different spans

Table 14: Summary characteristics of selected surfaced road projects

ITEM	NO	PERCENTAGE
Location/Region		
Eastern	11	27.50
Western	9	22.50
Volta	1	2.50
Brong Ahafo	7	17.50
Upper East	1	2.50
Central	4	10.00
Ashanti	2	5.00
Greater Accra	5	12.50
Time overruns (T)		
T< 0	7	17.50
0≤ T ≤5%	7	17.50
5< T ≤20%	1	2.50
T >20%	25	62.50

To statistically establish the wide variations between the initial and final contract durations for both bridge and road construction projects, hypothesis 2 stated under research method is tested at the 5% level of significance (see Table 15).

Table 15: Paired Samples test for initial and actual durations for bridge and road projects.

		Paired Differences					
		Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Pair 1	Planned duration – Actual duration (bridge)	-318.30	331.04	60.44	-5.266	29	.000
Pair 2	Planned duration – Actual duration (road)	-252.45	261.39	41.33	-6.108	39	.000

The difference in means between the planned and the actual durations for both road and bridge projects is shown in the mean column of Table 15. From Table 15, pair 1 indicates that the differences in means is significant at the 5% level [i.e. t (29) = -5.266, $p<0.05$ since p = 0.000]. Therefore, the alternative hypothesis of significant difference between the planned mean of duration and the mean of actual duration is accepted. Pair 2 in Table 15 also shows that the differences in means is significant at the 5% level [i.e. t (39) = -6.108, $p<0.05$ since p = 0.000]. This shows that the durations fixed by the professionals at the agency for bridge contracts are actually different from that used by the contractors in executing the projects. This is possibly because of the predominant method of similar experience (68.2%) employed by the professionals at the agency in fixing contract duration (see Table 9)

which has been adjudged subjective and thus unreliable (Hassan et al, 2015). The implication of this is that professionals at the Department of Feeder Roads ought to look at the methods they employ in fixing duration for road projects.

SUMMARY OF FINDINGS

With respect to the methods used in contract duration determination, 13.6% of the professionals at the agency indicated that they arbitrarily fix contract durations for both bridge and road construction projects. 68.2% of the professionals indicated they used similar experience on previous projects to fix duration. Therefore, the use of fixing contract duration by similar experience, arbitrariness and a combination of experience and arbitrariness collectively sums up to 89.4% of the respondents. Thus, the usage of similar experience is the predominant method used by the professionals at the agency in contract duration determination.

With respect to the variability between the initial and final contract duration of completed projects, 22 of bridge projects representing 73.33% of the sample experienced a time overrun above 20%. 10% of the bridge projects, however, went beyond the initial (planned) durations up to 5% with 6.67% being completed between 5% up to 20% above the initial contract durations. Only 3 projects representing 10% were completed before the initial contract duration stipulated in the contract documents. For road projects, the quantitative data showed that 25 of the projects representing 62.50% of the sample experienced a time overrun above 20%. 17.50% of the projects, however, went beyond the initial durations up to 5% with only 2.50% being completed between 5% up to 20% above the initial contract durations. Only 7 projects representing 17.5% were completed before the initial contract duration stipulated in the contract documents.

For the two types of projects, a hypothesis was tested at the 5% level of significance to ascertain whether there is significant difference between the initial contract duration and the final or actual duration. The finding was that there was a significant difference or a wide variability between the initial contract duration fixed by professionals at the department and the actual durations used by most of the contractors in completing both bridge and road construction projects.

An important revelation that emerges from this finding is that the estimated duration of construction projects at the agency are often exceeded by contractors who execute such contracts. The possible reason for this development is the predominant use of similar experience and in some cases arbitrariness by the professionals at the agency in fixing contract durations.

CONCLUSIONS AND RECOMMENDATIONS

This paper has shown that professionals at the Department of Feeder Roads predominantly use experience of similar jobs to estimate the duration for future projects. The study has shown that the usage of similar experience in

fixing contract duration is one of the possible reasons for the wide variations in the initial (planned) contract duration and the duration actually used by the professionals at the agency.

It is therefore recommended that the professionals at the agency adopt a system just like the transportation departments in the United States to determine the duration of projects since the method of similar experience used by them are not scientific in nature. The adoption of this recommendation would go a long way to enable the agency to reasonably estimate the duration of road and bridge construction projects to eliminate or reduce time overrun on their projects as well as the deduction of liquidated and ascertained damages from contractors for late completion.

REFERENCES

Aibinu A.A and Jagboro G.O (2002), *The effects of construction delays in Nigerian construction industry.* International Journal of Project Management 20(8): 593-599.

Amoatey, C.T., Ameyaw, Y.A., Adaku, E. and Famiyeh, S. (2015). *Analysing delay causes and effects in Ghanaian state housing construction projects.* International Journal of Managing Projects in Business, 8(1): 198 - 214.

Amoatey C. and Ankrah A.N.O, (2017) "*Exploring critical road project delay factors in Ghana"*, Journal of Facilities Management, Vol. 15 Issue: 2, doi: 10.1108/JFM-09-2016-0036

Asiedu R.O, Frempong N.K and Nani G. (2016), *Parametric time overrun estimation of building projects*. Journal of Financial Management of Property and Construction, 21(3): 253 – 268.

Atreya S. (2007), *Development of an Improved System for Contract Time Determination. MSc Thesis.* Oklahoma State University. http://ntl.bts.gov/lib/11000/11100/11121/KY-CTDS.pdf - Accessed 25/12/15.

Chong, W.K., Lee, S.H. and O'Connor, J.T., 2011. Estimating highway construction production rates during design: Elements of a useful estimation tool. *Leadership and Management in Engineering*, *11*(3), pp.258-266.

Federal Highway Administration (2002), *FHWA Guide for Construction Contract Time Determination Procedures.* www.fhwa.dot.gov/construction/contracts/t508015.cfm - 25/12/15

Hancher, D.E., McFarland, W and Alabay, R.T (1992), *Construction Contract Time Determination.* Texas Transportation Institute, Texas A&M University System Research Report 1262-1F.

Hancher D.E and Werkmeister R.F (2000), *Kentucky Contract Time Determination Systems*. Kentucky Transportation Centre, Univeristy of Kentucky Research Foundation Report.

Hassan Adaviriku Ahmadu, Yahaya Makarfi Ibrahim, Ahmed Doko Ibrahim and Muhammed Abdullahi (2015), *Modelling building construction durations*. Journal of Financial Management of Property and Construction 20(1): 65 - 84.

Lim, C.S. and Mohamed, M.Z. (1999), *Criteria of project success: an exploratory re-examination*. International Journal of Project Management, 17(4): 243-248.

Jin R, Han S, Hyun C.T and Cha Y. (2016), *Application of Case – Based Reasoning for Estimating Preliminary Duration of Building Projects*. Journal of Construction Engineering and Management 142(2):04015082.

Kumaraswamy M. and Chan W (1998), *Contributors to Construction Delay*. Construction Management and Economics 16(1):17-29.

Mensah, I, Adjei –Kumi T. and Nani G. (2016a), *Duration Determination for Rural Roads using the Principal Component analysis and Artificial Neural Network*. Engineering, Construction and Architectural Management 23 (5): 638 – 656.

Mensah, I, Nani G. and Adjei –Kumi T. (2016b), *Development of a Model for Estimating the Duration of Bridge Construction Projects in Ghana*. International Journal of Construction Engineering and Management 5 (2): 55 – 64.

Nkado R.N, Akintoye A., Bowen P.A and Pearl R.G (1999), *Forecasting construction Time by Quantity Surveying Practices in South Africa*. Urban Forum 10(2): 166 – 182.

Odusami K.T and Olusanya O.O (2000), *Client's Contribution to Delays on Building Projects*. The Quantity Surveyor 30: 30 -33.

Ofori – Kuragu J.K, Baiden B.K and Badu E. (2016), *Key Performance Indicators for Project Success in Ghanaian Contractors*. International Journal of Construction Engineering and Management, 5(1): 1 – 10.

Olawale Y. and Sun M. (2015), *Construction project control in the UK: Current practice, existing problems and recommendations for future improvement*. International Journal of Project Management 33: 623 – 637

Seshie C.S. (2009), *Time Performance for Public building Projects in Ghana*. MSc thesis, Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

NATURE AND FEATURES OF TENDERS PROCESSED BY A UK CONTRACTOR IN 2010

Samuel Laryea[1] and Alex Lubbock[2]

[1]*School of Construction Economics and Management, Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, South Africa*

[2]*Carillion PLC, Property and Facilities Office, Cuffas Lea House, 3500 John Smith Dr., Oxford OX4 2WD, UK*

Construction contractors are constantly tendering for work. One reason is because of the widespread use of competitive tendering by clients as a strategy for awarding construction and engineering projects. Tenders submitted by contractors are often influenced by a range of factors which include cost of resources, profit, risk, market conditions and the firm's particular circumstances. Major contractors process several tenders annually in order to respond to client invitations, win work and sustain their business. However, little empirical research is often reported on the nature of tenders processed by contractors. Several studies acknowledge difficulty in accessing such data. Here, however, the authors were able to negotiate access into the database of a major UK contractor for documentary analysis of tenders processed in 2010. The purpose was to examine the nature of tenders processed and its essential features. 35 out of 57 tenders processed in one year were analysed to develop an empirical understanding of variables such as the value of projects and their tender period, costs of tendering, and extent to which subcontractors respond to tender invitations. No significant relationship was found between project value and the amount of time allowed for tendering. Tendering costs for the 35 projects analysed represented 1.76% of the company's annual turnover of £150m. This estimate excludes tendering costs for 22 other projects which could increase annual tendering costs of the firm to 3% of turnover. 72 enquiries to subcontractors received quotations from 50% of them. This demonstrates waste; one area contractors should address to reduce tendering costs. The value of this paper lies in reporting empirical findings on contractor tendering from an organisational perspective.

Keywords: relationship between project value and tender period, subcontractors' response to tender invitations, tendering, tendering costs

INTRODUCTION

Contractors are constantly in the business of tendering for work. One reason for this is the widespread use of competitive tendering by clients as a

[1] samuel.laryea@wits.ac.za

[2] alex.lubbock64@googlemail.com

Laryea, S. and Lubbock, A. (2017) Nature and features of tenders processed by a UK contractor in 2010 *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1079-1096

strategy for awarding construction and engineering projects. The tender submitted by a contractor is often influenced by a range of factors which include cost of resources, profit, risk, market conditions and the firm's particular circumstances at the time of tendering (see Liu and Ling, 2005).

Major contractors process several tenders annually in order to respond to client invitations, win work and sustain their business. Access was negotiated into the database of a major UK contractor to enable a detailed analysis of tenders processed in 2010 to be carried out. The purpose of the study was to develop a better understanding of the tenders prepared during the year and the essential features of the tenders. Results of the study are reported in this paper. The reason this paper is important is that access to such information is often limited and as a result little empirical research has been reported on the nature of contractor's tendering activity from an organisational perspective.

LITERATURE REVIEW

Published literature on construction tendering and tendering in the context of construction contractors is reviewed to provide a theoretical context for they study and discussion of findings.

Tendering in construction

The International Organisation for Standardisation (2014) Building and Civil Engineering – Vocabulary – Part 2: Contract terms (ISO 6707-2: 2014, 7.12) defines "tendering" as the process of obtaining tenders, with the intention of forming a contract with one or more of the tenderers. Most construction contracts are created by the process of tender (Hughes et al., 2015). Construction clients typically use tendering as a strategy to obtain 'bargain' bids from contractors. However, research by Smith and Bohn (1999) and Rooke *et al.* (2004) challenges the notion that competition leads necessarily to bargain prices. Rooke *et al.* (2004) found that some contractors would plan to recover losses from low bids through claims in the construction phase. In difficult economic times, contractors may offer unrealistic bids (Neufville and King, 1991; Laryea and Hughes, 2008). However, Smith and Bohn (1999) argue that should a contractor become insolvent as a result, such bargain bids may prove to be no bargains in the end for an employer. A balanced relationship between competition and sustainable procurement should be aimed for in practice.

Construction tendering is often characterised by lowest price (Hillebrandt, 2000; Wong et al., 2000); short time frame for bidding (see Smith and Bohn, 1999); unclear tender documents (Laryea, 2011; Wåhlström, 1991); and in some cases, unethical behaviour (see Ray *et al.*, 2007; Bowen *et al.*, 2007). To some extent, these issues can be addressed through the principles of sustainable procurement. Sustainable procurement requires consideration of economic, social and environmental factors in the award of contracts; not only in terms of the tender evaluation criteria but all actions connected with the procurement process (BS 8903: 2010). Many employers employ tendering primarily as a means for achieving their economic interests.

From a sustainability perspective, procurement should take wider economic, social and environmental objectives into account (BS 8903: 2010). In most forms of competitive procurement, price is often the overriding concern. This can create an imbalance in the sustainability equation and hence research is needed to examine the relationship between competitive tendering and sustainable procurement in construction.

Several studies indicate that tendering costs in construction can be significant. For example, Hughes *et al*. (2006) sought to quantify the commercial costs associated with procurement and tendering in the UK based on four main parameters: marketing, agreeing terms, monitoring of work, and resolving disputes. The authors found that tendering costs varied between 0-9% depending on a firm's position within the supply chain and nature of the work involved. For contractors, it was found that the total cost of obtaining work could be as high: ½-1% for traditional contracts and 2-3% for those involving Private Finance Initiative (PFI) projects. It was discovered that it was typical for contractors and consultants to be winning one in six contracts bid for and one in four for complex projects, meaning that the total costs of obtaining work were 3-6% for traditional work and 8-12% for complex work. Some of the factors responsible for high tendering costs included anonymity of competition; excessively long tender lists; diverse pre-qualification practices; and poor quality and timing of information for bidders were identified as wasteful practices in tendering.

The UK Government Construction Strategy (2011) reflected on the problem of wasteful practices in construction tendering. An obvious outcome of current procurement practice is the wastefulness of teams completing and costing a series of alternative designs for a single project, only one of which will be built. The UK is exploring alternative procurement models designed to eliminate waste; and promote a more collaborative, integrated model that nonetheless maintains competitive tension and the ability to demonstrate value for money (UK Government Construction Strategy, 2011: 16). Two propositions have been put forward by industry teams as a potential solution: the first effectively pitches framework contractors against a challenging cost benchmark, with the understanding that if no member of the framework can beat the benchmark, then the project will go to tender without framework contractors being permitted to bid, providing opportunities for new entrants; the second offers a guaranteed maximum price underwritten by insurance, which also extends to protection against defects. Both propositions assume the full engagement of an integrated team – with designers, other professional consultants and constructors offering an integrated proposition, and with key trade contractors and manufacturers involved in developing the design. The adoption of either will impact on the current tendering landscape.

It seems clear that when several companies are bidding for the same work, some will inevitably be wasting resource that could be used elsewhere. The reasons why clients feel comfortable in entering into a competitive procurement strategy and awarding on price may be many and complex, but this procurement process has been shown not to be the most successful often

ending in dispute, wasting even more resource. Research is needed on the drivers from client's perspective to help develop alternative procurement strategies that reduce bidding cost and contributes to reducing the current wasted effort. If construction companies were able to reduce their bidding costs, their overhead would reduce and construction cost could reduce.

The use of digital technologies in construction procurement is increasing internationally. E-procurement has been used successfully in construction to achieve economic and efficiency benefits. Digital technologies like e-sourcing, e-tendering, e-reverse auctioning, e-informing, and e-marketsite enable organisations to engage in seamless, paperless, efficient, open and transparent procurement process. This includes notification of an opportunity, expressing an interest, prequalification procedures, downloading tender documents, and submitting bids regardless of geographical location, which can be performed 24 hours a day, 365 days a year. This promotes competition for the tender; and also provides a process that is transparent to suppliers.

Tendering as a commercial, strategic and technical exercise for contractors

Contractor tendering generally entails certain commercial, strategic and technical functions (Laryea and Hughes, 2011). The commercial functions relate to the financial aspects of a tender and its implications should a tender be successful including profitability. The strategic functions relate to the tactics used by contractors, including bid qualifications, to navigate in competitive environments in relation to project selection, risk management and market strategies. The technical functions comprise of the work done in relation to the calculation of a price and programme for a proposed construction project.

Tendering requires strategic judgment on the part of a contractor who wishes to be successful. For contractors operating in the same market, the costs of a project can be assumed to be significantly similar. The main element of a tender where significant differences may arise is the mark-up element. That is one reason why a contractor who wins a tender is often the one most likely to have made some errors of judgment probably on the assessment of risk rather than the one genuinely able to do the work at the lowest cost and mark-up (Hillebrandt, 2000). Thus, the tender for a project comprises of costs, and a mark-up for profit, overheads, risk and uncertainty (Hillebrandt, 2000). A study of tenders for office projects in the UK in 1982-83 by Flanagan and Norman (1989) found that on contracts over £1million, more than 80 per cent were within 10 per cent of the lowest bid, compared to less than 60 per cent for contracts under £1million. This means that a small change in the mark-up would have a very substantial effect on the number of contracts obtained. According to Hillebrandt (2000), the very fact that a contractor can win more work at a lower price than at a higher price invalidates any claim that construction is near to a perfectly competitive market.

In construction contracts, price formation and contract formation takes place through the same tendering process (Hughes et al., 2015). Therefore, a detailed amount of project information and specifications are needed at the time of drawing up a contract, to help establish exactly what is covered by the contract. However, tender documents are usually not complete and clear, leading to several problems including disputes. The lack of information and inconsistences in documents is one problem that complicates a contractor's tendering process. This problem was the subject of a paper by Laryea (2011) where it was argued that clearer documents leads to better bids from contractors and lesser risk of disputes. A paper by Wåhlström (1991) examined the relationship between quality of tender documents and construction cost. Based on data from projects in Sweden, the research demonstrated that reduction of total costs was possible with a set of appropriate tender documents.

RESEARCH DESIGN AND METHOD

The main aim of this study was to examine tenders prepared within a major contractor's organisation in one specific year in order to develop a better understanding of the essential features of the tenders. Key variables examined using document analysis included project value, tender period, forms of contract, supply chain response to tender enquiries from contractors, and tendering costs. The document analysis carried out enabled possible relationships between some of the variables to be explored. Scott (2006) provides guidance on use of the document analysis method.

Tendering is a process that demands significant documentation of its evidence within construction firms because of the commercial implications and accountability procedures. Therefore, it was inferred that much of the information relating to all tenders prepared will be available in documents at a contractor's office. However, the main challenge with research of this nature is often cited to be access because of commercial sensitivity of the information required (as explained in studies by Skitmore and Wilcock, 1994; Laryea and Hughes, 2011).

However, the researchers relied on personal relationship in the organisation to negotiate access to the relevant data. The approval processes involved a confirmation of the research goals and purpose with all appropriate personnel including our personal contacts. Researchers like Johnson (1979) advocated for the use of personal contacts in access negotiations which was the case here. The access provided enabled the researchers to go through all documents for 60% of the firm's 2010 tenders. It was not possible to examine data on some tenders for various reasons including commercial sensitivity. Nonetheless, the 35 tenders examined still provided a vast amount of historical tendering data and a suitable basis for the research.

As the research was carried out in 2011, 2010 was the year which had the most recent information on tenders available. The firm, hereafter referred to in this paper as Beta, has an internal data management system. This electronic data system contains all information about tenders hence this

was the source from which all data was collected including the information on throughput in the supply chain, tender periods, tender values, type of contract, enquiries, etc. Although this study is published five years after completing the study, the findings are relevant for the current context.

The tender evidence was drawn into a pool of tenders received and submitted during 2010. This was then reviewed for suitability, completeness and accessibility of data. The important data elements drawn in for this research were the index of documents to assess the megabytes (MB) of data and number of documents issued, (did not differentiate between a 1 page and a 1000 page document), to the contractor during the tender and hence the MB of data to manage. Perhaps this aspect of the tendering process could be supported in the future using a cloud system to reduce costs for tenderer in data storage and through to the suppliers.

The folders and documents representing the tracking of tender enquiries and the technical queries were also drawn in. These were then assimilated to form an overarching picture on a spreadsheet tender by tender. Tender enquiries tracking spreadsheet (Bid List or tender list) was assessed for number of enquiries sent out and the level of response. For practical purposes, this did not take into account the subtle differences between types of sub-contractor and their proneness to respond or not. However, it is assumed that there may be subtle differences here and probably additional wastage on not targeting suppliers particular needs or not being able to, e.g. White Lining (simple) v M&E (Complex). There was an existing tracking sheet for tenders that highlighted programme for delivering the tender and the type of contract although this could have been sourced from the works information documents. This was assessed and examined to produce the data for number of days of a tender.

The data on tendering costs was based on secondary data already available in the Beta's data management system. Tendering costs were estimated by viewing the submitted price per tender and the context of the submission (e.g. whether it had design or not) and cross referenced with the firm's tendering cost estimates in Table 8. The proportion attributed to supply chain costs is an experiential estimate based on a template of work winning bid cost build up (10%).

Table 1: Description of sample

Tenders	No	Annotation(s)
Total tenders in 2010	57	Total number of tender preparations in Beta in 2010
Tenders used in analyses	35	Sample used for data analysis (61% of population)
Tenders not used in analysis	22	It was not possible to include the data on 22 projects for reasons including restricted access to information, bid / no-bid decision produced a no-bid scenario, lack of information available on the electronic file, negotiated framework pricing

The research method can thus be described as documentary research which involves the use of texts and documents as source materials in electronic or hard copy form. Documentary research is the use of outside sources to support the viewpoint or argument of a piece of research work. The process

of documentary research often involves some or all of conceptualising, using and assessing documents. The analysis of the documents in documentary research would be either quantitative or qualitative analysis or both (Saunders et al., 2012). The key issues surrounding types of documents and our ability to use them as reliable sources of evidence on the social world must be considered by all who use documents in their research. Here, tendering is a real commercial exercise that contractors take seriously. The information in the firm's data management system is a record of what actually happened in the tendering process. Hence, the information is reliable and indicative of a high degree of ecological validity (Gill and Johnson, 2010).

DATA COLLECTION AND RESULTS

Table 1 summarizes the sample of 35 projects upon which the research findings is based. Only the data from 35 tenders could be used for this work because of reasons including restricted access to information, bid / no-bid process produced a no bid scenario, lack of information available on the electronic file, and negotiated framework pricing. Therefore, the analysis involves data from 60% of all 2010 tenders.

Table 2 presents a summary of the main variables examined in relation to the portfolio of 35 tenders. A detailed analysis of the tenders is summarized in Tables 3 - 7. The estimate of number of documents to read/process per day should be seen as a minimum given that the documents need to be reviewed within the first 4 weeks in practice. The same argument can be extended to the estimate of 20MB of information per day. The estimate for waste is based on instances where there is no quote from contractor and no pricing during tender.

Table 2: Summary of tendering portfolio in Beta for 2010

Tender Action	Average
Tender Period (weeks)	6
Number of Working Days	31
Number of Documents	341
Number of Docs Per Day	11
MB of Information	626
MB per Day	20
Work Packages (Trades)	18
Enquiries	72
Enquiries per trade	4
Quotations Received	38
No quote	15
Did not price During Tender	26
Technical Queries	17
Price (average of tender prices submitted in 2010)	£18,378,571
Tendering Cost to Contractor	£75,429
Estimated Supply Chain Budget 10%	£7,543
Estimated Waste in Budget	£3,771

Table 3: Budget Tender Costs (Based on Value of Tender) – (2010)

Contract Value	Direct Costs	Quantities	Design	Total
£0- £2m	15,000	5,000	5,000	25,000
£2m - £4m	25,000	5,000	7,000	37,000
£4m - £8m	35,000	5,000	7,000	47,000
£8m - £15m	50,000	10,000	7,000	67,000
£15m - £24m	75,000	10,000	10,000	95,000
£24m - £40m	95,000	12,000	10,000	117,000
£40m - £60m	125,000	12,000	15,000	152,000
£60m - £80m	160,000	15,000	30,000	205,000
£80m - £150m	220,000	35,000	50,000	305,000
£150m - £250m	330,000	45,000	60,000	435,000
£250m - £350m	460,000	50,000	80,000	590,000

The examination and analysis of data relating to the 35 tenders enabled relationships and extent of variables in a contractor's annual tendering environment to be explored. The data flowing from the research carried in Beta in 2010 is summarized in Tables 4-8. In some sections of Tables 4-8, the relevant data was not available and hence could not be captured in the analysis. This is a limitation of the study which was not considered to impact significantly on the overall findings and its interpretation.

Table 4: Tender period and tender documents

Result Number	Tender Period (Weeks	MB of Tender Information Issued to Contractor	Number of Documents issued to Contractor
1	6	635	513
2	6	692	384
3	6	502	209
4	6	21.6	44
5	4	45.9	72
6	10	188	164
7	12	2080	494
8	4	173	166
9	12	686	508
10	4	113	177
11	6	696	935
12	6	7.86	20
13	6	177	121
14	8	466	260
15	8	1450	487
16	6	736	257
17	8	453	353
18	6	3490	1191
19	6	313	123
20	6	493	435
21	6	339	301
22	6	965	604
23	4	58.5	62
24	6	692	266
25	4	214	60

Table 4 cont'd: Tender period and tender documents

26	6	195	146
27	6	1960	864
28	6	464	268
29	6	927	885
30	6	673	872
31	6	271	172
32	4	174	41
33	4	401	35
34	6	150	215
35	6	1020	243
Total	218	21921.86	11947
AVERAGE	6.23	626.34	341.34

Table 5: Enquiries from contractor

Result Number	Work packages (Trades)	Enquiries	Average Number of Enquiries Per Trade Sent out to Supply Chain
1	19	106	5.58
2	13	55	4.23
3	13	66	5.08
4	1	7	7
5	17	99	5.82
6	7	17	2.43
7	-	-	-
8	13	73	5.62
9	62	227	3.66
10	15	73	4.87
11	10	38	3.8
12	21	110	5.24
13	9	21	2.33
14	19	83	4.37
15	25	102	4.08
16	25	103	4.12
17	15	42	2.8
18	10	38	3.8
19	18	60	3.33
20	21	82	3.9
21	31	117	3.77
22	30	91	3.03
23	10	27	2.7
24	3	11	3.67
25	-	-	-
26	19	79	4.16
27	45	179	3.98
28	21	78	3.71
29	20	82	4.1
30	34	116	3.41
31	4	18	4.5
32	8	27	3.38
33	8	23	2.88
34	9	43	4.78
35	20	98	4.9
Total	595	2391	
AVERAGE	18	72	4

Table 6: Response to enquiries

Result Number	Enquiries	Quote Received	Refused to Quote During the Tender Period fo Project	Did not Price or Respond During the Tender Period	Quote Received %	Refused to Quote %	No Response During Tender Period %
1	106	58	15	33	55	14	31
2	55	25	3	27	45	5	49
3	66	35	13	18	53	20	27
4	7	3	0	4	43	0	57
5	99	64	21	14	65	21	14
6	17	14	2	1	82	12	6
7	-	-	-	-	-	-	-
8	73	23	1	49	32	1	67
9	227	77	40	110	34	18	48
10	73	43	9	21	59	12	29
11	38	-	-	-	-	-	-
12	110	56	19	35	51	17	32
13	21	-	-	-	-	-	-
14	83	42	16	25	51	19	30
15	102	42	20	40	41	20	39
16	103	47	22	34	46	21	33
17	42	30	5	7	71	12	17
18	38	21	2	15	55	5	39
19	60	16	13	31	27	22	52
20	82	44	5	33	54	6	40
21	117	62	35	20	53	30	17
22	91	50	18	23	55	20	25
23	27	13	2	12	48	7	44
24	11	-	-	-	-	-	-
25	-	-	-	-	-	-	-
26	79	54	17	8	68	22	10
27	179	89	63	27	50	35	15
28	78	25	13	40	32	17	51
29	82	44	22	16	54	27	20
30	116	44	13	59	38	11	51
31	18	7	6	5	39	33	28
32	27	14	9	4	52	33	15
33	23	-	-	-	-	-	-
34	43	24	9	10	56	21	23
35	98	48	31	19	49	32	19
Total	2391	1114	444	740	-	-	-
AVERAGE	72	38	15	26	50	18	32

Table 7: Tender queries and form of contract

Result Number	No. Documents	TQ's	Contract Type
1	513	4	NEC 3 Option B
2	384	27	JCT D&B
3	209	10	NR Framework
4	44	-	NEC 3 Option A
5	72	5	NEC 3 Option C
6	164	5	NEC 3 Option C
7	494	56	NR9
8	166	-	NEC 3 Option C
9	508	-	NEC 3 Option C
10	177	-	NEC 3 Option C
11	935	-	NEC 3 Option C
12	20	12	NEC 3 Option A
13	121	35	NR Framework
14	260	26	NEC 3 Option C
15	487	24	NR9
16	257	15	NEC 3 Option C
17	353	17	Framework LUL
18	1191	12	NR12 D&B
19	123	5	NEC 3 Option A
20	435	11	NEC 3 Option A
21	301	6	NEC 2 Option A
22	604	11	NEC 3 Option A
23	62	20	NEC 3 Option A
24	266	18	NR Framework
25	60	8	NEC 3 Option A
26	146	-	NEC 3 Option B
27	864	24	NEC 3 Option C
28	268	-	NEC 3 Option C
29	885	-	NEC 3 Option C
30	872	-	NEC 3 Option C
31	172	11	NEC 3 Option A
32	41	-	NEC 3 Option C
33	35	-	NEC 3 Option C
34	215	2	NEC 2 Option A
35	243	54	NR9
Total	11947	418	
AVERAGE	341	12	

Table 8: Tendering costs

Result Number	Submission Price to nearest million	Cost of Tender	% Allowance for Supply Chain
1	£9,500,000	£50,000	£5,000.00
2	£5,000,000	£47,000	£4,700.00
3	£10,000,000	£60,000	£6,000.00
4	£9,000,000	£60,000	£6,000.00
5	£2,500,000	£30,000	£3,000.00
6	£100,000,000	£255,000	£25,500.00
7	£40,000,000	£137,000	£13,700.00
8	£5,500,000	£40,000	£4,000.00
9	£28,000,000	£107,000	£10,700.00
10	£500,000	£20,000	£2,000.00
11	£12,000,000	£60,000	£6,000.00
12	£8,000,000	£60,000	£6,000.00
13	£5,000,000	£40,000	£4,000.00
14	£30,000,000	£107,000	£10,700.00
15	£15,000,000	£85,000	£8,500.00
16	£15,000,000	£85,000	£8,500.00
17	£10,000,000	£60,000	£6,000.00
18	£30,000,000	£107,000	£10,700.00
19	£2,000,000	£30,000	£3,000.00
20	£5,000,000	£60,000	£6,000.00
21	£10,000,000	£60,000	£6,000.00
22	£20,000,000	£85,000	£8,500.00
23	£3,000,000	£30,000	£3,000.00
24	£50,000,000	£137,000	£13,700.00
25	£4,000,000	£40,000	£4,000.00
26	£3,000,000	£25,000	£2,500.00
27	£75,000,000	£175,000	£17,500.00
28	£30,000,000	£107,000	£10,700.00
29	£25,000,000	£107,000	£10,700.00
30	£30,000,000	£107,000	£10,700.00
31	£2,000,000	£30,000	£3,000.00
32	£750,000	£20,000	£2,000.00
33	£500,000	£20,000	£2,000.00
34	£8,000,000	£60,000	£6,000.00
35	£40,000,000	£137,000	£13,700.00
Total	£643,250,000	£2,640,000	£264,000
AVERAGE	£18,378,571	£75,429	£7,543

DISCUSSION OF RESULTS

Five main issues are brought forward for discussion. Further studies and additional data will be required to validate some of the preliminary observations presented here.

Project value and tender period

Several studies on contractor bidding including Smith and Bohn (1999) and Laryea (2011) allude to the short bidding time frame contractors often have to calculate their bids for construction work. Here, data presented in Tables 4 and 10 shows an average tender period of approximately six weeks across

35 projects of value between £100m and £500,000. The frequency of occurrence of tender periods from 4-12 weeks is summarized in Table 9.

Table 9: Frequency of occurrence of various tender periods

	Tender period and frequency of occurrence				
Tender period (weeks)	12	10	8	6	4
Frequency of occurrence	2	1	3	22	7

It was decided to examine the project value and amount of time allowed for tendering. In other words, do clients allow more time for tendering when the value of a tender is bigger? Table 10 summarizes a comparison and examination of tender periods for the ten largest projects and ten smallest projects.

Table 10: Comparison of tender periods for ten largest and ten smallest projects

	Estimated value and tender period for ten largest projects										
Project value (£million)	100	75	50	40	40	30	30	30	30	28	AVG
Tender period (weeks)	10	6	6	12	6	8	6	6	6	12	7.8
	Estimated value and tender period for ten smallest projects										
Project value (£million)	5	5	5	4	3	3	2	0.75	0.5	0.5	
Tender period (weeks)	6	6	6	4	4	6	6	4	4	4	5

A comparison of tender periods for the ten largest projects of value £100m - £28m with tender periods for the ten smallest projects of value £5m - £500,000 reveals no direct relationship between project size (value) and amount of time allowed for tendering (see Table 10). This reveals an interesting question for further research on the determinants of tender periods by clients. If there is no direct relationship between the value of a project and tender period, then how do clients determine the amount of time to allow for contractors to put together their bid for a construction project, what factors or characteristics are taken into account?

Supply chain response to enquiries

The research by Laryea (2009) on subcontract and supply enquires in the tender process of two UK contractors found that 43 subcontract enquiries were made across two projects with average value of £7m and 15 subcontract packages. Thus, about three subcontractors were invited to bid within each package (or trade). Here, the average number of work packages and enquiries across 35 tenders of value between £100m and £500,000 (see Table 11) was 18 and 72 respectively which results in an average of four enquiries per work package. The latter clearly represents a wider distribution of projects. A close examination of the data for the five projects of value around £7m (£5m – £9m) reveals an average of 11 work packages

and 51 enquiries. This seems closer to the earlier finding in Laryea (2009). However, little correlation seems to exist between the value of a project and its number of work packages which will clearly depend on the nature of the project (see Table 8 and 5).

The overall average of 72 enquiries sent out received quotations from only 50 per cent of subcontractors during the period specified. The highest response to enquiries was 82 per cent and the lowest was 27 per cent. 32 per cent of subcontractors contacted did not offer a response at all to the enquiries from Beta. 18 per cent of subcontractors indicated they would not quote. This clearly demonstrates waste in the process; and represents one area contractors should focus management attention in order to reduce their tendering costs. In the research by Laryea (2009), contractors sent three enquiries per work package and received responses in 80 per cent of enquiries. However, that research was limited to two cases but it also concluded on the need to eliminate wasteful practices in tendering.

Standard form contracts

The use of standard form contracts seems prevalent throughout the 35 cases (see Table 7). However, it should be noted that clients typically amend the terms and conditions in practice (see Laryea and Hughes, 2009). The contract type used across the 35 projects can be summarized as follows: NEC 3 Option C (14 tenders), NEC 3 Option A (10), NR9 (3), NR Framework (3), NEC 3 Option B (2), NR12 Design and Build (1), JCT Design and Build (1) and Framework LUL (1). It should be noted here that this distribution of the types of contract is influenced by the area of construction "Civil engineering" and Beta's Bid / No Bid process. The firm's strategy is to focus mainly on target cost contracts as it sees greater commercial and partnering benefits from this as opposed to other types of contract. The data in Appendix 1 reveals that lower value contracts tended to be lump sum. A possible reason for this being that the client's advisors clearly felt transfer of risk up to a level was reasonable in these.

The NEC 3 Engineering and Construction Contract Option C is a target cost contract with an activity schedule where the out-turn financial risks are shared between the client and the contractor in an agreed proportion. The NEC 3 Contract Option A is a priced contract with an activity schedule where the risk of carrying out the work at the agreed prices is largely borne by the contractor. The NEC 3 Option B is a priced contract with a bill of quantities where the risk of carrying out the work at the agreed prices being is borne by the contractor.

Contractual risk is clearly established as one of the major risks to contractors (see Murdoch and Hughes, 2008; Uff, 2012; Laryea and Hughes, 2009). Hence, the implications here are that contractors should fully understand the operational mechanism and commercial implications of the NEC suite of contracts, and develop an appropriate commercial response when clients amend the terms and conditions of the standard form contract.

Tender documentation

The data presented in Tables 2 and 4 confirms that the tendering process in construction involves extensive information and documents exchange. This creates an essential need for effective handling and accuracy of the information contained in tender documents. The research carried out by Laryea (2011) to ascertain the clarity and adequacy of tender documents used in practice recorded a significant amount of tender queries, amendments and addenda were recorded. The 30+ tender queries demonstrated that quality of tender documentation is a problem despite the existence of standards such as Co-ordinated Project Information (1987) and British Standard 1192 (1984, 1990, 2007) meant to help in producing clear and consistent project information. In the current research, there was an average of 12 technical queries (TQ's) across the 6.5-week tender period for 35 tenders (see Table 11). There seems to be little correlation between number of documents and the resulting amount of tender queries (see Table 7). Given the time constraints on technical queries this translates to approximately 3-4 queries raised per week. Poor quality tender documents are often a source of inaccurate estimates, claims and disputes on contracts.

The tender documents varied greatly between tenders and one tender contained over a thousand documents to process into a single tender price and programme within six weeks. The data on number of documents (see Table 4) does not take into account the number of pages within each document. Therefore, this should be interpreted higher than the figures presented since the set of drawings and specifications for each project could be over a thousand pages. The relatively short time available for processing such significant amounts of information into a tender offer is a clear source of risk to contractors. The risk becomes more severe when the project information is insufficient, incomplete or contradicting. A wise contractor will decline to bid or qualify their bids to hedge against such risks. However, this becomes practically difficult in instances where a contractor is hungry for work and the client does not want qualifications in a contractor's bid proposal (see Smith and Bohn, 1999).

Table 11: Frequency of occurrence of tender queries

	Queries and frequency of occurrence					
Tender queries	0-10	11-20	21-30	31-40	41+	No information available
Frequency of occurrence	8	9	4	1	2	11

There was an average of 626MB of data transferred by the client to the contractor at the start of the tender period again ranging up to nearly 3.5GB's. This requires significant investment in infrastructure to support the use of digital technologies in construction procurement and providing personnel with relevant training connected with the use of such technologies. The average data could be copied onto a writable CD but would require a DVD or USB to copy above 700-800MB which incurs a higher cost.

The tender documentation highlights the increasing use of digital technologies in construction tendering.

Tendering costs

The research by Hughes et al. (2006) demonstrated the high costs associated with tendering. Here, estimates of tender preparation costs in Beta for projects of value ranging from £0 to £350m are summarized in Table 6. The data seems to suggest that the direct cost of preparing a tender, increases in relative direct proportion with the value of a project. This includes the costs of preparing a design and bills of quantities as part of the tendering process.

The research by Hughes *et al*. (2006) found that for contractors, the total cost of obtaining work could be as high: ½-1% for traditional contracts and 2-3% for those involving Private Finance Initiative (PFI) projects. It was discovered that it was typical for contractors and consultants to be winning one in six contracts bid for and one in four for complex projects, meaning that the total costs of obtaining work were 3-6% for traditional work and 8-12% for complex work. Some of the factors responsible for high tendering costs included anonymity of competition; excessively long tender lists; diverse pre-qualification practices; and poor quality and timing of information for bidders were identified as wasteful practices in tendering. If such wasteful practices can be removed, it may help to lower costs associated with tendering. The Publicly Available Specification (PAS) 91 (2010) has been introduced in the UK to help in standardising industry practices relating to contractor prequalification. The research by Laryea and Hughes (2008) also shows a view would be taken on the number of competitors. In practice, contractors may tolerate up to 5-6 competitors. A higher number of competitors may influence instant no-bid decision unless there is the feeling of high likelihood of success. Hughes et al. (2006) recommended tender lists of 2-3 bidders.

The budget figures in the Table 6 attempt to value the cost per tender and the allowance used on sending and receiving enquiries through the supply chain. This is an estimate and is based upon the values in Tables 6-10, as well as a budget value of 10% of tender costs being allowed for sending and receiving enquiries. For a firm like Beta with annual turnover of £150m, the total tendering cost of £2,640,000 for 35 tenders (see Table 8) represents 1.76% of turnover. This excludes tendering costs for 22 others that will increase the costs to 3%. The result aligns significantly with findings in earlier research by Hughes et al. (2006) although the calculation does not cover for the bid team's post tender period work relating to negotiation.

CONCLUSIONS

Tendering information on 35 tenders processed by a UK contractor in 2010 are examined and analysed. All tenders were processed under competitive tendering conditions and required extensive reliance on supply chains. The main purpose of the study was to examine the nature of tenders processed and its essential features.

The bidding time frames ranged between 4-12 weeks. The value of the projects ranged between £500,000 to £100m. The evidence examined did not reveal a strong relationship between project value and tender period. This should be investigated further in other studies. Hence, the amount of time allowed for tendering does not really correspond to the size of a project. Further research should be carried out to ascertain the determinants of tender period. Clients should take the features of a project into account to determine the amount of time to allow for tendering.

Tendering costs were found to range between 1.76% - 3% of the company's annual turnover of £150m. This is significant and in line with previous literature findings.

Engagement with supply chains in the tender process should be managed efficiently in order to minimize tendering costs. About 50 per cent of subcontractors contacted did not offer a quote. This clearly demonstrates waste in the process; and represents one area contractors should focus management attention in order to reduce their tendering costs. Targeted system of engagement is recommended. One recommendation is for contractors to approach supply chain quotations beyond a project-to-project basis. The possibility of developing a quotations database for pricing some of the normal items in a project should be explored.

REFERENCES

Bowen, P., Akintoye, A., Pearl, R. and Edwards, P.J. (2007) Ethical behaviour in the South African construction industry, Construction Management and Economics, 25(6), 631-648

Chartered Institute of Building (CIOB) (2009) Code of Estimating Practice, 7 Edition, Wiley-Blackwell, ISBN: 978-1-4051-2971-8

Ferguson, NS, Langford, DA and Chan, WM (1995) Empirical study of tendering practice of Dutch municipalities for the procurement of civil-engineering contracts, International Journal of Project Management, 13 (3), 157-161

Flanagan, R. and Norman, G. (1985) Sealed bid auctions: an application to the building industry, Construction Management and Economics, 3(2), 145-161

Gill, J. and Johnson, P. (2002) *Research Methods for Managers*, 3ed. London: Sage

Hackett, M., Robinson, I. and Statam, G. (2007) *Procurement, tendering, and contract administration*, Oxford: Blackwell.

Harrison, S. (1981) Estimating and tendering – some aspects of theory and practice, *Estimating information service, The Chartered Institute of Building*, ISSN 0308 8073, No.41. 1981.

Hillebrandt, P.M. (200) *Economic Theory and the Construction Industry,* London: Macmillan.

Hughes, W. P., Hillebrandt, P., Greenwood, D. G. and Kwawu, W. E. K. (2006) *Procurement in the construction industry: the impact and cost of alternative market and supply processes*, Taylor and Francis, London.

Laryea, S. (2009) Subcontract and supply enquiries in the tender process of contractors, Construction Management and Economics, 27(12), 1219-1230

Laryea, S. (2011) Quality of tender documents: Case studies from the UK, Construction Management and Economics, 29(3), 1219-1230

Laryea, S. and Hughes, W. (2008) How contractors price risk in bids: theory and practice, Construction Management and Economics, 26: 9, 911- 924

Laryea, S. and Hughes, W. (2011) Risk and price in the bidding process of contractors, Journal of Construction Engineering and Management, 137(4), 248-258

Liu, M. and Ling, Y.Y. (2005) Modeling a contractor's markup estimation, Journal of Construction Engineering and Management, 131(4), 391-399

Neufville, R. and King, D. (1991) Risk and need-for-work premiums in contractor bidding, Journal of Construction Engineering and Management, 117(4), 659-673

Prior, L. (2003), Using documents in social research, London, Sage.

Ray, R.S., Hornibrook, J., Skitmore, M. and Zarkada-Fraser, A. (1999) Ethics in tendering: a survey of Australian opinion and practice, Construction Management and Economics, 17(2), 139-153

Rooke, J., Seymour, D. and Fellows, R. (2004) Planning for claims: an ethnography of industry culture, *Construction Management and Economics* **22**(6) 655-662

Saunders, M.N.K., Lewis, P. and Thornhill, A. (2007) *Research methods for business students*, 4ed, Harlow: FT/Prentice Hall

Scott, J. (2006), Documentary research, London, Sage Publications Ltd

Silverman, D. (1997) *Qualitative Research,* London: Sage

Skitmore, M. and Smyth, H. (2007) Pricing construction work: a marketing viewpoint, Construction Management and Economics, 25(6), 619-630

Skitmore, M. and Wilcock, J. (1994) Estimating processes of smaller builders, *Construction Management and Economics*, 12, 139-154

Smith, G. R. and Bohn, M. C. (1999) Small to medium contractor contingency and assumption of risk, *Journal of Construction Engineering and Management, ASCE,* **125**(2), 101-108.

Tsai, H., Wang, L. and Lin, L. (2007) A study on improving the ranking procedure for determining the most advantageous tender, Construction Management and Economics, 25(5), 545-554

Tah, J.H.M., Thorpe, A. and McCaffer, R. (1994) A survey of indirect cost estimating in practice, *Construction Management and Economics,* **12**(31), 31-36.

Tzeng, W., Li, J.C. and Chang, T. (2006) A study on the effectiveness of the most advantageous tendering method in the public works of Taiwan, International Journal of Project Management, 24(5), 431-437

Wong, C.H., Holt, G.D. and Cooper, P.A. (2000) Lowest price or value? Investigation of UK construction clients' tender selection process, Construction Management and Economics, 18(7), 767-774

PERCEPTIONS OF CONSTRUCTION MANAGEMENT STUDENTS ABOUT THEIR CAREER PATHS TO BECOME CONSTRUCTION SUPERINTENDENTS

Darrian Robinson[1], Salman Azhar[2] and Abid Nadeem[3]
[1,2]McWhorter School of Building Science, Auburn University, Auburn, Alabama, USA
[1]School of Engineering, Nazarbayev University, Astana, Kazakhstan

A construction superintendent plays an important role in any construction project. The construction superintendent works closely with a construction project manager to make sure that the project stays on time and on budget. Superintendents in many ways function as bosses for building sites. It is their responsibility to make sure that projects are completed on schedule, within budget, and in a way, that is safe and follow local building codes and by-laws. Growth in the number of students becoming construction superintendents may become an emergent problem in the US construction industry soon. As it is known, companies have begun to heavily recruit project managers and superintendents out of school due to the improved technology used in the industry. However, few students are embarking on the route to become a superintendent upon graduating. This research study explores the market forces driving the need for superintendents and the potential shortages anticipated which are already being felt. It reveals the career track the current generation of construction management students are pursuing and the reasons for such choices; and it identifies different avenues the industry and CM programs can take to improve the issue. The major data for this research was collected via literature review and questionnaire surveys. Based on the analysis of these data, conclusive evidence concerning the current generation of construction student's preference in career path and the role the construction program plays were realized. The number of students going toward a superintendent career path tend to go up throughout the curriculum depending on formal construction experience. There were no freshman respondents to quantify, however from the academic status of sophomore up to the senior level tend to choose field positions after having worked in the field for a certain amount of time. Although there were more students wanting to become project managers due to personal preference, it can be said that acquiring construction experience while in school heavily sways a student's decision. Most students have a general understanding of the differences between a PM and Superintendent.

[1] drr0013@tigermail.auburn.edu
[2] sza0001@auburn.edu; salman@auburn.edu
[3] abid.nadeem@nu.edu.kz

Robinson, D., Azhar, S. and Nadeem, A. (2017) Perceptions of construction management students about their career paths to become construction superintendents *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1097-1110

Keywords: careers in construction, construction education, construction superintendent, labor force

INTRODUCTION

A construction superintendent plays an essential role in any significant construction project. The construction superintendent works closely with a construction project manager to make sure that the project stays on time and on budget (Monster.com, 2015). These professionals often need several years of experience in the construction industry before they can advance to the position of construction superintendent. Once they get there, however, they can expect to earn a higher-than-average salary, according to the U.S. Bureau of Labor Statistics. They can also expect to sometimes put in long hours on-the-job to make sure project deadlines are met.

Superintendents in many ways function as bosses for building sites. It is their responsibility to make sure that projects are completed on schedule, within budget, and in a way that is safe and follow local building codes and laws. There is a lot of paperwork, particularly when it comes to things like building permits and licensing materials, but the job also requires significant personal interactions. Most superintendents oversee both forming teams and resolving conflicts large and small (WiseGeek.org, nd). Superintendents are almost universally stationed on the construction site, while project managers are usually based in the contractor's office with part-time on-site responsibilities. Presence at the site is one of the biggest differences between construction superintendents and project managers. In other respects, these two professionals have similar responsibilities, particularly when it comes to managing things like scheduling and budget concerns, and in nearly all cases, the two work together, one on the ground and one in a larger corporate office to see a project through to completion. Project managers focus on the complications of whatever is happening at the site, including making initial bids and selecting the project in the first place. Then, the superintendent makes sure that things are going smoothly, and manages day-to-day execution (WiseGeek.org, nd).

Growth in the number of students becoming construction superintendents may become an emergent problem in the construction industry soon. As it is known, companies have begun to heavily recruit project managers and superintendents out of school due to the improved technology in the industry. However, not many students are embarking on the route of superintendent upon graduating. The numbers of workers who left the industry after the recession has worsened the problem. Superintendents are retiring from the construction industry faster than they are being replaced (Lester, 2013). Census data suggests this problem will be much more severe in another decade. Statistics released by the United States Department of Labor show that the median age of first line supervisors of construction trades and extraction occupations was 46.3 in 2012, with a bulk of the

employees in that position falling into the 45 – 54 age category (Lester, 2013).

There are many reasons why students are not choosing the role of construction superintendent. One reason is that they have an outdated notion of what a construction superintendent does. The typical misconception is that a superintendent is an onsite laborer or someone who directly oversees laborers, instead of it being the professional management position. Another reason is attributed to the fact that in general, millennial generation workers are less interested in construction industry careers than previous generations. The common wisdom is that these workers were scared off by the recession or that they have misconceptions about the construction industry that lead them to view it as "dirty work" (Lester, 2013).

As the design and construction industry continues to adapt to new approaches and technologies, the workforce required to do jobs efficiently and profitably will need skills. Industry players also need to determine how they can tap into existing expertise and attract new workers. This is a pivotal time in the construction industry. Several factors are impacting the industry at once, creating uncertainty about how well prepared the future workforce and pipeline of new workers will be to deal with the changes emerging (Bernstein, 2012).

This research study explores the market forces driving the need for superintendents and the potential shortages anticipated and already being felt. It reveals which career track the current generation of construction management students are pursing and why; and it explores different avenues the industry and CM programs can take to improve the issue.

LITERATURE REVIEW

Role of superintendent

The superintendent supervises daily construction activities on the project by the contractor's workers or those employed by subcontractors (Schaufelberger and Holm, 2002). Mincks and Johnston (2004) state that the superintendent is also responsible for the correct, timely, and profitable construction of the project by coordinating labor, material, equipment and subcontractors during construction.

Superintendents often come up through the trades, and have many years of experience (Schexnayder and Mayo, 2004). However, Gould and Joyce (2002) identify the changing source of superintendents stating that increasingly more superintendents have been hired out of college engineering or construction management programs. Colleges and universities are now educating young people about the skill sets required to be a superintendent. Superintendents are doing tasks that were earlier thought to be the responsibility of the construction project manager (Gunderson et al., 2007).

Education & Skills Needed

David E. Gunderson developed post-secondary curricula to support superintendent education. Gunderson (2008) identified several skills required by a construction superintendent including the people skills as the most important besides other skills such understanding the work and sequencing, organizational and managerial skills, scheduling, estimating, and cost control/awareness skills. Like managers in general, the superintendents also were considered to adopts combinations of three main decision-making styles: 1) Autocratic, 2) Participatory, and 3) Free-rein (Jung and Mills, 2012).

Gunderson et al. (2007) emphasized on having proper education and construction experience for young people to become construction superintendents. Scheduling, estimating, communication, writing and English, people skills, sustainable construction materials and methods including LEED (Leadership in Energy and Environmental Design) certification were considered as important topics for construction superintendents to learn in school besides the internships for obtaining the relevant experience for the superintendent's job. Peculiarly "college superintendents give a lot of computer skills to the craft superintendent, and that one helps him learn how to build the actual job. There will still be [superintendents] coming from the fields and the trades, but I think we will see a lot more coming from college." (Gunderson et al., 2007)

There are several educational paths for potential construction superintendents. A high school diploma or an associate's degree, combined with work experience, can qualify one for some positions. However, acquiring a bachelor's degree or even master's degree in building science, civil engineering, construction management or construction science has become more common.

Research has shown that superintendents with better safety records maintain low turnover on their jobs and are sensitive to the changing needs of the workers (Hinze 1978). A "safe superintendent" possesses the qualities of a good manager (Hinze, 1987). An interesting and beneficial by-product of such traits is, as the evidence suggests, that the safety performance will also be good (Hinze, 1987).

Gunderson finally identified 27 most important skill sets or attributes to the success of a construction superintendent. The Table 1 provides the results for the ranked superintendent skills sets and attributes (Gunderson, 2008). 11 out of the top 27 ranked competencies and attributes can be considered people skills. Which indicates a need for more "soft skills" education and training for existing superintendents, foremen and craft personnel moving up toward a superintendent position, and people in postsecondary construction education programs (Gunderson et al., 2011).

Need for this Research

Today, there's a prevalence of students choosing alternate career routes than that of a superintendent. What has been the result of this reduction in the numbers of superintendents? Many construction industry businesses

have had to turn down work because they cannot find superintendents (Lester, 2013). Something has to be done now before the problem gets worse. "Construction education can be a big part of the solution to the problem. There must be more of an industry wide effort to provide construction education to younger generations, and to correct misconceptions about the profession and about the career prospects of a construction superintendent. In a wider sense, the industry needs to find a way to reeducate the general population, not only those who are already drawn to a career in construction" (Lester, 2013).

Table 1: Superintendent Competencies or Attributes Rankings (Gunderson, 2008)

Rank	Competency or Attribute Description	Rank	Competency or Attribute Description
1	Oral Communication	16	Trust Building
2	Leadership	17	Time Management
3	Scheduling	17	Written Communication
4	Strong Values	19	Ability to "Keep your Cool"
5	Ability to Plan Ahead	20	Reinforcing Behaviors
6	Detailed Knowledge of Construction	21	Strong Work Ethics
7	Team Building	22	Collaboration
8	Broad Knowledge of Construction	23	Understand Materials
9	Computer Skills	23	Good with Numbers
10	Listening Skills	25	Conceptualization
10	Cost Control	26	Get Along with People
12	Ability to Work with Different Kinds of People	27	Estimating
13	Understand Subcontractors' Work	27	Typing Skills
14	Ability to Teach	27	Ability to Sketch
15	Ability to Learn from Others		

The aim of this research is to investigate the professional routes the current generation of construction students would prefer to take in the construction industry with an emphasis on the role of a construction superintendent. The objectives of this research are:

1. to assess the conditions for the construction students to take roles of a construction superintendent
2. to analyze whether the trend of the number of construction students going toward a superintendent career role go up or down during the 4-year undergraduate program
3. to assess if the construction program could bring more students over to a superintendent role of career.

METHODOLOGY

The preliminary data for this research was collected by performing the preliminary literature review. Based on the findings of the preliminary data, an in-depth study was conducted. This part of the research consisted of a detailed literature review and a questionnaire survey administered to the undergraduate and graduate building science students at the Auburn University, Alabama, the USA.

The first step in the formation of the research objectives was to understand the conditions in terms of the role of superintendent and the education/skills needed to be a competent superintendent. To understand the role of superintendent and to assess the requirements to be one, a literature review was conducted.

Once an understanding of the role of superintendent was recognized and an idea about the current demand for superintendents was established, the online questionnaire survey was developed and sent to all undergraduate and graduate students taking courses in construction via email to complete. The goal was to determine whether the number of students going towards a superintendent career path goes up or down throughout the four-year curriculum. From the responses gathered from the questionnaire surveys, the professional route being taken by the current generation of construction students was better understood and quantified. Once the surveys were completed, the analysis of all the data (quantitative) was performed.

Questionnaire Survey

The questionnaire survey questions were designed to establish both the factual, and opinion-based data. The survey was structured in 3 main sections with several questions. The section and their details are as follows:

- Basic Information
    - To classify respondent as freshman (year 1), sophomore (year 3), junior (year 3), senior (year 4), graduate student
    - Determine which course they were currently enrolled
    - Explore the respondent's construction experience and job preference
- Factual Information
    - Established specific reasoning behind the respondent choosing a particular career path
- Opinion Based Information
    - Focused on the individual opinions of the respondents of the program they are enrolled in now as it plays a part in their career role decision

DATA COLLECTION

The survey was sent to 466 undergraduate and graduate construction students at Auburn University. Of the 49 respondents, 6 were sophomores, 13 were juniors, 22 were seniors, and 5 were graduate students, as shown in Table 2. There were no freshman respondents to the survey, and 3 respondents skipped the question identifying their academic status. 49 responses thus produced a 10.5% response rate which is rather low. However, if we exclude freshman and sophomore from the population then the response rate is 29% which is acceptable in construction. The exclusion of freshman and sophomore for the consideration of response rate can be justified as these are early years in the 4-year degree program. The students usually do not have strong idea about career path in the early years of their degree programs.

Table 2: Responses to Survey

Academic Status	Number of Surveys	# of Respondents	Percentage (%)
Freshman	147	0	0.0
Sophomore	171	6	3.5
Junior	100	13	13.0
Senior	94	22	23.4
Graduate Student	14	5	35.7
Total (Not counting Duplicates)	466	46	

RESULTS AND DISCUSSIONS

The results from the questionnaire survey are presented in 3 main categories: Basic Information, Factual Information, and Opinion Based information.

Basic information

The first section consisted of 5 questions exploring some basic information of the respondents. The purpose was to gain insight into which group of students were responding.

The first questions asked the students' academic status. The results are shown in Table 2. The next question asked the respondents to select the courses currently taken. There were 9 categories to choose from: History & Introduction to Construction, Materials and Methods, Structures for Buildings I, Construction Communication, Project Controls I, Project Controls II, Project Controls III, Thesis, and Graduate Foundation Courses. The recipients had the option to select all that apply. Some students were enrolled in more than one of the courses at the time. Duplicate respondents were considered. There was 43 respondents total while 6 respondents

skipped. This question gives initial insight to whether a particular course swayed a student's decision on career choice.

The next 3 questions explored the respondent's construction experience and job preference. When asked if the respondent had prior construction experience i.e. full-time, part-time, internship, etc., 87% of the respondents said yes while only 13% said no. This gives insight on having construction experience alters the respondents' career path preference. The next 2 questions explore what area of career role the respondent prefers. When asked does the idea of having a 'field job' appeal to you, 80.4% respondents responded yes, 13.0% responded no, while 6.5% skipped the question. The next question was more specific in asking which area you would prefer to work in, field, office, or other as shown in Figure 1. 56.5% respondents said they prefer working in the field, 34.8% respondents said office, while 8.7% of the respondents said other. Of the respondents who stated 'other', 2 of the respondents stated they would like to work in both the field and office if possible, 1 respondent stated design work, and the last respondent would prefer working remotely from home.

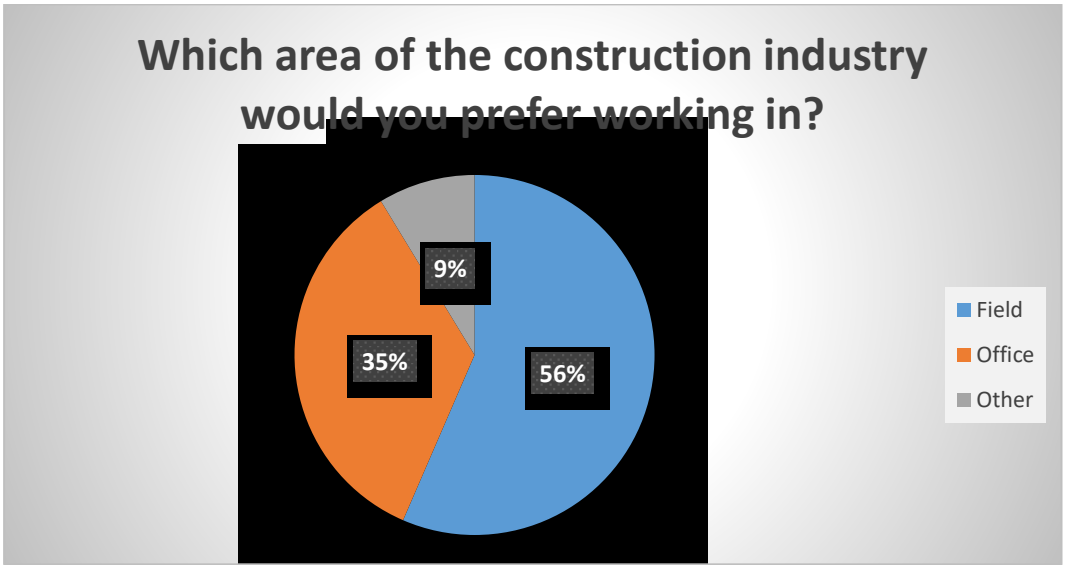


Figure 1: Career Area Preference

Factual information

This section of the questionnaire survey focused on establishing specific reasoning behind the respondent choosing a particular career path. Figure 2 indicates the majority of the respondents, 77.3%, choosing a career path based on "past field or volunteer experience". 40.9% of the respondents said that it is the "current demand" for the career path they desire, while the remaining 11.4% selected "other". 7 of the respondents wrote additional comments as to the specific reasoning behind their choice. 3 of the respondents stated that they prefer and enjoy being outside on the jobsite actually working on and seeing the entire building process. A couple of the respondents indicated that having worked directly in the field for several years made them want to continue doing it, while the remaining respondents stated to strictly desire to work in design.

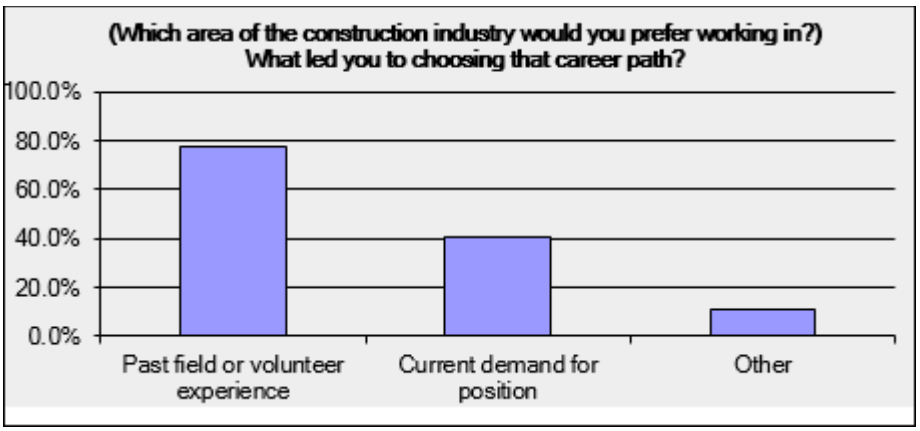


Figure 2: Reasoning for Career Path Choice

The next three questions asked the respondents to select a specific career role they plan to take in the industry followed by questions asking why or why they aren't interested in a superintendent career path. These questions serve as the greatest source of data collected due to the freedom to voice their detailed opinion. Table 3 shows the numbers of respondents to each career role selected.

Table 3: Role Preference

What career role do you plan to take in the construction industry?

Answer Options	Response Percent	Response Count
Project Manager	40.9%	18
Superintendent	31.8%	14
BIM specialist	4.5%	2
Pre-Construction	0.0%	0
Estimator	11.4%	5
Safety Specialist	0.0%	0
Other (please specify)	11.4%	5
answered question		44
skipped question		5

Of the respondents that selected the "Other" choice listed a variety of answers. One respondent stated wanting to work as a home builder, while another wants to be an architect. A respondent wants to work as a technology consultant, while another respondent stated wanting to be a Quality Control Representative. The last respondent wants a Project Engineer career. From the table, there was only 4 more respondents that stated wanting to be a Project Manager than Superintendent. From this it can be said that there are many students that favor the path of

superintendent. If a respondent chose superintendent as a career role, they were directed to a question as to why they desire to be one. All of the respondents cited simply enjoying or wanting to be onsite everyday opposed to working in an office and only visiting the site when needed. Some of the respondents got a bit more detailed in saying that being a superintendent accommodates for better application of the material learned in class, it's the most effective way to learn things hands on, allows for interaction with the subcontractors and the platform to give guidance to them.

If the respondent chose any career role other than superintendent they were directed to a question as to why they don't desire a superintendent career path. Many of those respondents voiced having interest in being a superintendent, but are simply more interested in a different career role. Other respondents cited that the superintendent role doesn't have many career advancement opportunities, dislikes the requirements of the position such as long hours and years of travel, and simply not the type of responsibility they want to have.

The last couple of questions in this section explore the respondents career desires in terms of time and their current knowledge of the industry. Table 4 shows the response rate of respondents when asked if they would enjoy working in the field their entire career. 60.5% of the respondents said yes. Often time workers will change career roles after a number of years, which has caused speculation as to the number of available superintendents declining in recent years. However, this data proves otherwise. The next question asked the respondents if they were aware of the current demand for superintendents. Majority of the respondents, 65.8%, said yes. That data reveals the respondents' awareness of the current state of the industry.

Table 4: Length of Time Desired in the Field

Would you enjoy working in the field your entire career?

Answer Options	Response Percent	Response Count
Yes	60.5%	23
No	39.5%	15
answered question		38
skipped question		11

Opinion-based information

This section's questions were focused on the individual opinions of the respondents of the program they are enrolled in now as it plays a part in their career role decision. The first question asked the respondent if a particular course has aided or altered their preference in career role since starting the program. Over half the number of respondents said no. However, of those that said yes were asked to state the name of the course that has aided or altered their career role choice. Project Controls III, construction communication, and structures lab II were the top responses

from the respondents as to being the courses that swayed their decision. This data specifically pinpoints where a trend could sway a student's career path as they matriculate through the curriculum. The next question asked the respondent to select which type of skills does the program instill the most. Whereas superintendents nowadays require keen soft skills, and a PM uses more technical skills. There were 3 categories to choose from were Technical Skills, Soft Skills (Communication, Teamwork, etc.), or both. Figure 3 shows the percentage of each response.

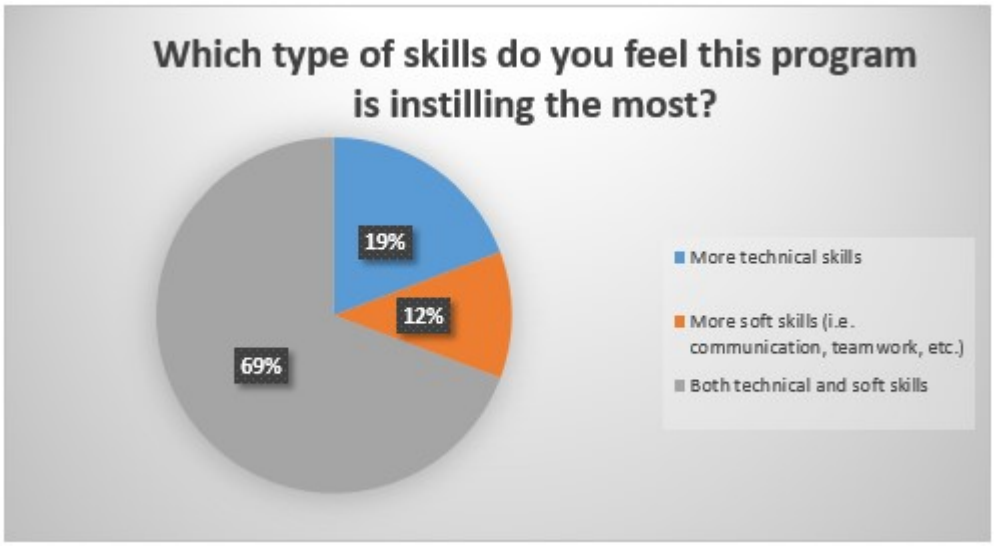


Figure 3: Skills Implemented in Program

The survey next asked whether the respondent felt the program has taught sufficient information about the superintendent role. Out of the 27 respondents who answered, 15 respondents believed the program has thoroughly educated them about a superintendent role, while the remaining 12 respondents felt opposite to that. 22 of the total survey respondents skipped this question, however of those that responded makes the data useful.

The next question explores the respondents' opinion on whether or not the program is recommendable to those who strictly desire to become superintendents. 92.6% of the respondents believed the program is great for anyone seeking to learn more about a superintendent role, while only 7.4% felt it is not, as shown in Table 5.

Table 5: Program Recommendation Responses

Would you recommend the Building Science program to anyone who strictly desires to become a superintendent?		
Answer Options	Response Percent	Response Count
Yes	92.6%	25
No	7.4%	2
answered question		27
skipped question		22

The final question explored the respondents' direct perception of the superintendent role in the construction industry. The first five respondents stated that the role of superintendent offers a more personal connection to construction projects, they're field people who interact with the laborers, deals with organizing and scheduling day to day operations, and a personal guide to the foremen onsite. The next group of respondents cited that superintendents have a lot of responsibility/stress/travel requirements, works in the field managing job onsite for the project manager, and of equal importance to a PM and held in same regard. The next group of respondents stated that superintendents push the job, manage the subcontractors, have strict travel obligations, position scarcity, great starting position for a career, constant learning experience, dirty work, hard career, and requires good leadership and organizational skills. There were some respondents who did not have any perception of the superintendent role. There was also some who desired more information in order to effectively judge the role as whole. No respondent had a negative perception of the career path. Only 27 respondents answered this question while the remaining 22 skipped the question. Those that responded serves as significant data.

CONCLUSION

The research was aimed towards establishing three main objectives: Assessing the role in the industry, construction students plan to take upon graduation, analyzing whether the number of construction students going toward a superintendent career role go up or down during the 4-year program, and assessing how the construction program could bring more students over to a superintendent role of career. The current state of superintendents in the construction industry was established in the literature review which revealed the types of education and skills needed to be a competent superintendent, how the role of superintendent has changed over the years, and the current drop in pool of superintendents to choose from. Many construction industry businesses have had to turn down work because they cannot find superintendents. Construction education is a big part of the solution to the problem.

From the survey of current construction students, 57% of the respondents prefer working in the field than in the office. Majority of the respondents could base their decision on past field or volunteer experience while the remaining based their decision on the current demand for workers in that role. Students feel that working in the field or being a superintendent accommodates for better application of the material learned in class. Getting that hands-on experience helps a lot of students make the decision of where they see their career was heading. The pleasure of being on the actual site witnessing the building process promotes a desire to continue in that direction upon finishing school. The literature suggested that there must be more of an industry wide effort to provide construction education to younger generations, and to correct misconceptions about the profession and about the career prospects of a construction superintendent. However, the

survey revealed majority of the students were aware of the daily duties of the superintendent and demand for more of them.

It is true that the construction program plays a major role in a students' choice of career path. Majority of the respondents felt that the Building Science program in which they are enrolled is reputable for anyone seeking to be or for learning more about the superintendent role. It instills both the technical and soft skills needed to be a competent superintendent, and vividly educates on the details of a superintendent's job description.

The number of students going toward a superintendent career path tend to go up throughout the curriculum depending on formal construction experience. There were no freshman respondents to quantify, however from the academic status of sophomore on up to a senior level they tend to choose field positions after having worked in the field for an amount of time. Although there were more students wanting to become project managers due to personal preferences, it can be said that acquiring construction experience while in school heavily sways a student's decision. Graduate students generally prefer the project manager role over a superintendent role without possessing any prior construction field experience. Undergraduates, however, generally decide based on their prior construction experience whether it was based in the field or office. Majority of students have a general understanding of the differences between a PM and Superintendent. Thus, the program is instilling the right tools to assist in the student's decision.

REFERENCES

Bernstein, H.M. (2012). Construction Industry Workforce Shortages: Role of Certification, Training and Green Jobs in Filling the Gaps, Smart Market Report. http://www.usgbc.org/Docs/Archive/General/Docs18984.pdf

Monster.com, Construction Superintendent Jobs - Search Construction Superintendent Job Listings. (n.d.). Retrieved February 7, 2015, from http://jobs.monster.com/v-construction-q-construction-superintendent-jobs.aspx

Gould, F. E. & Joyce, N. E. (2002). Construction project management: Professional edition. Upper Saddle River, NJ: Prentice Hall.

Gunderson, D. E., & Gloeckner, G. W., (2011). Superintendent Competencies and Attributes: First Look at a National Study. International Proceedings of the 47th Annual Associated Schools of Construction Conference hosted by Northern Arizona University, Flagstaff, Arizona, (pp. 571-582), Hattiesburg, MS: The University of Southern Mississippi

Gunderson, D. E., Barlow, P. L., & Hauck, A. J. (2007). Construction superintendent skill sets. International Proceedings of the 43rd annual Associated Schools of Construction Conference, hosted by Northern Arizona University, Flagstaff, Arizona, (pp. 571-582), Hattiesburg, MS: The University of Southern Mississippi

Gunderson, D. E. (2008). Ranking Construction Superintendent Competencies and Attributes Required for Success. International Journal of Construction Education and Research.

Hinze, J. (1978). "Turnover, new workers, and safety."/. Constr. Div., ASCE, 104(4), 409-417.

Hinze, J. (1987). Qualities of Safe Superintendents. Journal of Construction Engineering and Management, 113(1), 169–171.

Jung, Y., & Mills, T. H. (2012). A Survey of Construction Managerial Leadership Styles. ASC Annual International Conference Proceedings.

POWER SECTOR DEVELOPMENT REFORMS IN NIGERIA: THE ROOTS TO THE CHALLENGES

Abdullahi, D. [1], Suresh, S. [2], Renukappa, S.[3] , and Oloke, D. [4]
[1,2,3,4]*School of Architecture and Built Environment, Faculty of Science and Engineering, University of Wolverhampton, WV1 1LY*

Nigerian socioeconomic development has been threatening persistently with severe power shortage and they are currently experiencing growth in demand for electricity. Various factors are responsible for the challenging situations such as oil pipeline vandalizations, stealing of high-tension cables and economic sabotage. Although several reforms, policies and regulations have been applied to address the insufficient electricity supply for over 120 years in Nigeria, yet the problem of inadequate electricity supply is even getting worst. The complexity of possible inference of the data for the inadequate electricity supply is not well understood. The research examined the various electricity reforms, policies and regulations adopted since 1896 till date to determine the status of the power supply and demand, and the key factors responsible for it. The research adopted a literature-based from peered review methodology to analyse electricity reforms adopted. The result from the peered review indicated that Poor maintenance culture, corruptions, inadequate funding, insecurity and lack of turnaround in energy mix are the key challenges facing the power industry, making it incapable to generate, transmit and distribute adequate and efficient electric power in the country. The finding also showed that Government lack understanding of the economic benefits of the power sector, thus leading to lack of comprehensive review of their reforms and polices. The paper also suggested that tapping from other sources of energy such as renewable energy, i.e. solar with sounds polices and best practices is essential to supplement the existing source of energy while improving other key challenges identified.

Keywords: Nigerian electricity, power sector reform, electricity supply, privatisation

BACKGROUND OF CURRENT STATE NIGERIA'S ELECTRICITY

The total electricity generated by Nigeria's central grid oscillates about 5,000MW. Sharing that total electricity to the country's population

[1] D.Abdullahi@wlv.ac.uk
[2] S.Subashini@wlv.ac.uk
[3] Suresh.Renukappa@wlv.ac.uk
[4] D.A.Oloke@wlv.ac.uk

Abdullahi, D., Suresh, S., Renukappa, S. and Oloke, D. (2017) Power sector development reforms in Nigeria: the roots to the challenges *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1111-1122

(estimated at about 186 million) placed Nigeria as one of the lowest per capita power supply world-wide (Ingwe, 2014). The effect of inadequate electricity supply has resulted to slow or stagnant economic growth in Nigeria, especially the manufacturing sector and the household consumption (Okeke, *et al*. 2014). The inadequate electricity power system is associated with poor maintenance, obsolete equipment, illegal connections and theft of high voltage cables and sub-stations equipment, growth in population and loss of electricity energy on transmission (Emodi and Yusuf, 2016). Past government dictator's regimes in the 1980s also formulated poor policies such as the structural adjust program/policy that negatively impacted on the economy and the standard of living (Alley, *et al.* 2016). Consequently, these have led to many negative activities such as high crime rate and upraising of insurgencies.

Security of life and property has degenerated from normalcy to insecurity as a result of upraising of insurgent terrorist group such as Boko Haram insurgencies, the Odua People's Congress (OPC), The Niger Delta militants and Movement for the Actualisation of the Sovereign State of Biafra (MASSOP). Among other criminal vices are the increase in the number of armed robberies, kidnapping, rapes and advanced fee fraud (Amobi, 2007). These activities have further affected the normal generation and distribution of electricity due to increase in the bombing of oil pipeline that supply gas to the thermal plants in Nigeria by various insurgents (Emodi and Yusuf, 2016). Struggling to provide a means to curtail and control such activities with limited resources have plunged the economy and the standard of living into an unacceptable recession (Aliyu, *et al*. 2015), thus leading to an increase in poverty.

There is an increasing number of poverty because of various insurgent and terrorist activities, disrupting the economic operations in the country. For example, internationally comparable poverty i.e. people living beneath the poverty line (US$2/day) were over 90% of Nigeria's total population (UNCTAD, 2010; World Bank Group, 2017)). Income distribution among Nigerians since independence has exhibited enormous inequality with one percent of the population, stealing about 90% of all earnings from various sources, including oil and gas revenues (Gujba, et al. 2010). However, the government has called for urgent economic reforms and total restructuring of infrastructure in Nigeria yet the level of progress achieved in economic growth is minimal (Husseini and Abdull Majid, 2015).

Economic progress, goes hand in hand with improved energy efficiency as a driving force for socioeconomic development (Aliyu et al. 2015. It is unclear, how well the different governments understood the challenges facing the power sector since 1896 and the frameworks developed to address it in relation to sound socioeconomic activities (Jacob and Abubaker, 2015). Therefore, it is of paramount importance to have a clear understanding and proper assessment of why the various reforms failed to address inadequate electricity supply and to identify the key factors responsible for the failure, so that inform suggestion can be made (Obi and Uzodigwe, 2016). In order, to examine and determine the factors affecting the efficiency of electricity

supply in Nigeria, the next sections below provided information on Nigeria Electricity Transition between 1896 to 2016, Nigeria electricity capacities, Nigeria electric power sector reforms act, Generation company of Nigeria (GENCO), Transmission company of Nigeria (TCN), Distribution company of Nigeria (Disco), The factors responsible for erratic power failure in Nigeria, the research methodology applied, the findings from the study and lastly the conclusion (Oseni, 2011; Saidu, 2011; Sulaimon, 2016).

FINDINGS

Nigerian electricity transition (1896-2016)

Table 1: Nigerian electricity development between 1898 – 2016

S/N	Period	Development activities
1	1896	Electricity was first installed and generation began in Marina Lagos Nigeria
2	1929	Nigerian Electricity Supply Corporation (NESCO) started operation with the construction of a hydro power station at Kuru Plateau Jos, Nigeria.
3	1951	Electricity Corporation of Nigeria (ECN) was a central body created to regulate coal and diesel plants throughout Nigeria.
4	1956	With the increase in demand for electricity, project such as Ijora in Lagos, Oji in Enugu, Kano and Ibadan was commissioned for expansion purpose.
5	1962	Niger Dam Authority (NDA) and Kainji Dam was completed in 1968, while the first 132 KV lin between Lagos and Ibadan was constructed
6	1972	ECN and NDA were integrated to form the National Electric Power Authority (NEPA), which was saddled with generation, transmission, distribution and marketing to consumers solely owned by the Nigerian Government.
7	1968-1990	The Four major stations: Kainji Hydro, Ijora, Afam, and Delta stations were established to operate with full responsibility for power supply.
8	1998	IPPs came on board and the NEPA high-class monopoly of generation, transmission, distribution and marketing was sculpted down.
9	2000	Electric Power Implementation Committee (EPIC) was set up to advocate privatisation including a full report to National Council on Privatisation.
10	2001	Out of the report submitted by NCP, the National Electric Power Policy was born based on the recommendation of the EPIC.
11	2004	NEPA installed a capacity of 5,906 MW, but only generate 3,400 MW due to several issues within the sector. It was therefore necessary to call for a reform
12	2005	The Electric Power Sector Reform Act (EPSRA) was enacted to unbundle and restructure the Nigerian power sector. The Nigerian Electricity Regulatory Commission (NERC) was established to regulate the electric power and tariff in the sector. Rural Electrification Agency (REA) was established. Nigerian Electric Power Authority (NEPA) was unbundled into six (6) generating companies, one (1) transmission company and Eleven (11) distribution companies.
13	2009	National Power Training Institute of Nigeria (NAPTIN) was established and Rural Electrification Policy (REP) was also approved to work with REA.
14	2010	Roadmap for power sector Reform was launched as policy documents to help the restructuring of PHCN.
15	2012	PHCN was liquidated which relinquished 70% of ownership shares to generation and distribution private companies and retained the ownership of the transmission company.
16	2013	The successfully privatised generation and distribution was handed over to the successor private owners known as GenCos and DisCos.
17	2014	Strengthening of renewable energy programs and seven out of ten NIPP generation asset sales are completed.
18	2015	Power Purchase Agreement (PPA) were established, Transnational Stage Electricity Market (TEM) satisfied by the NERC. The TCN Independence System Operator were made public. National Renewable Energy and Energy Efficiency Policy (NREEEP) were approved to drive the power sector reform.
19	2016	Draft for Mini-Grids operation approved (NERC, 2016). National Renewable Energy Action Plans (NREAP) approved (NREAP, 2016).

Source: ECN (2016); NERC (2014); Abam, *et al*. (2014); Awosope, (2014); Aliyu, *et al*. (2015); Emodi and Yusuf (2015).

Nigerian electricity has developed through various processes over a period, which can be traced back to the 19th century, just 15 years after it was introduced in England (Awosope, 2014). The sector developed through various transformations from one company to another, until it was unbundled during the privatisation exercises which resulted in three companies serving the generation, transmission and distribution as shown in the table 1.

From the table, above, it is evident that the Nigerian Electricity developed gradually under different phases aimed at improving the supply of the electricity to meet the demand of the Nigerian population (Aliyu, et al. 2015). The inability for the industry to generate, transmit and distribute adequate electricity to maximum capacity has resulted in crippling the commercial industries. Individuals and various organisations depend heavily on self-generated electricity from Generators (Gujba, et al. 2011), thus increasing operational cost, increase on Co2 emission, poor quality of life, etc. Therefore, the next section presented various sources of electricity generation.

Electricity generated capacity

The Nigerian electricity is sourced from thermal power plants and four (4) major hydroelectric stations as shown in the table (2) below.

Table 2: Commissioned large hydropower stations in Nigeria

S/N	Location	Capacity (MW)	Commissioned Date	Rivers	State
1	Kainji Dam	760	1968	Niger	Niger
2	Jebba Dam	570	1984	Niger	Niger
3	Shiroro Dam	600	1990	Kaduna	Kaduna
4	Zamfara Dam	100	2012	Bunsuru	Zamfara
	Total	2,030			

Source: Aliyu, *et al*. (2015); Emodi and Yusuf (2015)

Table 2 above shows four major commissioned dams for hydroelectricity built between 1968 and 2012. Thus, the output capacity from the table above is 2,030MW is inadequate compared to the growing demand of electricity and the population growth, to sustain the socioeconomic development activities in the country. Hence, the additional capacity of power generation via hydroelectricity from dams to support the high demand was proposed. The seven more dams initiated to further generate 8, 602 MW of electricity from hydro throughout the country as part of the power sector reform.

From the tables, the available electricity generated from hydro is inadequate since the major four dams in Nigeria only generate just above 2,000 MWs at full capacity while the additional proposed hydroelectricity is expected to generate additional 8, 602 MW when they are fully operational (Aliyu, et al. 2015). This means that the total electricity to be generated once

these projects are completed and fully operational will be 10, 602 MW against nearly 184 million Nigerians (Emodi and Yusuf, 2015). This indicated that demand will surpass electricity supply, which will still be a threat to socioeconomic activities (The World Bank, 2017). The next section provides detail analysis of Nigeria Power reform.

Table 3: Planned large hydropower stations in Nigeria

S/N	Location	Capacity (MW)	Commissioned date	Rivers
1	Ikom	730	N/A	Cross River
2	Lokoja	1050	N/A	Osse River
3	Zungeru	450	N/A	Kaduna
4	Mambilla Hydro	3960	N/A	Donga River
5	Makudi Hydro	1062	N/A	Benue
6	Onitsha Hydro	1050	N/A	Cross River
7	Gurara Hydro	300	N/A	River Kaduna
	Total	8602		

Source: Aliyu, *et al*. (2015)

Nigerian Electric Power Sector Reform Act (NEPSR, 2005)

The Nigerian electric power sector has been experiencing an enormous transformation for years with an effort to pull together strategies towards achieving stable power supply through generation, transmission and distribution projects as part of the Federal Government Economic Reforms (Oyedepo, 2014). Although, the expansion plans indicate that the power sector will undergo significant changes soon to achieve the vision 20:20 as indicated in (table 3) and this is further expected to increase almost four times by the year 2030 to accomplish the Independent Power Producer (IPP) plans (Aliyu, et al. 2015).

Oyedepo, (2014) argued that the current situation of the Nigerian power sector is dilapidated, as 70-80% of the powers, generated are thermal and 20-30% are hydroelectric, though, only about 40-51 % of Nigerians have access to electricity and only 18% of the rural dwellers have access to electricity. In other words, those who are connected to the national grid face extensive power interruption throughout the year (Ikeme and Ebohon, 2005). As shown in table 2 above, the total capacity generated before 2012 was only 2,030MW to serve 160, million Nigerians (Gatugel, *et al*. 2015). It was, therefore, apparent for the government to showcase alternative plans to boost electricity by reinvesting more on large hydroelectric plants as well as diversifying to energy mix (Aliyu, et al. 2013).

In 2005, the Nigerian Government raised concerns over compelling issues, principally; power outages, unreliable services, unrealistic bills and many other issues emerged for need of action to enact the Electric Power Sector Reform Act of 2005 (TCN, 2005). The act called for unbundling the National Power Utility Company into a series of six generating companies, twelve distribution companies while retaining the ownership and management of

the transmission company to the Federal Government of Nigeria (NERC, 2015). Eve though, the reform was aimed at finding a solution to the long experiences of inadequate electric power supply in Nigeria, there was little indication in the reform to diversifying into renewable energy projects as support for the Independent Power Producers (IPP) (The World Bank, 2012). The next three sections discuss the outcome of the privatisation and unbundling the defunct Power Holding Company of Nigeria (PHCN) into generation, transmission and distribution companies of Nigeria.

Generation Company of Nigeria (GenCo)

The generation company of Nigeria, popularly known as GENCO was the first company among the three born out of PHCN to be found as part of the IPP to a private company. Thus, the Nigerian Electricity Supply Industry (NESI) processed 23 grid-connected generating plans with total capacity of 10, 396.0 MW, in which, the available capacity at the time of this exercise was to be 6, 056 MW. However, among the installed capacity, the mainstream of the generation is a thermal power plant with total installed capacity of 8, 457 MW (81%) and available capacity of 4, 996 MW (83%) (Nnemeka, et al. 2015) Emodi and Yusuf (2015), further emphasised that, hydropower from the three (3) plants account for 1, 938.4 MW, of which 1, 060 MW, is the available for transmission.

Table 4: Generation Company of Nigeria

S/N	NIPPs	CAPACITY (MW)
1	Alaoji Generation Company Nigeria Limited	1,131
2	Benin Generation Company Limited	508
3	Calabar Generation Company Limited	634
4	Egbema Generation Company Limited	381
5	Gbarain Generation Company Limited	254
6	Geregu Generation Company Limited	506
7	Ogorode Generation Company Limited	508
8	Olorunsogo Generation Company Limited	754
9	Omoku Generation Company Limited	265
10	Omotosho Generation Company Limited	513
	Total	5, 454 Megawatts

Source: ECN (2016); NERC (2014)

The table 4 above shows that, the NIPP can generate up to 5, 454 MW of electricity for six geopolitical zones in Nigeria. Although, the amount of MW that is available for the TCN to distribute to Discos centres cannot be quantified due to loss of electricity on transmission lines (Emodi and Yusuf, 2015).

Transmission Company of Nigeria (TCN)

The transmission Company of Nigeria (TCN) is one of the successors of the PHCN, after the unbundling of the power sector. Though, the TCN remains the only company that was not privatised during the privatisation process

of PHCN (NBET, 2016). The federal government of Nigeria contracted the TCN to a Canadian firm; Manitoba Hydro International (Canada) whose major responsibility, among others, is to ensure market operator (MO), the system operator (SO) and Transmission Service Provider (TSP) become autonomous (ECN, 2015). The TCN holds the PHCN grid assets and manages it on behalf of the Nigerian government.

Distribution Company of Nigeria (DisCo)

The Nigerian Distribution Company (Disco) was born out of the Nigerian Power sector reform proposed in 2005, through 2013 and beyond (NBET, 2016). As part of the privatisation exercise, the Power Holding Company of Nigeria's (PHCN) distribution was broken into eleven (11) regional grids, which were acquired by private local and foreign investors (Transmission Plans, 2013). Each distribution company is allocated a certain amount of grid energy even though the amount of grid varies in quantity to match the demographic population demand (The World Bank, 2017). The distribution companies are faced with numerous challenges, including distribution losses and technical difficulties. Other challenges are associated with commercial and billing system, which the distribution company was not anticipating after the handover of assets to them by the PHCN in 2014. It was estimated that technical barriers caused a loss of (12%), commercial (6%) and collection of revenues (28%) respectively. The table below shows the Distribution companies of Nigeria after the privatisation exercises.

Table 5: Distribution Companies of Nigeria (ECN, 2016)

s/n	Distribution company of Nigeria (DISCO)	Percentage %	Location/Region
1	Abuja Distribution Company Plc	11.5	FCT, Kogi, Nassarawa & Niger state
2	Benin Distribution Company Plc	9	Edo, Delta, Ondo and Ekiti
3	Eko Distribution Company Plc	11	Lagos, Island, VI, Lekki and Epe
4	Enugu Distribution Company Plc	9	Enugu, Abia, Anambra, Ebonyi & Imo
5	Ibadan Distribution Company Pl	13	Oyo, Kwara, Ogun, and Osun
6	Ikeja Distribution Company Plc	15	Lagos, Mainland, Ikeja, and Badagry
7	Jos Distribution Company Plc	5.5	Plateau, Bauchi, Gombe, Benue and Kogi state
8	Kaduna Distribution Company Plc	8	Kaduna, Kebbi, Zamfara, Sokoto and Niger state
9	Kano Distribution Company Plc	8	Kano, Jigawa and Katsina state
10	Port Harcourt Distribution Company Plc	6.5	Rivers, Akwa Ibom, Bayelsa and Cross River state
11	Yola Distribution Company Plc	11.5	Adamawa, Borno, Taraba and Yobe

Source: Aliyu et al. 2015

The Nigerian Government made efforts to actualise reforms over the years to tackle the decaying electricity source industry from the generation to transmission and to distribution (Awosope, 2014). However, the reforms are basically conventional and therefore, not far from the old systems of fossil fuel. Literatures have proven that the reforms pay little or no attention to

renewable energy sources. The table below is a comparison for generated electricity versus population growth.

Table 6 Installed and available power generation versus Nigerian population

Year	Installed Capacity (MW)	Available power (MW)	Population (Million)
1980	2507	783	73.7
1985	4192	1133	83.9
1990	4548	1537	95.6
1995	4548	1810	108
2000	5580	1738	122.9
2005	6538	2494	139.6
2010	6904	3358	159.7
2014	8876	3795	177
2016	13761	4285	184

Source: World Bank, 2014; Oyedepo, 2014

The section below discussed the factors responsible for inadequate power supply in Nigeria.

Factors responsible for erratic power failure in Nigeria

The consistent failure of power supply in Nigeria does not occur naturally, it is associated with some factors, which can be classified as man-made (Igwe, 2014), such as Economic factors, Government policies, Social factors, Technological factors, Security, and Corruption. The factors are further discussed:

1. Government Policy: The inconsistency in the Nigerian government policies towards power sector is one of the major challenges that led to the inability to find a sustainable solution to the electricity power crisis (Doner, 2007). For instance, the experienced unstable policies which began from ECN, NEPA, PHCN among others, which was entirely under government control, yet no positive impact can be traced to the reforms and policies over the years. The current failure of the privatisation scheme adopted to foster generation and distribution of electricity by various companies is an indication that the earlier policies failed (Ferroukhi, et. 2013).

2. Social Factors: While our communities need electricity for local household and small-scale industries, the attitudes towards payment of bills, for the services are inevitably discouraging (Olawunyi, 2013). Thus, the providers of the services are reluctant to improve services and infrastructure for the electricity in the communities (Akinwale, *et al*. 2014).

3. Financial Factors: Nigerian electric power sector is one, which it financing is solely from the government. Over the years, the entity is wholly owned by the government and therefore, no private individual had any opportunity to invest to help in reviving and restructuring the facilities to improve service efficiency (Kar and Sharma, 2015).

4. Security Factors: The Nigerian electricity power sector has suffered a series of insecurity challenges, ranging from equipment vandalism, cable theft, diversion of gas supplies and sabotage (Afe and Emmanuel, 2013). It was further argued that Insecurity from ethnic clashes and religious violence has also resulted to the poor access of technical expertise to monitor the utilities of electricity in the communities (Ingwe, 2014). Insecurity will, therefore, encompass that issue-hindering guarantee of safety, peace, justice, health and economic growth (Nkemdili, et al, 2013).

5. Corruption: The misuse of public office to private gain, immoral and unethical phenomenon, bribery, and illegal behaviour in the industry is alarming (Raimi, 2015). It is evident by the anti-corruption agencies in Nigeria that the electricity sector is broadly bounded with a lot of corruption and there was a need for unbundling it to public and private partnership investment (PPI) in 2005 (Afe and Emmanuel, 2013). Monies meant for new equipment, refurbishment, maintenance and new projects are diverted to private use, hence, the existing infrastructure became dilapidate and decay to a point whereby they no longer support production (Nkemdili, et al, 2013).

METHODOLOGY

The method adopted for this research was based on desk study, otherwise known as literature-based from peered-reviews. The secondary databases were searched from published resources from 2003 through 2017, with key articles obtained from PsyCho Info, ERIC, ProQuest, Science Direct, SocSci Search, EBSCO and COPAC which are systematically narrowed to a search of an information. To ensure that relevant studies were not omitted, the search terms remain broad. These were ("Nigeria", "Electricity", "Electricity", "Power* generation", "*Demand * Supply for power", "power*reforms" "challenges*Drivers", "Solar *potential" etc.). The peer-reviewed literature strategy was taken using the De Montfort University Library and University of Wolverhampton Library database. The search yielded a solid payload of data around the Nigerian power sector, the status, challenges and potentials for solar energy. Relevant literature where themed for critics, analysis, comparison and contraction to the sentiments of the literature and the outcome formed the finding of this inquiry.

DISCUSSIONS

The study showed that the 2005 power reform act yields a slight improvement by unbundling the power holding company of Nigeria into three companies; Genco, TCN and Disco. However, there is a lack of understanding of the economic benefits of power supply. No comprehensive review is traced to key policies laid by Nigerian Government that could involve local technical and technological industries to play a vital role in the generation, transmission and distribution of electricity or tapping from other sources of energy such as renewable energy in the country. The finding also identifies weakness of the Government for the inability to secure and put control measures that would mitigate the issues of infrastructure

vandalism, electric copper cable theft and diversion of Gas supply. The Industry suffered a pathetic supply output because it lacks long-term policies to confront the full-scale development challenges that face the fast-growing population in Nigeria.

CONCLUSION

The challenges faced by the Nigerian power sector are traced to poor policies since inception of the industry 1896, 15 years after it was discovered in the United Kingdom in 1883. The infrastructure and facilities continued to decay and became obsolete resulting in difficulty in generating adequate power supply to nearly 184 million Nigerians. Various factors were responsible for the power failure, including government policies, financial factors, social factors, technologies, security and corruption within the industry. It was clear that the government lack understanding of these factors, thus, long-term policy, reliable measures, security for infrastructural facilities and adequate funding to the sector were completely ignored. The power sector saw a series of reforms in the past, until the government saw the need to unbundled the company in the private public partnership which resulted in the generation, transmission and distribution companies of Nigeria. Nigerian government retained the ownership of the transmission company of Nigeria (TCN). The power sector reform Act was a stepping stone for the industry not only to private sector participation but also for the diversification in the energy mix. The research therefore, suggest the government and private investors diversify the sources of power into renewable energy by formulating sound policies and best practices to supplement the crippling industry and to improve the efficiency and socioeconomic growth.

REFERENCES

Abam, F.I., Nwankwojike, B.N., Ohunakin, O.S. & Ojomu, S.A. 2014, "Energy resource structure and on-going sustainable development policy in Nigeria: a review", *International Journal of Energy and Environmental Engineering,* vol. **5** (2), pp. 1-16.

Afe and Emmanuel, A., 2013. Insecurity in Contemporary Nigeria: Useful Lessons of Judicial Administration in the Old Ondo Province as a Panacea. *Journal of Arts and Humanities,* **2** (4), pp. 78-84.

Akinwale, Y.O., Ogundari, I.O., Ilevbare, O.E. and Adepoju, A.O., 2014. A Descriptive Analysis of Public Understanding and Attitudes of Renewable Energy Resources towards Energy Access and Development in Nigeria. *International Journal of Energy Economics and Policy,* **4** (4), pp. 636-646.

Aliyu, A.S., Dada, J.O. & Adam, I.K. 2015, "Status and prospects of renewable energy in Nigeria", *Renewable and Sustainable Energy Reviews,* (48), pp. 336-346.

Alley, I., Egbetunde, T. and Oligbi, b., 2016. Electricity supply, industrialization and economic growth: evidence from Nigeria. *International Journal of Energy Sector Management,* **10** (4), pp. 511-525.

Amobi, M.C. 2007, "Deregulating the electricity industry in Nigeria: Lessons from the British reform", *Socio-Economic Planning Sciences,* **41** (4), pp. 291-304.

Awosope, C. A. 2014, Nigeria Electricity Industry: Issues, Challenges and Solutions. *Public Lecture Series.* **3** (2), pp. 1-35.

Doner, J., 2007. Barriers to the Adoption of Renewable Energy Technology. Illinois State University Institute for Regulatory Policy Studies.

Emodi, N.V. and Yusuf, S.D., 2015. Improving Electricity Access in Nigeria: Obstacles and the Way Forward. *International Journal of Energy Economics and Policy,* **5** (1), pp. 335-351.

Energy Commission of Nigeria (2016) Stakeholders [Online]. [Accessed 12 February 2017]. Available at: http://www.energy.gov.ng/.

Gatugel Usman, Z., Abbasoglu, S., Tekbiyik Ersoy, N. & Fahrioglu, M. 2015, "Transforming the Nigerian power sector for sustainable development", *Energy Policy,* **87**, pp. 429-437.

Gujba, H., Mulugetta, Y. & Azapagic, A. 2010, "Environmental and economic appraisal of power generation capacity expansion plan in Nigeria", *Energy Policy,* **38** (10), pp. 5636-5652.

Ikeme, J. & Ebohon, O.J. 2005, "Nigeria's electric power sector reform: what should form the key objectives?", *Energy Policy,* **33** (9), pp. 1213-1221.

Ingwe, R. 2014, "Why Access to Electricity is a Big Deal for Nigeria's Development and its Linkages to Poverty, Security and Disease", *Valahian Journal of Economic Studies,* **5** (1), pp. 45-54.

Jacob, J. & Abubakar, S.O. 2015, "Power Sector Viability and Development in Nigeria: Problems and Prospects", *African Journal of International Affairs & Development,* **18** (1/2), pp. 37-50.

Kar, S. K. and Sharma, A. 2015. Wind Power Development in India: *Renewable and Sustainable Energy Reviews*.

Nkemdili, N.A., Bonaventure, U. & Kingsley, A. 2013, "NO LIGHT AT THE END OF THE TUNNEL: CORRUPTION AND INSECURITY IN NIGERIA", *Arabian Journal of Business and Management Review (Oman Chapter),* 2 (12), pp. 41.

Nnaemeka, V.E. and Kyung-Jin boo, 2015. Sustainable Energy Development in Nigeria: Overcoming Energy Poverty. *International Journal of Energy Economics and Policy*, **5** (2).

Obi, K.O. and Uzodigwe, A.A., 2016. Assessing the Optimal Electricity Supply in Nigeria. *Journal of Business Studies Quarterly,* **7** (3), pp. 110-126.

Okeke, R.C., E M C Izueke & Nzekwe, F.I. 2014, "ENERGY SECURITY AND SUSTAINABLE DEVELOPMENT IN NIGERIA", *Arabian Journal of Business and Management Review (Oman Chapter),* vol. **4** (3), pp. 63.

Olawuyi, D.S., 2013. Renewable Energy Sources - Legal Barriers and Potential - *Environmental Policy and Law,* **43** (4), pp. 233-238.

Oseni, M.O. 2011, "An analysis of the power sector performance in Nigeria", *Renewable and Sustainable Energy Reviews,* **15** (9), pp. 4765-4774.

Oyedepo, S.O. 2012, "On energy for sustainable development in Nigeria", *Renewable and Sustainable Energy Reviews,* **16** (5), pp. 2583.

Oyedepo, S.O., 2014. Towards achieving energy for sustainable development in Nigeria. Renew. Sustain. Energy Rev. 34, 255–272.

Raimi, L., Akhuemonkhan, I. and Ogunjirin, O.D., 2015. Corporate Social Responsibility and Entrepreneurship (CSRE): antidotes to poverty, insecurity and underdevelopment in Nigeria. *Social Responsibility Journal,* **11** (1), pp. 56.

Saidu, B., 2011. Roadmap for Power Sector Reform in Nigeria 2010: Out of the Dark into the Dark Ages. *Journal of Structured Finance,* **17** (3), pp. 96-104,8-9.

Sulaimon Salau (2016) Nigeria needs 160,000 MW to meet national electricity demands. The Guardian Newspaper [Online]. 08 January. [Accessed 16th December 2016]. Available at: http://guardian.ng/business-services/nigeria-needs-160000mw-to-meet-national-electricity-demands/.

The World Bank (2017) Population overview [ONLINE]. Available at: http://www.worldbank.org/en/country/nigeria/overview. [Accessed 12 February 2017].

The World Bank, 2012. Enhancing Energy Production and Delivery [ONLINE]. Available at: http://www.worldbank.org/en/results/2012/12/12/enhancing-energy-production-and-delivery. [Accessed 23 March 2017].

Transmission Company of Nigeria (2016) Renewable energy [Online]. [Accessed 28 February 2017]. Available from: http://www.tcnorg.com/.

Transmission Plans (2013 -2017) and Evacuation of Niger Delta Power Holding Company (NDPHC) Power Plants Generation (20 Sep 2013 communication).

UNCTAD, 2010. Renewable Energy Technology for Rural Development. *United Nations Conference on Trade and Development*.

World Bank Group [ONLINE] Available at: www.doingbusness.org/data/exploreeconomies/nigeria. [Accessed 13 February 2017].

World Bank, 2014. World Bank Development Indicators: Countries and Economies [ONLINE]. Available at: http://data.worldbank.org/country?display¼default. [Accessed 23 May 2017].

PREDICTING THE VOLUME OF MATERIAL WASTE: A CASE OF ONGOING BUILDING PROJECTS IN ABUJA, NIGERIA

Saidu, Ibrahim[1] and Winston M. W. Shakantu[2]
[1&2]*Department of Construction Management, Nelson Mandela Metropolitan University, Eastern Cape, Port Elizabeth, South Africa*

While quantification of material waste is crucial for construction waste management, accurate estimation can be accomplished by developing waste quantification model that is applicable for national or regional construction waste generation. This is important for building professionals to properly plan and control their disposal thereof. The purpose of this study was to develop mathematical models for quantifying the volume of building-material waste in Abuja, Nigeria. The methodological approach adopted is the quantitative technique that is rooted in the positivist research paradigm. 31 ongoing building construction projects were investigated, which includes public and private projects using purposive sampling technique (projects to the value of 1.6 billion Naira/8 million USD and above). The data for this research were sourced from the field investigation (measurement of the volume of material waste) and data from the archival records (drawings, project-progress reports, and specifications) on building materials and volume of material waste. Linear-regression analytical tool was used for the analyses. The study revealed a statistically significant relationship between the variables analysed models for predicting the volume of building-material waste in a project were developed from the linear-regression analyses. These models are presented and discussed in this paper. The study recommends the use of this model by construction professionals of the Nigerian construction industry in quantifying volume of waste at an early stage in the life of a project. This in turn, would minimise waste generation, which is in line with the prime objective of waste-management for a building project.

Keywords: building size, building materials volume, material waste, models , waste volume

INTRODUCTION

The rapid urbanisation in developing nations has resulted in a substantial increase in construction activities, which in turn, has led to the generation of a large quantity of construction waste (Chikezirim and Mwanaumo, 2013:

[1] saidu.ibr@futminna.edu.ng
[2] Winston.shakantu@nmmu.ac.za

Saidu, I, and Shakantu, W. M. W. (2017) Predicting the volume of material waste: a case of ongoing building projects in Abuja, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1123-1143

498). Construction waste is a major source of municipal solid waste in all the megacities around the world, frequently accounting for 10% to 30% of the total waste sent to landfills. For instance, in Hong Kong, construction waste consists of 30% to 40% of the total waste (Li and Zhang, 2013: 142; Begum, 2009: 321)

Material wastage has become a serious problem, which requires urgent attention in the construction industries. This constraint harmfully affects the delivery of many projects in Nigeria (Adewuyi and Otali, 2013: 746). Ameh and Itodo (2013: 748) assert that, for every 100 houses built, there is sufficient waste material to build another 10 houses in Nigeria. Accordingly, Osmani (2011: 209) added that 10% of the materials delivered to sites in the UK construction industry end up as waste.

Nguyen, Gupta and Faniran (nd: 2) emphasise that, despite the studies that have highlighted the future benefits of reducing construction waste, there has been little progress in implementing the waste-management option available, in order to ensure that construction waste is minimised. Wahab and Lawal (2011: 247) suggest that a more effective control of materials on site should be adopted; as the problems of material wastage cannot be fully treated without efficient material control. Hence, Begum, Siwar, Pereira, Jaafar (2007: 191) propose various construction material waste management approaches.

In the last decade, little attention has been paid to the management of waste generated in the Nigerian construction industry (Wahab and Lawal, 2011: 248). This could be as a result of the low level of awareness of the construction workers, a low level of available means of waste disposal, or the slow adoption of environmentally sustainable practices. Yuan and Shen (2011: 670) highlighted that the insufficient attention given to material-waste generation in developing nations during the past decades has meant that the statistical data on the quantity of material-waste generation are not readily available. This is supported by Babatunde (2012: 328), who believes that the situation is not any different in the Nigerian construction industry and these are important for the building practitioners to properly plan and control their disposal thereof.

Moreover, Masudi *et al.* (2012: 269) believe that, while quantification is crucial for construction waste management, accurate estimation can be satisfied by developing waste quantification model that is applicable for regional or nation-wide construction waste generation.

Over the years, research interests in addressing construction and demolition waste management issues across the world have resulted in a large number of publications. However, research evidence has shown that previous studies from different parts of Nigeria centered mostly on waste and waste-management practices in the construction industry; as well as the techniques for their management. Nonetheless, these studies failed to develop models for predicting the volume of material waste for building projects in Nigeria. As this would assist construction professionals in having idea on the probable volume of material waste to be generated for their

projects, in order to plan and adopt at an early stage the best material waste management principles and disposal thereof. This led to the development of the problem posed in this study that: data on the quantities of material waste have not been well documented and statistics on the waste generated are minimal in Nigeria (Babatunde, 2012: 328). Hence, this research aims to develop mathematical models for quantifying the volume of building-material waste in Abuja, Nigeria.

LITERATURE REVIEW

Sources and causes of material waste in construction

Construction waste is generated throughout the project lifecycle from the pre-construction stage through to the construction stage, and on to the finishing stage (Nagapan *et al.*, 2012). Waste sources and causes revolve around four factors, namely: procurement, handling, operation and culture (Al-Hajj and Hammani, 2011). Kareem and Pandy (2013) added that construction waste could arise from different sources, depending on the complexity of the project, namely: design stage, procurement stage, operation stage, material management stage, and material storage area.

Poor site management and supervision, the lack of experience, inadequate planning and scheduling, mistakes and errors in design, and construction were ranked as the top causes of waste in a project (Nagapan *et al.*, 2012; Babatunde, 2012). Furthermore, Al-hajj and Hamani (2011) summarised that design error leading to unnecessary off-cuts, low-quality products, lack of awareness, rework and variations, and temporary works are the major causes of material waste on construction sites. Nagapan *et al.* (2012) conducted a survey on the causes of material waste at three construction sites in Malaysia and revealed that inappropriate storage of materials, poor materials handling, low quality of materials, error in material ordering, mistakes in estimation, and bad attitudes of workers are the major causes of material waste.

Osmani *et al.* (2008) categorised construction waste into: *Contractual waste:* which includes client-driven waste; mistakes in contract documents; and incomplete contract and tender documents. *Procurement waste:* lack of early stakeholders' involvement, poor communication flow, improper co-ordination amongst the parties and trades, and lack of allocated duties for decision making. *Design:* changes in design, complexity in design and specifications, mistakes in design and construction details, insufficient or incoherent specifications; poor co-ordination and communication (late information, last-minute client requirements, slow in drawing revision and distribution).

Adewuyi and Otali (2013) found that, rework, design changes, waste from uneconomical outlines, inclement weather, and bad quality materials contrary to specification were ranked as the top causes of waste in the Rivers State of Nigeria. In Nigeria, the various causes of material wastage identified by Oladiran (2009) are: changes in design, errors and mistakes of workers; improper flow of communication amongst the parties; waste

resulting from uneconomical shape; poor specifications; unfamiliarity of designers with alternative products; improper supervision; wrong interpretation of drawings; vandalism; poor site conditions; poor transportation of materials; building failure/defects; loading and unloading of materials; poor setting out; theft of material, use of substandard materials; bulk material delivery; and errors in estimation.

The procedures for construction materials-waste quantification

The quantification of the amount of construction-material waste is important for the building practitioners to properly plan and control their disposal thereof (Jingkuang, Yousong and Yiyong, 2012: 398). Li, Ding, Mi and Wang (2013: 20) highlight that researchers quantify construction-site waste in many ways:

In the Netherlands, construction waste has been measured in three ways: as a percentage of the total amount of waste; the purchased amount of material; and the total material-waste costs. It was also found that the amount of waste for each building material lies between 1% and 10% of the amount purchased (Ekanayake and Ofori, 2004: 852; Liatas, 2011:1263).

The quantification of material waste is based on the volume of stockpiled waste, which is determined either on the basis of a rectangular prism, or in a pyramidal shape (Nagapan, *et al.* 2013: 102)

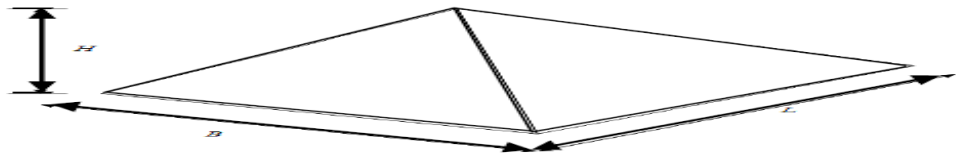


Figure 2.4 The volume method of pyramid shape

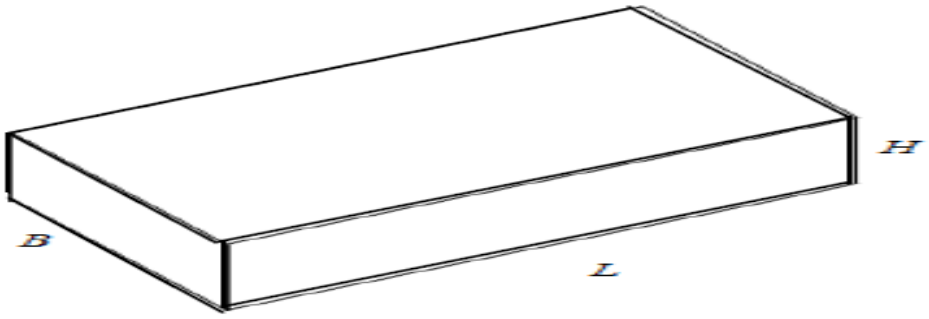


Figure 2.5 The volume method of rectangular shape
(Source: Nagapan et al., 2013)

For the pyramidal shape, the volume= 1/3 (B x L x H); and for the rectangular prism form, the calculated volume is = L x B x H. Where **L** is the length, **B** is the base, and **H** is the height.

Waste Generation Rates (WGRs) are useful variables that lie at the core of many efforts for understanding waste management in the construction sector. WGRs can provide quantitative information for benchmarking different construction waste-management practices (Lu, Yuan, Li, Hao, Mi, and Ding, 2011: 680). This is achieved by measuring the quantity of construction waste generated by weight (tons) for every square metre of normalised floor space at the construction sites (Lachimpadia, Pereira, Taha, and Mokhtar, 2012: 93).

Lu *et al.* (2011: 681) suggested that different practices can be used to measure waste: either by weight (kg or ton), or by volume (cubic metres/m^3). However, the WGRs are calculated by dividing the waste by either the amount of purchased materials, the amount of materials required by the design, or per square metre/m^2 of Gross Floor Area (GFA). Therefore, the four typical measurements for WGRs are: (1) the percentage of purchased materials (2) the percentage of material required by the design; (3) kg/m^2 of GFA; and (4) m^3/ m^2 of GFA.

$$WGR = \frac{\text{Total construction waste (tons)}}{\text{Total floor space (m2 of normalized floor space)}}$$ (Lu *et al.,* 2011: 682)

Li *et al.* (2013: 21) highlighted that material-waste quantification commences with the following steps: (1) listing the major types of construction material; (2) the purchased amount of major materials; and (3) the actual Material Waste Rate (MWR) of each type of material listed in 1, by dividing the amount of waste by either the amount of purchased material (Tam, Shen and Tam, 2007), or by the amount of material required by the design; and, lastly, (4) estimation of the percentage of the remaining waste.

Major materials account for nearly 90% of the total construction waste. The remaining waste occupies approximately 10 percent of the total waste (Li *et al.,* 2013: 22-23).

Listing the major types of construction materials

Although buildings across the world are varied in building structure and construction techniques, typical construction waste components include: concrete, bricks and blocks, steel reinforcement, timber, cement and mortar, ceramic tiles, plastic and cardboard packaging materials, and so on (Li *et al.,* 2013: 22-23).

Investigating the purchased amounts of the major materials

The amount of material purchased can be determined from the purchasing records of the finished projects, or from the budget documents of ongoing projects. The amount in the budget document generally includes normal material loss during construction, and thus is close to the actual purchased amount (Li *et al.,* 2013: 22-23).

The Table 1 below shows the previous studies from different countries on waste- generation rates.

Table 2.1: Previous studies on waste generation rates

Sn	Author	Country	Measurement of WGR	Methodology	Conclusions
1	Skoyles (1976)	UK	Percentage by weight (of the amount required according to design)	Direct observation and comparing contractor's record	2-15% by weight account to the amount purchased for 37 materials
2	Mc Gregor et al. (1993)	USA	Weight and percentage of total waste from an individual project	Questionnaire and telephone survey	Varied with construction typ and project cost
3	Bossink & Brouwers (1996)	Netherlan d	Percentage by weight (of purchased materials)	Sorted and weighted the waste materials	1-10% by weight of the amount purchased for seven materials, with an average of 9%
4	Mcdonald & Smithers (1998)	Australia	The volume (m3) of waste generated per m2 of gross floor area	Sort in waste bins and deliver records of bins	Total waste rate: 0.084m3/m2
5	Forsthe and Marsden (1999)	Australia	Waste ordered materials-insitu quantities	Insitu quantities from drawings o site measurement: ordered materials from delivery and order document	Maximal and minimal generation rate for eight materials by percentage in two projects
6	Poon et al. (2002)	Hong Kon	Percentage by weight or volume according to different materials	Site observation and questionnaire	1-8% for public housing and 1-100% for private housing
7	Morris Specificatio ns Inc. (2001)	Canada	NA	NA	WGRs for main construction materials (wood, drywall, metal, concrete, others) are given
8	Formoso et al. (2003)	Brazil	$\boldsymbol{Waste}$ (%) = $\frac{\{Mpurchased-Inv)-Mdesign\}}{Mdesigned}$ where Inv indicates the final inventory of materials	Direct observation and contractors record	19.1-91.2% by weight according to the amount purchased for eight materials
9	Treloar et al. (2003)	Australia	Not clear	Consultation with construction company employer	3-10% for eight materials
10	Poon et al. (2004)	Hong Kon	The volume (m3) of waste generated per m2 of gross floor area	Visual inspection, tape measurement, truck load records	The total waste generation rate: 0.17m3/m2; 0.4-0.65m3/m2
11	Lin (2006)	Taiwan	The volume (m3) of waste generated per m2 of gross floor area	The neutral network method	0.85m3/m2; for factory and 0.54-0.66m3/m2 for residential
12	Tan et al. (2007)	Hong Kon	Waste level= (Materia purchased-material used)/material used multiplied by 100	Interview with the people involved in the industry	8.9-20% and 4.11-6.62% by weight for five materials according to different sub-contracting arrangements

Investigating the actual material waste rate
MWR is measured by dividing the amount of waste by either the amount of purchased material (Tam, Shen and Tam, 2007), or by the amount of material required by the design. The two possible rates would differ to a very small extent, unless the rate is huge. MWR is evaluated as the ratio of waste material to purchased material, expressed as a percentage (Li *et al.,* 2013: 22-23).

Estimation of the percentage of remaining wastes
In addition to the waste generated from the major materials listed in the first phase, there are also numerous types of small quantities of waste, such as cardboard packaging, plastic pile, iron wire, and so forth. These remaining wastes include numerous categories; but they comprise only a small part of the total waste by weight.

Previous studies have revealed that the waste generated from major materials accounts for nearly 90 percent of the total construction waste. It can be deduced that in this situation, this remaining waste comprise approximately 10 percent of the total waste (Li *et al.,* 2013: 22-23).

Calculation of waste generation per gross floor area (wga)
In the first step, the total construction waste generated on site is calculated using Eq (1):

$$WG = \sum_{i=1}^{n}(Mi\ (ri) + wo) \quad \text{.....1}$$

where WG refers to the total construction waste generated from the project by weight (kg), Mi means the purchased amount of major material i in the identified list by weight (kg); ri is the MWR of major material i; W0 is the remaining waste; n is the number of major material types.

In the second step, the total WGA is calculated using Eq. 2

$$WGA = \frac{WG}{GFA}, \quad \text{.....2}$$

Where GFA is the gross floor area of the building project in meter square (m^2) (Li *et al.,* 2013: 22-23).

Summary and literature gap
It is obvious from the literature that past research on material waste quantification focused on direct on site measurement of waste (for instance, measuring waste as a percentage of the total amount of waste or based on the volume of stockpiled waste) and by measurement of waste generation rates. However, none of this research focused specifically on using parameters such as estimated volume of materials from the bill of quantities or building size (length by width by height) from the drawing to predict material waste. Hence, the need for this research as the project manager or other professionals do not need to go to site or wait until the waste is generated on site before the volume of waste can be known.

RESEARCH METHODOLOGY

The research employed the quantitative method that is rooted in the positivist research paradigm. It is quantitative because, the data were generated from the numeric measurement of the volume of on-site material waste; the designed quantities of the building materials, all converted to cubic metre (volume); the volume of materials used for projects; the building volume (length*width*height); the estimated cost of projects; the estimated time for projects, the actual time (time now); and the percentage of work completed. The table containing these details is presented in Appendix 1 of this study.

The study population is public and private on-going building construction projects within Abuja, the Federal Capital Territory of Nigeria, from which a sample of 31 projects was selected. Only building projects with value of 1.6 billion Naira (8 million UD) and above, were selected using the purposive sampling techniques. As at the period of data collection, only 31 of such projects were noticeable. The rationale for this selection is that, building-construction projects of this value and above are likely to generate large quantities of material waste when compared with projects of less value (Saidu & Shakantu, 2016: 104).

Abuja as a geographical case study area was selected because; it has the highest population of professionals within the built environment, and has many on-going building-construction projects.

This study focused mainly on primary data, which included: the field investigation on the on-site material waste and data from the archival records (drawings, bills of quantities, project progress reports, and specifications). The structural components of the buildings are mostly of reinforced concrete/steel structures with hollow but filled solid/solid sandcrete blocks.

The research is designed to answer the following research questions:

1. What are the parameters, constant and coefficient values for predicting the volume of onsite material waste for a building project?
2. What are the parameters, constant and coefficient values for predicting the volume of materials to be used for a project?

Archival records:
The designed volume of materials for each building project were generated from the measured quantities of each material from the priced/unpriced bills of quantities (BOQ) prepared for the project. The measurement units of each material, as contained in the BOQ (linear, square and cubic metre, number, kilogram, tonne, and so on) were converted to a common standard unit (volume/cubic metre). The converted volumes were summed up to achieve the Total Volume of Materials for each Building (TVoMB).

Where access to BOQ was denied, the volume of material was generated by taking direct measurements of the quantities from drawings, and by making the necessary adjustment (for openings, plastering, finishes, and so forth),

in accordance with the rules of the Standard Method of Measurement (SMM) for building works, in order to determine the net volume of materials for the buildings.

The volume of material used for each project was determined from the **'% of WC'** and the '**TVoMB'.** The 'building volume (L*B*W)', was measured from the design/working drawing. This involves measuring and multiplying the length, width, and the height of the building.

The data on Time Now (TN), the Percentage of the Work Completed ($\%\ of\ WC$), for different projects were generated from the records of projects compiled by the Quantity Surveyor

Field investigations:
The data on the volume of on-site material waste was generated by physical on-site measurements with the aid of measuring instruments, such as tape and measurement rule. The volume of the stockpiled waste is determined by the shape it created on site, for instance, rectangular prism, pyramidal shape, and so forth.

Where the generated on-site material waste has already been disposed and removed from site, a request was made to allow the researcher to access the total volume (material waste) disposed/removed from the project's onsite records (number of truck- load record).

Analyses of the data:
The inferential analysis of the data was employed in this study and the results were presented in Tables and Figures.

Regression analyses are used to describe data and to explain the relationship between one dependent variable and one or more independent variables. They are also used as a basic predictive analysis. The simplest form is with one dependent and one independent variable. (Morenikeji, 2006).

The linear-regression equation was used to develop the statistical models. For a linear regression equation:

$$\boldsymbol{y = a + bx};\quad \boldsymbol{x = a - \frac{y}{b}};\ \ and\quad \boldsymbol{b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}}.$$

Where "y" is the dependent variable (volume of material waste); "x" is the independent variable (building volume); "b" is the coefficient of "x; and "a" is a constant.

This study was conducted between December 2014 to March 2015 and the approximate conversion rates as at November 2014 were: Nigerian Naira to US dollar = ₦200 = 1USD.

Since the projects considered were on-going, the average percentage completion for the entire projects was 52.4% as at the period of data collection.

Reliability and Validity of the research:
Reliability in research is generally the ability of a collected data, and the interpretation or the analysis to be dependable, trustworthy, uniform and repeatable (Miller, 2008). Validity determines whether the research truly measures that which it was intended to measure, or how valid the research results are (Golafshani, 2003).

All information presented in this research are factual, substantiated by the collection of the relevant data. All the feedbacks are incorporated in the study instrument in the research report. There, the results can be trust worthy.

RESULTS

Table 2. Summary of the archival record and field investigations for the data collected

Descriptive Statistics	Valid number of projects	Minimum	Maximum	Mean	Standard Deviation
Estimated Cost of Project (EC) (₦)	31	1,635,000, 000.0	63, 000, 000, 000	7,864, 085 426.0	13,009, 813, 196.0
Estimated Time for the Project (Month)	31	16.0 month	68.0 month	27.0 month	12.1
Time Now (Month)	31	3.0 month	96.0 month	25.8 month	23.0
Building Volume (L*W*H)	31	17486.6 m^3	5181480.0m^3	387600.8 m^3	1, 061, 644.6
Estimated volume of materials for Project (M^3)	31	4982.4 m^3	673592.4 m^3	45468.1 m^3	122, 643.0
Volume of materials used (M^3)	31	1146.0 m^3	190723.1 m^3	14972.4 m^3	33, 437.7
Generated volume of onsite material waste (M^3)	30	36.0 m^3	4005.2 m^3	455.6 m^3	721.3
Transformed 100% Volume of waste	30	156.6 m^3	14145.4 m^3	1273.9 m^3	2, 584.0

Table 2 shows that 31 valid construction projects were visited in the study area. The projects' values ranged from ₦1.635 billion to ₦63 billion (R102.3 million to R3.94 billion) with a mean average of ₦7.864 billion

(R491.31million), which are above the target of ₦1.6 billion (R100 million) stated in section 3 of this study. The projects had attained between 5 to 100% completion with a total average completion of **52.4%.** The '**estimated time'** for the projects ranged from 16 to 68 months, with an average of 27 months; while the **'actual time'** (time now) ranged from 3 to 96 months, with an average of 25.8 months.

The measured **'Buildings Volume' (L*W*H)** ranged from 17,486.6 to 5,181,480.0 cubic metres with an average of 387,600.8 cubic metres. The **'volume of materials used'** for the projects ranged from 4,982.4 to 673, 592.4 cubic metres, with an average of 45,468.1 cubic metres. The **'generated volume of onsite material waste'** ranged from 36.0 to 4,005.2 cubic metres, with an average of 455.6 cubic metres.

The collected data from which this summary was drawn is presented in the appendix 1 of this study.

Regression analyses and mathematical models

This section presents the results of the linear-regression analyses performed and the mathematical models developed from the analyses.

Relationship between the Volume of Materials Used for Projects (VMUP) (52.4% average projects completion) and the Building Volume (L*W*H)'

Table 3 shows the result of the regression analysis between the Building Volume (L*W*H) and the VMUP (52.4% completion). The result depicts a linear and a strong correlation with the R-square (R^2) value of 61.62%. The probability value (0.0002) is less than the 5% significance level; and the hypothesis was tested at the 95% confidence level.

Therefore, the relationship is statistically significant; and the alternative hypothesis is accepted; while the null hypothesis is rejected.

The result shows that any change in the either of the variables (X and Y) would lead to a corresponding change in the other.

Table 3: Result of regression analysis between building volume (L*W*H) and the VMUP (52.4% completion)

	Variables		Type of model	Observation			Inference		
	X	Y		Regression Equation	R squar	Probabi ity valu	Strength of relationship	Remarks	Action on Hypotheses
1	Building volume (m3) (L*W*H)	Volume of materials used for project (m3 52.4%	Linear regression	Estimated volume of materials used =7449.7315+0. 0194*(*x*)	61.62%	0.0002	Strong	Statisticall significant	Accept Hi and reject Ho

Therefore, to predict the VMUP (52.4% project completion) using the Building Volume (L*W*H) for that project will be determined by: adding the constant value (7449.7315) to the coefficient value of the Building Volume (0.0194), and multiplied by the value of the 'Building Volume (L*W*H)' as shown in Figure 1. This result is in line with the findings of Nagapan *et al.* (2013) who concluded that the quantification of waste is based on the volume of stockpiled waste and that of Lu *et al.* (2011) who concluded that waste could be quantified using different practices, one of which is by volume. This result quantifies material waste by volume.

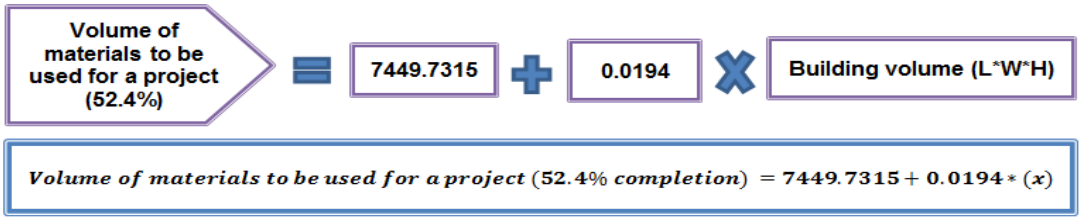


Figure 1: Mathematical model for predicting the volume of materials to be used for a proposed building project (52.4% completion)

Relationship between the VMUP 100% completion and the Building Volume (L*W*H)

The results in Table 4 depicts that, if the project is 100% completed, the regression analysis between the Building Volume (L*W*H)' and the VMUP (100%) also reveals a linear and a very-strong correlation with the (R-square) value of 96.3%. The probability value (0.000) was less than the 0.05 (5%) level of significance; and the hypothesis was tested at the 95% confidence level.

The relationship is statistically significant; and the alternative hypothesis is accepted; while the null hypothesis is rejected.

Table 4: Result of regression analysis between the Building Volume (L*W*H) and the VMUP (100% completion)

	Variables		Type of model	Observation		Inference			
	X	Y		Regression Equation	R2	Probability valu	Strength of relationship	Remarks	Action on Hypotheses
2	Building volume (m3) (L*W*H)	Estimated volume of materials	Linear regressio	Estimated volume of materials=2334.7586+0.1113*(*x*)	96.3%	0.000	Very strong	Statistically significant	Accept Hi and reject Ho

To predict the VMUP 100% completion using the Building Volume (L*W*H) for that project is determined by, adding the constant value (2334.7586) to the coefficient value of the building volume (0.1113), and multiplied by the building volume (L*W*H) as shown in the Figure 2. This result is in line with the findings of Nagapan *et al.* (2013) who concluded that the quantification of waste is based on the volume of stockpiled waste and that

of Lu *et al.* (2011) who concluded that waste could be quantified using different practices, one of which is by volume. This result quantifies material waste by volume.

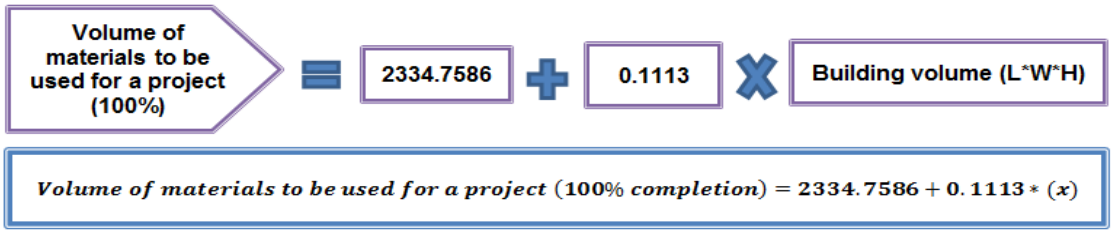


Figure 2: Mathematical model for predicting 100% VMUP for a proposed building project

Relationship between the Generated Volume of On-site Material-Waste (GVOMW), (52.4% completion) and the Building Volume (L*W*H)

Table 5 shows the result of the linear-regression analysis between the Building Volume (L*W*H) and the GVOMW (52.4% completion). The results indicate a strong correlation between the variables with an R-square value of 55.43% and a probability value of 0.0015, which is less than the 5% significance level at the 95% confidence level.

It is inferred that a statistically significant relationship exists between the variables; and the alternative hypothesis is accepted; while the null hypothesis is rejected.

To predict the volume of onsite material waste (52.4% completion) using the Building Volume (L*W*H) for that project, is determined by adding the constant value (333.5738) to the coefficient value of Building Volume (L*W*H), (0.0004), and multiplied by the Building Volume (L*W*H), as shown in Figure 3. This result is not in line with the findings of Lin (2006), Poon *et al.* (2004), and McDonald and Smither (1998) who both concluded that the volume of waste is generated based on the gross floor area. But this result uses building volume as a benchmark

Table 5: Result of regression analysis between the Building Volume (L*W*H) and the GVOMW (52.4% completion)

S/n	Variables		Type of model	Observation			Inference		
	X	Y		Regression Equation	R2	Probability value	Strength of relationship	Remarks	Action on Hypotheses
3	Building volume (m3) (L*W*H)	Generated volume of onsite material waste (52.4% completion)	Linear regression	Volume of material waste recorded =333.5738+0.0004*x	55.43%	0.0015	Strong	Statistically significant	Accept Hi & reject Ho

.

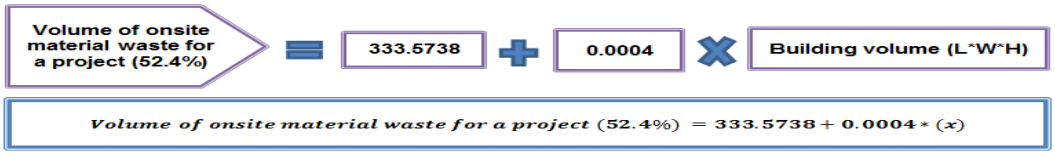


Figure 3: Mathematical model for predicting the volume of material waste for a proposed project

Relationship between the Building Volume (L*W*H) and GVOMW (100% completion)

The 52.4% GVOMW in Table 5 above was upgraded to 100%, in order to determine a relationship at project completion.

The result is presented in Table 6 and shows a very-strong correlation between the variables with an R-square value of 95.2% and a probability value of 0.000.

It is inferred that a statistically significant relationship exists between the variables and the alternative hypothesis is accepted; while the null hypothesis is rejected.

Table 6: Results of the regression analysis between the building volume (L*W*H) and an 100% generated volume of material waste

	Variables		Type of mod	Observation			Inference		
	X	Y		Regression Equation	R square	Probabilit value	Strength of relationship	Remarks	Action on H
4	Building volume (m3) (L*W*H)	100% Generated volume of onsite material waste	Linear regression	100% volume c material waste =361.9173+0.0 023*x	95.2%	0.000	Very strong	Statisticall significant	Accept Hi & reject H

To predict the 100% volume of onsite material waste for a proposed building using the Building Volume (L*W*H) for that project is determined by adding the constant value (361.9173) to the coefficient value of building volume (0.0023), and multiplying the result by the building volume (L*W*H), as shown in Figure 4. This result is in line with the findings of Nagapan *et al.* (2013) who concluded that the quantification of waste is based on the volume of stockpiled waste and that of Lu *et al.* (2011) who concluded that waste could be quantified using different practices, one of which is by volume. This result quantifies material waste by volume.

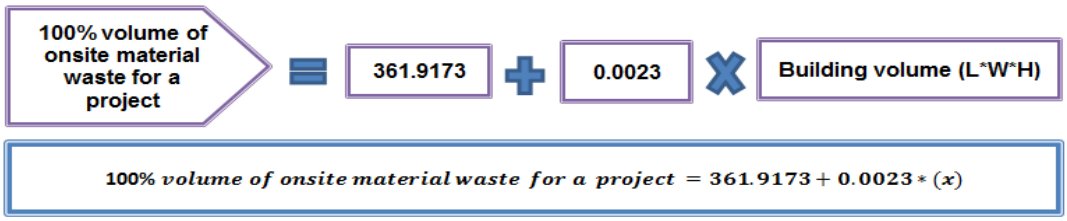


Figure 4: Mathematical model for predicting the total volume (100%) of on-site material waste for a proposed building project

Results of the relationship between the Estimated Volume of Materials for Projects (EVMP) and the GVOMW (52.4% completion)

Table 7 shows the results of the relationship between the EVMP and the generated volume of on-site material waste for the projects.

The result shows a non-statistically significant relationship; because the probability value (0.0698) is greater than the significance value (0.05); and the hypothesis was tested at the 95% confidence level. The R-squared value of 33.57% was weak. The alternative hypothesis was rejected in favour of the null hypothesis.

Table 7: The results of regression analysis between the estimated volume of material for the project (m³) and the volume of on-site material waste recorded

S/N	Variables		Type of model	Observation	Inference				
	X	Y		Regression Equation	R2	Probability value	Strength of relationship	Remarks	Action on Hypothesis
5	Estimated volume of material for project	Generated volume of material waste (52.4% completion)	Linear	Volume of onsite material waste recorded =390.8538+0.009*x	33.57%	0.0698	Weak	Not statistically significant	Accept Hi & reject Ho

To predict the volume of onsite material waste to be generated for a proposed building project (52.4%) using the EVMP if the volume of materials is known.

This is determined by adding the constant value (390.8538) to the coefficient value of the volume of materials for the proposed project (0.0019), and multiplied by the volume of materials for the proposed project as shown in Figure 5. This result is not in line with the findings of Lin (2006), Poon et al. (2004), and McDonald and Smither (1998) who both concluded that the volume of waste is generated based on the gross floor area. But this result uses building volume as a benchmark.

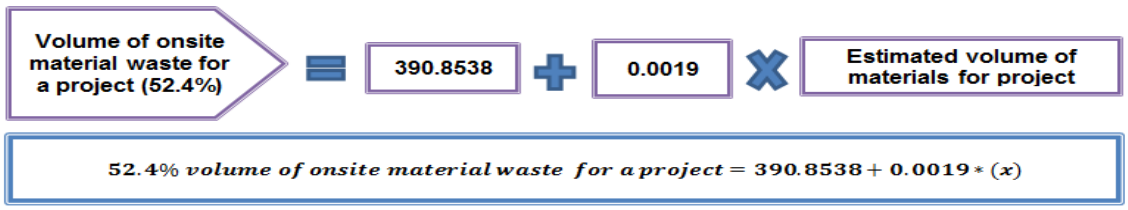


Figure 5: Mathematical model for predicting the volume of on-site material waste for a proposed project (52.4% completion)

Results of the relationship between the EVMP and a 100% GVOMW

The results in Table 8 show how the 52.4% onsite material waste volume in Table 7 is upgraded to 100%. The result shows a very strong correlation between the variable with an R-squared value of 99.29% and a probability value (0.000) less than the significance level (0.05). The hypothesis was tested at the 95% confidence level.

The relationship is statistically significant; and the null hypothesis was accepted and alternative was rejected.

Table 8: The results of the regression analysis between the EVMP (m^3) and the100% GVOMW

	Variables		Type of model	Observation			Inference		
	X	Y		Regression Equation	R2	Probability value	Strength of relationship	Remarks	Action on Hypotheses
6	Estimated volume of material for project	100% material waste volume	Linear	Volume of waste =309.4626+0.0206 *x*	99.29 %	0.000	Very strong	Statistically significant	Accept Hi & reject Ho

To predict the **100%** volume of onsite material waste for a proposed project using the estimated volume of materials for that project is determined by adding the constant value (309.4626) to the coefficient value of the volume of materials for a proposed project (0.0206), and multiplied by the volume of materials for the proposed project as shown in Figure 6. This result is in line with the findings of Nagapan *et al.* (2013) who concluded that the quantification of waste is based on the volume of stockpiled waste and that of Lu *et al.* (2011) who concluded that waste could be quantified using different practices, one of which is by volume. This result quantifies material waste by volume.

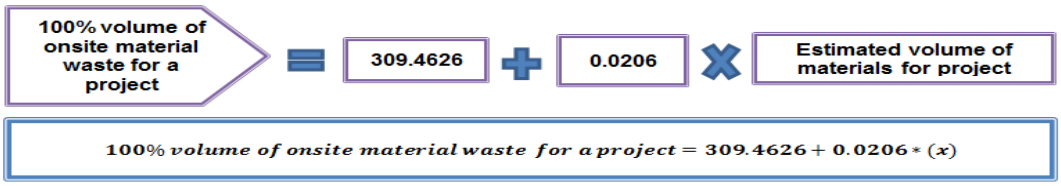


Figure 6: Mathematical model for predicting 100% volume of on-site material waste for a proposed project

To gain a general insight into the mathematical models for quantifying the total volume of materials and material waste for a proposed project, Figure 6 presents the general summary.

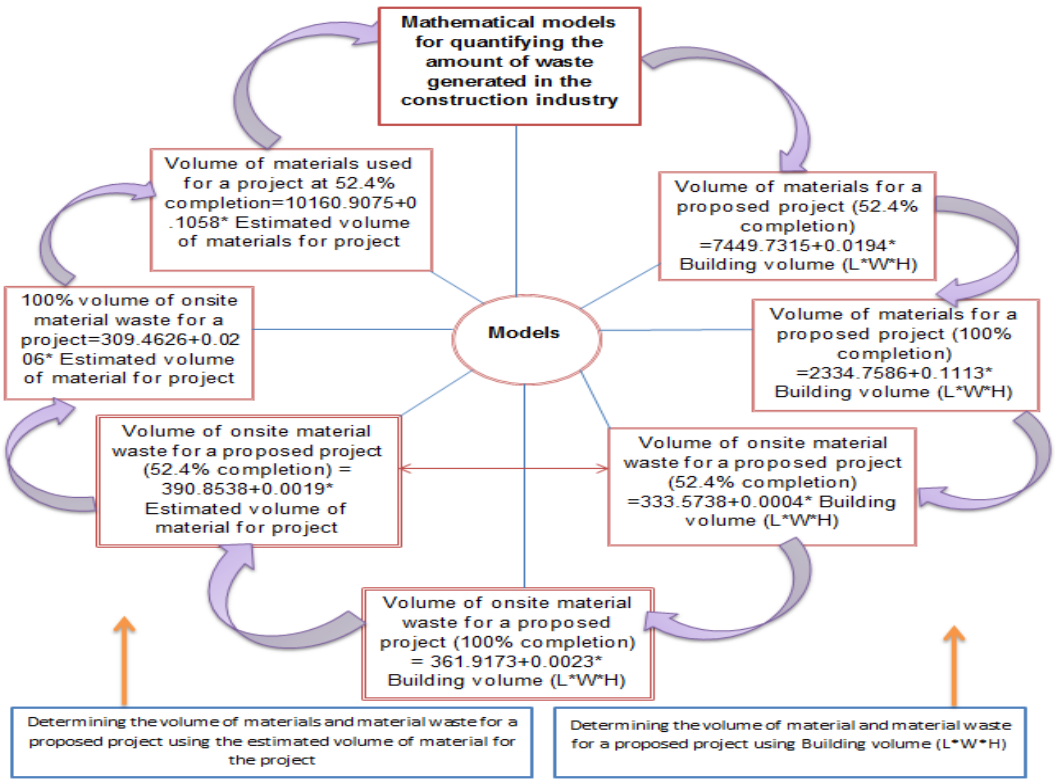


Figure 7: Summary of mathematical models for quantifying the amount of material waste on construction site

Merits, limitations, practicability and basic assumptions of the model

The model can be used to determine the volume of onsite material waste to be generated from drawing, using the building size (length by width by height). It is also easier to determine the entire volume of materials to be used in lump for a proposed building using this model.

However, the volume of material waste predicted by this model comes in lump (combination of waste from different building materials), as it does not consider segregation/separation of waste for individual material.

The model was developed at the level of 52.4% average project completion, since the projects considered were ongoing as at the period of data collection. However, adjustment has been made to the volume of the 52.4% waste to accommodate 100% project completion, as shown in the last column of the appendix.

The research assumes that the generated volume of waste has pass through re-using process, but not recycled; because only one out of the 31 construction projects visited was involved in material waste recycling.

The practicability of this model is that it gives the professionals the idea of the likely volume of material waste to be generated for projects, as well as the idea on how to plan the waste minimisation and disposal processes.

This research is limited to building construction projects that use hollow filled solid blockwork commonly used in the Nigerian context. The research did not consider other similar building materials, such as burnt bricks, precast unit walling and other paneled building.

CONCLUSION AND RECOMMENDATIONS

The study concludes that; a statistically significant relationship exists between the variables considered in the study. (Building Volume (L*W*H) and the estimated volume of materials used for projects; the Building Volume (L*W*H) and the 'generated volume of on-site material waste'; and 'the estimated volume of material for building projects' and the 'volume of material waste generated'). This implies that any change in the either of the variables would lead to a corresponding change in the other.

The linear-regression analyses revealed the mathematical models for quantifying and predicting both the 'volume of building-material waste' and the 'volume of materials for a building'.

The mathematical models for the quantification of onsite-material waste developed in the study are recommended to the Nigerian construction industry. This should enable the construction professionals to have some idea of what amount of waste is generated, and to evaluate the extent to which it could be minimised, in order to meet the required waste-management objectives for a project.

REFERENCES

Adewuyi, T. O., and M. Otali. 2013. "Evaluation of Causes of Construction Material Waste: Case of River State, Nigeria." *Ethiopian Journal of Environmental Studies and Management* 6: 746-753.

Al-Hajj, A., and K. Hamani. 2011. "Material Waste in the UAE Construction Industry: Main Causes and Minimisation Practices." *Architectural Engineering and Design Management* (Heriot-Watt University Gate way) 7 (4): 221-235.

Ameh, J. O., and E. D. Itodo. 2013. "Professionals' views of material wastage on construction sites." *Organi zat ion, Technology and Management in Const ruct ion. An international Journal* 5 (1): 747-757.

Babatunde, S.O. 2012. "Quantitative assessment of construction material wastage in Nigerian construction sites." *Journal of Emerging Trends in Economics and Managent Sciences* 3 (3): 238-241.

Begum, R. A., C. Siwar, J. J. Pereira, and A. Jaafar. 2007. "Implementation of waste management and minimisation in the construction industry of Malaysia." *Resources, Conservation and Recycling* 51: 190–202.

Chikezirim, O., and E. Mwanaumo. 2013. "Evaluation of Waste Management Strategies Adopted in Tshwane Building Industry." *Journal of Construction Project Management and Innovation* (Centre of Construction Management and Leadership Development 2013) 3 (1): 498 - 510.

Ekanayake, L. L., and G. Ofori. 2004. "Building waste assessment score: design-based tool." *Building and Environment* 39: 851 – 861.

Golafshani, N. 2003. "Understanding Reliability and Validity in Qualitative Research." *The Qualitative Report Volume* 8 (4): 597-607.

Jingkuang, L., W. Yousong, and L. Yiyong. 2012. "A Model for Quantification of Construction Waste in New Residential." *The Open Construction and Building Technology Journal* 6: 398-403.

Kareem, K. R., and R. K. Pandey. 2013. "Study of Management and Control of Waste: Construction Materials in Civil Construction Project." *International Journal of Engineering and Advanced Technology (IJEAT)* 2 (3): 345-350.

Lachimpadia, S.K., J.J. Pereira, M.R. Taha, and M. Mokhtar. "Construction waste minimisation comparing conventional and precastconstruction (Mixed System and IBS) methods in high-rise buildings: A Malaysiacase study." *Resources, Conservation and Recycling* 68 (2012): 96– 103.

Li, J., Zhang, X. (2013). Web-based Construction Waste Estimation System for Building

Construction Projects: Automation in Construction, 35: 142–156.

Li, J., Z. Ding, X. Mi, and J. Wang. "A model for estimating construction waste generation indexfor building project in China." *Resources, Conservation and Recycling* 74 (2013): 20– 26.

Liatas, C. 2011. "A model for quantifying construction waste in projects according." *Waste Management* (Elsevier Ltd.) 31: 1261–1276.

Lu, W., H. Yuan, J. Li, J.J.L Hao, X. Mi, and Z. Ding. 2011. "An empirical investigation of construction and demolition waste generation rates in Shenzhen city, South China." *Waste Management* 31: 680–687.

Masudi, A.F., C.R.C. Hassan, N.Z. Mahmood, S.N. Moktar and N.M. Sulaiman. 2012. "Waste quantification models for estimation of construction and demolition waste generation: a review." *International Journal of Global Environmental Issues*, 12: 269-281

Miller, P. 2008. "Validity." In *The Sage Encyclopedia of Qualitative Research Methods*, edited by L. Given, 909-910. Los Angeles: SAGE Publications Inc.

MOU, K. 2008. "The role of government and construction waste." MSC Dissertation, The Centre of Urban Planning & Environmental Management , University of Hong Kong, Hong kong, 1-179.

Nagapan, S., I. Abdul-Rahman, A. Asmi, and N.F. Adnan. 2012. "Study of Site's construction waste in Batu Pahat, Johor." *Procedia Engineering* 53: 99 – 103.

Nguyen, B., H. Gupta, and S. Faniran. n.d. "Waste minimization strategiesin the construction industry-A Geelong case study." Geelong, 1-10.

Oladiran, O.J. 2009. "Causes and Minimization Techniques of Materials Waste in Nigerian Construction Process." *Fifth International Conference on Construction in the 21st Century (CITC-V).* Istanbul, Turkey. 20-22.

Osmani, M. 2011. "Construction waste." Chap. 15 in *Waste: A handbook for management*, by Letcher and Vallero, 1-565. San Diego: Academic Press an imprint of Elsevier.

Osmani, M., J. Glass, and A.D.F. Price. 2008. "Architects 'Perspectives on Construction Waste Reduction by Design." *Waste Management* 28: 1147–1158.

Tam, V.W.Y., L.Y. Shen, C.M. Tam. 2007. "Assessing the levels of material wastage affected by sub-contracting relationships and projects types with their correlations." *Building and Environment* 42: 1471–1477.

Wahab, A. B., and A. F. Lawal. 2011. "An evaluation of waste control measures in." *African Journal of Environmental Science and Technology* 5 (3): 246-254.

Yuan, H., and L. Shen. 2011. "Trend of the research on construction and demolition waste management." *Waste Management* 31: 670–679.

APPENDIX

It is apparent from Table 1 that the entire building-projects considered in this investigation had attained an average percentage completion of 52.4%. 15 of the 30 projects had attained 50% completion and 7 others were between 90-99.9% completed when this survey was conducted. These findings are reliable; because the average percentage of project completion shown in Table 1 is above the average level of 50% (Saidu & Shakantu 2016b: 110).

Table 8: The research data collected

S/n	Estimated Time for the Project (Month)	Actual time (Time Now) (Month)	% of work Completed	Estimated volum of materials for Project (M3)	Volume of material used fo projects (M3)	Building Volume (L x W X H) (M3)	Volume of waste recorded	100% Volume of waste
1	24	11	17%	8, 925	1,517.25	26, 262. 94	65.24	383.7647059
2	24	15	47%	35, 503. 40	16, 686.60	186, 860.00	634.09	1349.12766
3	20	36	59%	5,126. 84	3, 024. 84	17, 486.60	124.02	210.2033898
4	24	12	35%	10, 741. 08	3,759. 38	56, 532. 00	155.49	444.2571429
5	22.5	54	43%	7, 191. 36	3, 092. 29	29, 964. 00	196.23	456.3488372
6	16	11	63%	19, 082.68	12, 022.09	102,320. 00	963.40	1529.206349
7	36	13	30%	75, 033.66	22, 510. 10	635, 737. 20	891.85	2972.8333
8	24	32	30%	14, 651.39	4, 395.42	93, 440. 00	128.04	426.8
9	24	21	68%	5, 566.77	3, 785.40	18,170. 00	232.14	341.3823529
10	24	16	23%	14, 010. 25	3, 222. 36	105, 658. 00	136.34	592.7826087
11	24	23	65%	17, 201.13	11, 180.74	130, 311. 60	572.45	880.6923077
12	18	9	25%	13, 953. 60	3, 488. 40	82, 080. 00	108.14	432.56
13	18	7	15%	14, 633. 00	2, 194. 95	81, 622. 41	57.72	384.8
14	36	3	5%	673, 592.40	33, 679.62	5, 181, 480. 00	707.27	14145.4
15	48	19	17%	17, 320.70	2,944.519	102, 550.00	57.71	339.4705882
16	24	11	23%	4, 982. 44	1, 145. 96	26, 223.37	36.01	156.5652174
17	18	8	31%	20, 791.48	6, 445. 36	127, 615.319	223.01	719.3870968
18	24	10	25%	17, 207. 19	4, 301.80	104, 286. 00	141.96	567.84
19	24	21	90%	19, 019. 15	17, 117. 24	130, 000. 00	701.81	779.7888889
20	40	5	11%	67, 385.61	7, 412. 42	622, 021. 36	158.85	1444.090909
21	20	14	48%	19, 305. 56	9, 266. 67	148, 500	398.47	830.1458333
22	17	39	100%	9, 522. 10	9, 522. 10	42, 700. 00	400.88	400.88
23	24	18	56%	7, 231.41	4, 049. 59	43, 747.20	247.03	441.125
24	26	16	68%	10, 951.20	7, 446. 82	84, 240.00	156.38	229.9705882
25	24	54	100%	5, 322.35	5, 322.35	29, 568. 00	NR	NR
26	68	92	60%	15, 414.00	9, 248. 40	84, 000. 00	322.74	537.9
27	24	36	88%	16, 728. 00	14, 720.64	136,000. 00	529.94	602.2045455
28	20	54	100%	15, 585. 50	15, 585. 50	89, 060.00	568.87	568.87
29	18	21	95%	19, 158.61	18, 200. 68	118, 263. 00	893.65	940.6842105
30	24	24	98%	16, 459. 95	16, 130. 75	126, 615	645.23	658.3979592
31	60	96	90%	211, 914. 50	190, 723. 05	3, 252, 311. 00	4,005.18	4450.2

Source: Researcher's field survey, 2015.

QUALITY CULTURE ORIENTATION OF CONSTRUCTION FIRMS AS DRIVER OF PROJECT PERFORMANCE IN NIGERIA

Godwin Iroroakpo Idoro[1] and Olutayo Ajibola Akinkumi[2]
[1,2]Department of Building, University of Lagos, Akoka, Lagos, Nigeria

Construction is known to play significant role in driving economic growth by providing the needed infrastructure. This role is however hampered by poor quality standards which are manifested in high value of rework and incessant building collapse. Studies have identified culture in various forms as a moderator of performance and quality culture is considered as a useful tool for quality improvement. However, studies on the interrelationship between quality culture and performance are generally scarce. This study therefore investigates the orientations of the Quality Culture (QC) of construction firms in Nigeria and its contribution to project performance. The objectives are to determine the orientation of the quality culture of construction firms and its relationship with project outcome. To achieve these objectives, a survey of 86 firms drawn from the population of construction firms in Nigeria was conducted. 43 QC components were identified and categorised into seven QC orientations namely: management commitment, management support, technical staff, labour, system, process and values. The adoption of QC component was measured on a 5-point Likert scale namely: nil, low, moderate, high and very high which were scored 1, 2, 3, 4 and 5 respectively. Data were collected on contractors' staff perception of the adoption of QC components, initial and actual contract periods and sums and values of variation and rework of projects executed by construction firms sampled using structured questionnaires. Data collected were analysed to derive the levels of adoption of QC components groups or orientations, cost and time overruns and costs of variation and rework of projects using mean score. The relationship between QC orientations and project outcome was analysed using Pearson correlation test. The results show that management commitment and support, labour and process QC orientations have higher level of adoption than technical staff, system and value orientations. It is further discovered that only management commitment and support orientations have significant relationship with rework. It is concluded that the QC of construction firms is more oriented toward management commitment and support, labour and process QC components but only management commitment and support contribute to quality standards. It is recommended that construction firms should strive to improve their level of adoption of QC components in order to improve the performance especially the quality standards of projects executed.

[1] iroroidoro@yahoo.com
[2] tirano60@yahoo.com

Idoro, G. I., and Akinkumi, A. O. (2017) Quality culture orientation of construction firms as driver of project performance in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1144-1159

Keywords: construction firms, Nigeria, project performance, quality culture, quality culture orientation

INTRODUCTION

Poor quality of products has been identified as a major problem and challenge in the construction industry (Karim *et al.*, 2006; Idoro, 2010; Idoro and Akinkunmi, 2016). Poor quality manifests in various forms: works being redone, modified or compromised to lower standards (Suresh *et al.*, 2008), rework or defective works (Idoro and Akinkunmi, 2016), failures or collapse of structures (Oni, 2009; Idoro, 2010). The huge costs of rectifying poor quality standards in construction projects have also been well researched (Burati *et al.*, 1993; Thomas *et al.,* 2002). The causes of the problem of poor quality standards in construction works have also attracted the attention of researchers and several reasons have been given such as poor leadership, planning, training, education, communication and knowledge of quality (Abdul-Rahman, 1996), poor leadership, communication, motivation, organisational and management of construction supply chain (Love,2002; Chiang and Tang, 2003), inadequate supervision, carelessness and low construction labour skill (Love and Edward, 2004). These factors can be regarded as lead factors of project quality and linked to the quality culture of construction firms.

The focus of previous studies on quality culture in Nigeria has been directed at implementation (Bello, Soyingbe and Akinwande, 2012) and adoption (Idoro and Akinkunmi, 2016) of quality culture components and/or orientations. In an earlier study, Idoro and Akinkunmi (2016) investigated forty-three Quality Culture (QC) components which were classified into seven quality culture orientations. The study identified the ten top QC components as allocation of adequate human resources, effective communication of project status, preparation of firms' vision/mission statement, possession of requisite work experience, skill and qualification of workers, establishment of quality audit system, indiscipline, hard work, existence of quality control system and honesty. It also investigated the QC orientation of construction firms and discovered that the QC of construction firms in Nigeria is most oriented towards management commitment, management support, labour and process related QC components.

The question arising from the findings of the study is 'what is the implication of the adoption, implementation and orientation of the QC of construction firms? How do they affect the performance of projects in particular quality standards? This study is a follow-up of the earlier study conducted by Idoro and Akinkunmi (2016). It investigates the quality culture components and orientations of construction firms in Nigeria and its relationship with project outcome. The objectives are to evaluate the QC orientation of construction firms and its relationship with project outcome.

REVIEW OF LITERATURE

Quality is a parameter of project performance that is difficult to define because it varies from industry to industry, organisation to organisation and even individual to individual. King (2001) and Walker and Greenwood (2002) express difficulty in defining quality in the construction industry because its attributes vary among clients and other members of a project team. The implication of this expression is that, just like beauty, quality is in the eye of the assessor. In spite of the variation in the attributes, researchers have attempted to provide a specific understanding of quality.

Crosby (1984) describes quality as conformance to specifications and therefore identifies attributes of quality as conformance to requirements which is concerned with standards and regulations, system which involve prevention, zero defects and measurement which is concerned with the price of non-conformance. In agreement with the view of Crosby (1984), Arditi and Gunaydin (1997) and Mahmood *et al.* (2006) consider quality as the ability of products and processes to conform to established requirements and specifications. The above definitions tend to consider quality as a measure of agreement with already defined standards and requirements which are usually stated in project documents. However; quality sometimes goes beyond requirements and standards defined in project documents because project requirements and even standards do change during the course of construction. In recognition of this, Karna (2004) maintains that quality involves two measurements namely: conformance to requirements and client satisfaction. In agreement with the opinion of Karna (2004), Cheng *et al.* (2006) opine that client satisfaction is a key performance indicator in a successful project and quality is the main criterion for achieving client satisfaction. While this opinion seems to be an improvement on previous views about quality, Cheng *et al.* (2006) limit the party whose satisfaction is important in defining quality to the client. The requirements of other stakeholders are equally important and constitute the requirements of a project. For this reason, quality can be described as the ability of construction process and the completed project to meet functional requirements and stakeholders' satisfaction. Stakeholders' satisfaction is determined by values, taste, beliefs, status, attitudes, behaviours, religion etc and these can change within the delivery period of a project.

There is a consensus in previous studies that quality is an important measure of the performance of a project. Jackson (2004) states that quality impacts not only on appearance and durability but also on the performance of a project. Abdul-Rahman, Wang and Yap (2010) opine that both public and private sectors place more emphasis on quality than the cost and time which were the major concerns in the past. Rwelamila and Smallwood (1996) discover that the manifestation of non-achievement of quality which is rework constituted on average 13% of the value of completed construction in South Africa and resulted in loss of profit and client satisfaction while Joubert *et al.* (2005) conclude that the South African building industry has a negative image in terms of achieving quality. Smallwood and Rossouw

(2008) discover that inadequate or poor quality standards can result in rework, non-conformance, increased costs, client dissatisfaction, redirection of resources and ultimately, negatively impacts on the other project parameters namely: health and safety, productivity and time. These assertions imply that quality remains a major concern in construction worldwide.

Several attempts have been made to proffer solutions to the problem of quality standards in construction projects. Such attempts have focussed on several issues such as Quality Management Systems (Latham, 1994; Smallwood and Rwelamila, 1998; Love *et al.,* 1999; Love and Li, 2000; Langford *et al.,* 2000; King, 2001; Joubert *et al.,* 2005), Quality Assurance (Love and Li, 2000) and Total Quality Management (TQM). Further studies or recent attempts have tended to focus on Quality Culture. Sodangi *et al.* (2009) maintain that a strong quality culture continuously delivers high quality products and services. In reference to the elements of quality culture, studies (Mahmood *et al.,* 2006; Sodangi, Idris and Khamidi, 2010) maintain that it is not only the final product that is subject to criticisms but the process, parties, materials etc are under tremendous pressure for better quality in construction. While it may be argued that quality management systems, quality assurance and TQM cannot be separated from QC, studies have however distinguished the two. Mahmood *et al.* (2006) assert that the elements of QC are the success factors of TQM and they complement its implementation. In the attempt to emphasise the importance of quality culture, Harvey and Stensaker (2008) opine that quality actually stems from a broader cultural perspective. A model developed by Mojtahedzadeh and Arunugam (2011) shows that QC is a moderating variable between TQM and the parameters of performance such as customer satisfaction, market share and profit.

The assertions above show that QC indeed plays an important role in determining the quality of the products and services of an organisation and that positive QC may just be the way out of the serious problem of poor quality standards being experienced in construction projects. However, culture apart from being dynamic, varies based on individuals and organisations therefore; it is very difficult to conceptualise. Tharp (2009) considers culture as a complex issue that essentially includes all of groups' shared values, attitudes, beliefs, assumptions, artefacts and behaviours to the extent that members are not even aware they are influenced by it.

A few studies have investigated the issue of QC in construction especially in the Nigerian construction industry. Bello, Soyingbe and Akinwande (2012) examine the factors that determine the implementation of QC of construction firms in Nigeria and also assess the level of implementation of QC in construction. The focus of the study is mainly the drivers of QC therefore, it only identifies the most and least implemented elements of QC in the construction industry. The study does not cover the orientation of QC which relates to the disposition and direction of the firms on quality standards that is fostered by the beliefs, attitude, values, thoughts and practices of the management and workers in the firms. Furthermore, the

study does not relate QC of construction firms with the performance of the projects executed which is goal of every construction process, methods and practice.

Another study by Idoro and Akinkunmi (2016) also investigates the components of QC and the orientation of the QC of construction firms in Nigeria. The study limits its scope to the orientation of the QC of construction firms therefore, it reserves the relationship between the implementation or orientation of QC and performance of projects executed which is the reason for implementation or adoption for further studies. The study therefore; does not provide the justification and determine the effectiveness of QC. The attempt to fill the gap in the above studies in particular to establish the influence of QC of construction firms on the performance of construction projects prompts an investigation of the contribution of the orientation of the QC of construction firms in Nigeria to project performance especially project quality. The study adopts two categories of project performance parameters namely: objective performance which consists of project cost-overrun, time-overrun, cost of variation and cost of rework and subjective performance which consists of consultants' perception of project duration, cost and quality. It therefore investigates the relationship between the adoption of QC orientations and the two categories of project performance.

RESEARCH METHODS

To achieve the objectives of the study, a survey involving a sample of 86 construction firms was carried out. The sample was selected from a population of 180 construction firms in Nigeria. The population of construction firms operating in Nigeria could not readily be obtained therefore; a pilot study was carried out prior to the actual survey. In the pilot study, 180 firms were identified and used as the study sample. From this sample, 86 firms were selected by random sampling to form the sample size of the study. One project and the head of the project site were selected from each firm for the study.

Forty-three QC components identified from previous studies and personal interviews were used for the study. The components were categorized into seven QC orientations namely: Management commitment (Mc), Management support (Ms), Labour (Lb), Process (Pc), Technical staff (Ts), System (St) and Value (Vl). The level of adoption of each QC component was measured on a 5-point Likert scale namely: nil, low, moderate, high and very high which were scored 1, 2, 3, 4 and 5 respectively. The level of adoption of each category of QC component was analysed as the sum of the scores for the ranks of all the components in the group divided by the number of components in the group. Data were collected on the scale that represents the level of adoption of each QC component in each project, the initial and final contract sums and periods and values of variation works and rework recorded in the projects sampled. Data were collected with the aid of structured questionnaires administered to the respondents by

personal contact because it was considered most appropriate to reach all the respondents sampled.

Data collected were analysed using percentage and mean score while the research hypothesis was tested using inferential statistics namely: t-test, Pearson test and Spearman test. Percentage was used for the analysis of descriptive data on the characteristics of the respondents which are nominal data. Mean score was used for the analysis of ordinal data on the level of adoption of QC components. The research hypotheses were tested using inferential statistics. t-test was used to analyse significant difference between the levels of adoption of QC orientations because the data were quantitative. Pearson test was used to analyse significant correlation between adoption of QC orientations and four parameters of project outcome namely: cost-overrun, time-overrun, cost of variation and cost of rework because the data were quantitative while Spearman test was used to analyse significant correlation between the adoption of QC orientations and consultants' assessment of project duration, cost and quality because the data were ordinal.

RESULTS

The results of the analysis of data collected are presented as follows:

Characteristics of respondents of the study

Ten characteristics of the respondents namely: respondents' age, sex, profession, academic and professional qualifications, construction experience, length of service and position in their organisations were investigated. The distribution of the respondents among the sub-variables of each characteristic is presented in Table 1

Table 1: Descriptive results of respondents' characteristics

Characteristic	N	%	Characteristic	N	%
Age			Profession		
18-25 years	34	39.5	Quantity surveyor	35	40.7
26-35 years	46	53.5	Builder	15	17.4
Above 35 years	6	7.0	Engineer	28	32.6
Total	86	100	Architect	8	9.3
Sex			Total	86	100
Male	55	64.0	Professional qualification		
Female	31	36.0	NIA	8	9.3
Total	86	100	NIOB	17	19.8
Academic qualification			NIQS	39	45.3
HND	15	17.4	NSE	22	25.6
B. Sc.	45	52.3	Total	86	100
M. Sc.	26	30.2	Construction experience		
Total	86	100	1-10 years	38	44.2
Position in organisation			11-20 years	42	48.8
Middle manager	75	87.2	Above 20 years	6	7.0
Top manager	11	12.8	Total	86	100
Total	86	100			

N=Number of respondents, HND=Higher National Diploma, NIA=Nigerian Institute of Architects, NIOB=Nigerian Institute of Building, NIQS=Nigerian Institute of Quantity Surveyors, NSE=Nigerian Institute of Engineers

Table 1 shows that the respondents are all adult and consist of both male and female but male respondents constitute the majority. The results further reveal that all the respondents are graduates registered with four professional bodies in the construction industry. Table 1 further reveals that all the respondents are management staff with short, medium and long experience in the construction industry.

Level of adoption of quality culture component groups

The forty-three components of QC were investigated in an earlier study (Idoro and Akinkunmi, 2016). The components were divided into seven groups as explained above. To determine the orientation of the QC of the construction firms sampled, the mean scores of the level of adoption of the seven groups of components were analysed. The results are presented in Table 2.

Table 2: Mean scores of the level of adoption of quality culture component groups

Quality culture orientation	N	Min	Max	TS	MS	Rk
Process components	86	2.2	4.0	276.0	3.21	1
Management support components	86	2.0	4.3	274.5	3.19	2
Management commitment components	86	2.2	4.4	272.0	3.16	3
Labour components	86	2.3	4.0	270.7	3.15	4
System components	86	1.8	3.8	257.0	2.99	5
Technical staff components	86	2.2	4.0	255.4	2.97	6
Value components	86	2.2	3.6	252.4	2.94	7

N=Number of respondents, Min=Minimum, Max=Maximum, TS=Total score, MS=Mean score, Rk=Rank

Table 2 shows that process related component group is the most adopted. The levels of adoption of process related components of QC range from low (2.2) to high (4.0). Management support related component group of QC is the second most adopted. The levels of adoption of management support related components range from low (2.0) to high (4.3). Management commitment related component group is the third most adopted. The levels of adoption of management commitment related components range from low (2.2) to high (4.4). Labour and system related component groups are the fourth and fifth most adopted respectively. Technical staff related component group is the sixth most adopted while value related component group is the least adopted.

Difference between levels of adoption of quality culture component groups

The study also investigates the concentration of the components of QC by determining whether or not there is difference between the levels of adoption of the seven component groups of QC. To achieve this, a research hypothesis was postulated. The hypothesis states that the difference in the levels of adoption of QC component groups is not significant. The hypothesis was tested using the t-test at $p \leq 0.05$. The rule for the rejection of the

hypothesis is that when the p-value is > 0.05, the test fails to reject the hypothesis. However; when the p-value is ≤ 0.05, the test rejects the hypothesis. The mean scores of the QC component groups were used to test the hypothesis. The results are presented in Table 3.

Table 3 shows that the difference between the levels of adoption of management commitment related components and management support, labour and process related component groups are insignificant. The results indicate that the levels of adoption of the four QC component groups are the same. However, the difference between the levels of adoption of management commitment related component group and technical staff, system and value related component groups are significant. The results indicate that the level of adoption of management commitment component group is significantly different from the levels of adoption of labour, system and value related component groups. In other words, the adoption of management commitment QC components is significantly higher than those of labour, system and value related QC components.

Table 3 shows that the difference between the levels of adoption of management support, labour and process related component groups are insignificant. The results indicate that the levels of adoption of the three quality culture component groups are significantly the same. However, the test of the hypothesis reveals that the difference between the levels of adoption of management support related component group is significantly different from the levels of adoption of technical staff, system and value related component groups. The results indicate that the adoption of management support components of QC is significantly higher than those of labour, system and value related components of QC.

Table 3 further shows that the difference between the levels of adoption of labour related and process related component groups are insignificant. The results indicate that the adoption of labour related components is the same with process related components of QC. However, the test of the hypothesis reveals that the difference between the levels of adoption of labour related component group and technical staff, system and value related component groups are significant. The results indicate that the adoption of labour related components is significantly higher than those of labour, system and value related components. The results in Table 3 also reveal that the difference between the levels of adoption of process related component group and technical staff, system and value related component groups are significant. The results indicate that the adoption of process related components is significantly higher than those of labour, system and value related components.

Table 3 also shows that the difference between the levels of adoption of technical staff related component group and system and value related component groups are insignificant. The results indicate that the levels of adoption of the three QC component groups are significantly the same. In the same vein, Table 4 shows that the difference between the levels of adoption of system related component group and value related component

group are insignificant. The results indicate that the levels of adoption of the two QC component groups are the same

Table 3: Results of Paired t-test for difference between levels of adoption of quality culture orientations

Component groups paired	N	Mean	t-value	Df	p-value	Sig
Management commitment	86	3.16				
Management support	86	3.19	-0.750	85	0.455	NS
Labour	86	3.15	0.217	85	0.828	NS
Process	86	3.21	-0.744	85	0.459	NS
Technical staff	86	2.97	3.743	85	0.001	S
System	86	2.99	3.148	85	0.002	S
Value	86	2.94	4..239	85	0.001	S
Management support	86	3.19				
Labour	86	3.15	0.633	85	0.529	NS
Process	86	3.21	-0.286	85	0.776	NS
Technical staff	86	2.97	3.766	85	0.001	S
System	86	2.99	3.471	85	0.001	S
Value	86	2.94	4.578	85	0.001	S
Labour	86	3.15				
Process	86	3.21	-1.289	85	0.201	NS
Technical staff	86	2.97	-3.826	85	0.001	S
System	86	2.99	3.228	85	0.002	S
Value	86	2.94	3.950	85	0.001	S
Process	86	3.21				
Technical staff	86	2.97	-5.453	85	0.001	S
System	86	2.99	6.187	85	0.001	S
Value	86	2.94	5.744	85	0.001	S
Technical staff	86	2.97				
System	86	2.99	-0.449	85	0.665	NS
Value	86	2.94	0.822	85	0.413	NS
System	86	2.99				
Value	86	2.94	1.367	85	0.175	NS

N=Number of respondents, Df=Degree of freedom, S=Significant, NS=Not significant

Relationship between level of adoption of QC components and project outcome

The study also attempts to determine the relationship between QC orientation and the outcome of the projects sampled. To achieve this objective, the measurement of the seven QC orientations in Table 3 was used. Furthermore, seven parameters of project outcome consisting of four objective parameters namely: project time and cost overruns and costs of

variation and rework and three subjective parameters of project outcome namely: contractors' perception of project cost, duration and quality were used. A research hypothesis was postulated for this purpose. The hypothesis states that QC orientations do not relate significantly with project outcome. The hypothesis was tested using Pearson correlation test at $p \leq 0.05$ for objective parameters of project outcome and Spearman correlation test at $p \leq 0.05$ for subjective parameters of project outcome. The rule for the rejection of the hypothesis is that when the p-value>0.05, the test fails to reject the hypothesis but when the p-value≤0.05, the test rejects the hypothesis. The results are presented in Tables 5 and 6.

Relationship between level of adoption of QC components and objective parameters of project outcome

The relationship between QC orientations and the four objective parameters of project outcome was tested using Pearson correlation test. The results are presented in Table 5

Table 5: Results of Pearson test of correlation between adoption of QC orientation and project outcome

Variables correlated	N	S-value	p-value	Variables correlated	N	S-value	p-value
Cost-overrun				**Cost of variation**			
Mgt commitmen	32	0.083	0.653	Mgt commitmen	32	-0.037	0.840
Mgt support	32	0.075	0.682	Mgt support	32	-0.126	0.492
Technical staff	32	0.064	0.726	Technical staff	32	-0.018	0.923
Labour	32	-0.092	0.617	Labour	32	-0.119	0.515
Process	32	-0.209	0.251	Process	32	-0.228	0.209
System	32	-0.028	0.880	System	32	-0.129	0.481
Value	32	0.069	0.707	Value	32	-0.077	0.674
Time-overrun				**Cost of rework**			
Mgt commitmen	32	0.196	0.283	Mgt commitmen	32	0.318	0.076
Mgt support	32	0.138	0.451	Mgt support	32	0.291	0.106
Technical staff	32	0.064	0.726	Technical staff	32	0.170	0.353
Labour	32	0.096	0.601	Labour	32	0.118	0.521
Process	32	-0.052	0.779	Process	32	0.192	0.292
System	32	0.212	0.245	System	32	0.227	0.212
Value	32	0.144	0.433	Value	32	0.183	0.315

N=Number of respondents, S-value=Pearson correlation coefficient, Mgt=Management

Table 5 reveals that the p-values for the test of correlation between project cost-overrun, time-overrun, cost of variation, cost of rework and the seven QC orientations are higher than the critical p-value (0.05) therefore; the test fails to reject the hypothesis. The results indicate that the relationship between the seven QC orientations and the time and cost overruns, costs of variation and rework is not significant. The implication of this result is that

none of the seven QC orientations contribute to the four objective parameters of project outcome.

Relationship between level of adoption of QC components and subjective parameters of project outcome

The relationship between QC orientations and three subjective parameters of project outcome was tested using Pearson correlation test. The results are presented in Table 6

Table 6: Results of Spearman test of correlation between adoption of quality culture orientation and consultants' assessment of project outcome

Variables correlated	N	S-value	p-value	Variables correlated	N	S-value	p-value
Project duration				**Project quality**			
Mgt commitment	86	0.493	0.001	Mgt commitment	86	-0.311	0.004
Mgt support	86	0.348	0.001	Mgt support	86	-0.244	0.024
Technical staff	86	0.526	0.001	Technical staff	86	-0.076	0.485
Labour	86	0.153	0.158	Labour	86	-0.204	0.059
Process	86	0.129	0.238	Process	86	-0.198	0.068
System	86	0.190	0.080	System	86	-0.022	0.843
Value	86	0.233	0.031	Value	86	0.228	0.034
Project cost							
Mgt commitment	86	0.041	0.707				
Mgt support	86	0.003	0.978				
Technical staff	86	0.218	0.043				
Labour	86	0.611	0.001				
Process	86	0.577	0.001				
System	86	0.452	0.001				
Value	86	0.249	0.021				

N=Number of respondents, S-value=Spearman correlation coefficient, Mgt=Management

Table 6 reveals that the p-values for the test of correlation between contractors' assessment of project duration and Labour (0.158), Process (0.238) and System (0.080) QC orientations are higher than the critical p-value (0.05) therefore; the test fails to reject the hypothesis. The results indicate that the relationship between the seven QC orientations and contractors' assessment of project duration is not significant. The implication of this result is that none of the three QC orientations influence the perception of contractors on the duration of projects. However; Table 6 further shows that the p-values for the test of correlation between contractors' perception of project duration and Management commitment (0.001), Management support (0.001), Technical staff (0.001) and Value (0.031) QC orientations are less than the critical p-value (0.05) therefore, the test rejects the hypothesis. The results indicate that the relationship between the four QC orientations and the perception of the contractors on

project duration is significant. The implication of this result is that management commitment, management support, technical staff and value QC orientations influence contractors' perception of project duration.

On contractors' perception of project cost, Table 6 reveals that the p-values for the test of correlation between contractors' perception of project cost and Management commitment (0.707) and Management commitment (0.978) QC orientations are higher than the critical p-value (0.05) therefore; the test fails to reject the hypothesis. The results indicate that the relationship between the two QC orientations and contractors' assessment of project cost is not significant. The implication of this result is that the two QC orientations do not influence the perception of contractors on the duration of projects. However; Table 6 further shows that the p-values for the test of correlation between the contractors' perception of project cost and Technical staff (0.043), Labour (0.001), Process (0.001), System (0.001) and Value (0.001) QC orientations are less than the critical p-value (0.05) therefore, the test rejects the hypothesis. The results indicate that the relationship between the five QC orientations and the perception of the contractors on project cost is significant. The results imply that technical staff, labour, process, system and value QC orientations significantly influence contractors' perception of project cost.

On contractors' perception of project quality, Table 6 reveals that the p-values for the test of correlation between contractors' perception of project quality and Technical staff (0.485), Labour (0.059), Process (0.068) and System (0.843) QC orientations are higher than the critical p-value (0.05) therefore; the test fails to reject the hypothesis. The results indicate that the relationship between the four QC orientations and consultants' assessment of project quality is not significant. The implication of this result is that the four QC orientations do not influence the perception of contractors on the quality of projects. However; Table 6 further shows that the p-values for the test of correlation between the contractors' perception of project quality and Management commitment (0.004), Management support (0.024) and Value (0.034) QC orientations are less than the critical p-value (0.05) therefore, the test rejects the hypothesis. The results indicate that the relationship between the three QC orientations and the perception of the contractors on project quality is significant. The results imply that management commitment, management support and value QC orientations influence contractors' perception of project quality.

DISCUSSION OF RESULTS

The study has investigated the QC orientations of construction firms by evaluating the levels of adoption of the seven QC component groups. The results have shown that the QC of the firms is more oriented towards four QC component groups namely: management commitment and support, labour and process. The implication is that the four QC component groups are more adopted than the remaining three component groups namely: technical staff, system and workers' attitude.

The study has also investigated the influence of the seven QC orientations on two categories of parameters of project outcome namely: objective and contractors' perception. The results of the study have established that the seven QC component groups or orientations of construction firms in Nigeria do not influence any of the objective parameters of project outcome. However; each of the seven QC orientations of construction firms has influence on contractors' perception of project duration, cost and quality. It is established that project duration is influenced by four QC component groups namely: management commitment, management support, technical staff and workers' values. Project cost is influenced by five QC component groups namely: technical staff, labour, process, system and workers' values while project quality is influenced by three QC component groups namely: management commitment, management support and workers' values. These findings agree with the finding of Mahmood *et al.* (2006) that the elements of QC are success factors and the finding by Mejtahedzadeh and Arunugam (2011) that QC moderates performance. However, while the finding of Mejtahedzadeh and Arunugam (2011) discovers that QC moderates customer satisfaction, market share and profit, the findings of this study establish that QC influences contractors' satisfaction with project cost, duration and quality.

The implication of the above results is that all the seven QC component groups influence contractors' perception of the three most important parameters of project outcome. Workers' value which is a less adopted QC component group is the only group that influences contractors' perception of the three project outcome parameters namely: project duration, cost and quality. Technical staff which is another less adopted component group influences contractors' perception of project duration and cost while system which is the third less adopted QC component group is discovered to influence contractors' perception of project cost.

CONCLUSION AND RECOMMENDATIONS

The study has established that the adoption of four QC component groups namely: management commitment and support, labour and process are significantly higher than those of the remaining three QC component groups namely: technical staff, system and workers' values. It is therefore concluded that the QC of construction firms in Nigeria is oriented towards management commitment and support, labour and process. Similarly; it is established that the seven QC component groups contribute to contractors' perception of project outcome. It is therefore concluded that QC is a useful tool for improving contractors' assessment of project outcome. Since contractors' assessment of project outcome is based on the perception and ultimately satisfaction of project stakeholders, it is therefore concluded that QC can serve as a tool for achieving stakeholders' satisfaction with project outcome. From the conclusion, it is suggested that construction firms in Nigeria should improve on their adoption of all the components of QC with particular reference to technical staff, system and workers' values QC components.

Suggestion for Further Studies

This study has investigated the contribution of the QC orientations of construction firms to project performance. Project performance in the study is limited to four parameters namely: project time represented by time-overrun and contractors' perception of project duration, project cost represented by cost-overrun and contractors' perception of project cost, project quality represented by cost of rework and contractors' perception of project quality and project design performance represented by cost of variation. Several other parameters of project performance are not covered in the study. The contribution of QC of construction firms to the other parameters of project performance not included in this study is therefore recommended for further studies.

Furthermore, studies have emphasised the importance of stakeholders' perception in studies on project performance. This study only covers one of the project stakeholders namely: contractor. The contribution of QC to the perceptions of other stakeholders on project performance is very useful in the management of performance therefore, it is recommended for further studies.

REFERENCES

Abdul-Rahman, H (1996). Comparing the cost of non-conformance on sites, *International Journal of Quality and Reliability Management*, 13(1), 23-32

Abdul-Rahman, H, Wang, C and Yap, X W (2010). How Professional Ethics Impact Construction Quality Perception and Evidence in a Fast Developing Economy. *Scientific Research and Essays,* 5(28), 3742-3749

Arditi, D and Gunaydin, H M (1997). Total Quality Management in the Construction Process. *International Journal of Project Management,* 15(4), 235-252

Bello, W A, Soyingbe, A A abd Akinwande, M (2012). An Assessment of the Implementation of Quality Culture in Construction. *Proceedings of the Conference of the Royal Institution of Chartered Surveyors (COBRA)*, Las Vegas, USA, September 12-13

Burati, J L, Farrington, J J and Ledbetter, W B (1993) Causes of quality deviations in design and construction, *ASCE Journal of Construction Engineering and Management*, 118, 34-49

Cheng, J, Proverbs, D G and Oduoza, C F (2006). The Satisfaction Levels of UK Construction Clients based on the Performance of Consultants. *Engineering, Construction and Architectural Management*, 13(6), 567-583

Chiang, Y H and Tang, B S (2003) Submarines don't leak, why do buildings? Building quality, technological impediment and organisation of the building industry in Hong Kong, *Habitat International*, 27, 1-17

Crosby, P B (1984). *Quality without Tears: The Art of Hassle-free Management,* 1st Edition, McGraw-Hill, New-York

Harvey, L and Stensaker, B (2008). Quality Culture: Understandings, Boundaries and Linkages. *European Journal of Education,* 43(4), 1-18

Jackson, P A (2004). Local Consumption Cultures in a Globalizing World. *Transactions of the Institute of British Geographers,* 29(2), 165-178

Joubert, W, Cruywagen, J H and Basson, G A J (2005). Will the Implementation of a Quality Management System benefit South African Construction Companies? *South African Journal of Industrial Engineering,* 16(1), 29-40

Idoro, G I (2010) Influence of Quality Performance on Clients' Patronage of Indigenous and Expatriate Construction Contractors in Nigeria, *Journal of Civil Engineering and Management,* 16(1), 65-73

Idoro, G.I, and Akinkunmi, O (2016). Contractors' supervisory staff perception of the quality culture orientation of construction firms in Nigeria. *Proceedings of RICS Cobra Conference 2016.20-22 September 2016, Toronto, Canada.*

Karim, K, Marosszeky, M and Davis, S (2006). Managing subcontractor supply chain for quality in construction, *Engineering Construction and Architectural Management*, 13(1), 27-42

Karna, S (2004). Analysing Customer Satisfaction and Quality in Construction – The Case of Public and Private Customers. Nordic *Journal of Surveying and Real Estate Research,* 2(1), 67-80

King, M G (2001). Effective Quality Management in Construction. B.Sc Treatise, University of Port Elizabeth, Johannesburg, South Africa

Langford, D A, El-Tigani, H and Marosszeky, M (2000). Does Quality Assurance deliver higher Productivity? *Construction Management and Economics,* 18(7), 775-782

Latham, M (1994). *Constructing the Team: Final Report of the Government/Industry Review of the Procurement and Contractual Arrangements in the UK Construction Industry.* HMSO, London

Love, P (2002). Influence of project type and procurement method on rework costs in building construction projects, *Journal of Construction, Engineering and Management,* 128(1), 18-29

Love, P E D and Edwards, D J (2004). Determinants of rework in building construction projects, *Engineering Construction and Architectural Management*, 11(4), 259-274

Love, P E D and Li, H (2000). Quantifying the Causes and Costs of Rework in Construction. *Construction Management and Economics,* 18(2), 479-490

Love, P E D, Mandal, P and Li, H (1999). Determining the Casual Structure of Rework Influences in Construction. *Construction Management and Economics,* 17(4), 505-517

Mahmood, W Y, Mohammed, W, Misnam, M S, Yusof, Z M and Bakri, A (2006). Development of Quality Culture in the Construction Industry. *Proceedings of ICCI Conference,* Beijing, pp 1-11.

Mojtahedzadeh, R and Arumugam, V C (2011). Determinants of TQM in the Iranian Automotive Industry: A Theoretical Approach. *International Journal for Quality Research,* 5(1), 21-32

Oni, A O (2009). An Analysis of Incidences of Collapsed Buildings in Lagos Metropolis. *Construction Research Journal*, 2(1), 62

Rwelamila, P D and Smallwood, J J (1996). Department of Public Works Enabling Environment Initiative Final Report on Initiatives to promote Health and Safety, Productivity and Quality in South African Construction

Smallwood, J J and Rwelamila, P D (1998). The Need for the Implementation of Quality Management Systems in South African Construction. *Proceedings of the CIB World Building Congress and Symposium: Managing for Sustainability – Endurance through Change,* Gavle, Sweden, 7-12 June, pp 2225-2234

Smallwood, J and Rossouw, J (2008). The Implementation of Quality Management Systems in South African Construction. *Proceedings of the Construction and Building Research Conference of the Royal Institute of Chartered Surveyors (COBRA 2008),* Dublin Institute of Technology, Dublin, September 4-5

Sodangi, M, Idrus, A and Khamidi, F M (2010). Measuring Quality Performance in Construction. *Proceedings of International Conference on Sustainable Building and Infrastructure (ICSBI),* June 15-17, Kuala Lumpur

Suresh, S, Gameson, R, Chinyio, E (2008). The role of knowledge management (KM) in reducing the cost of poor quality (COPO) in the construction industry, *Proceedings of the Construction and Building Research conference of the Royal Institution of Chartered Surveyors (COBRA)*, Dublin Institute of Technology, 4th – 5th September

Tharp, B M (2009). Four Organisational Culture Types. *Haworth Organisational Culture White Paper,* 1-6

Thomas, R, Marrosszeky, M, Karim, K, Davis, S and McGeorge, D (2002). The importance of project cultures in achieving quality outcomes in construction, in Formoso, C T and Ballard, G (Eds), *Proceedings of the 10th conference of the International Group for Lean Construction,* Federal University of Rio Grande do Sul, Brazil, pp 101-113

Walker, P and Greenwood, D (2002). *Risk and Value Management*. RIBA Enterprises, London

READINESS OF NIGERIAN CONSTRUCTION FIRMS TO ADOPT LEAN CONSTRUCTION PRINCIPLES

Olajide Olamilokun[1] and Tolulope Samuel Fawale[2]
[1] Nigerian Institute of Quantity Surveyors, Gwarimpa FCT- Abuja, Nigeria
[2]Department of Quantity Surveying, University of Benin, Edo State, Nigeria

Lean construction principles are one of such innovative processes that bring about the much needed continuous improvement and desired change in the construction industry. Research have shown that construction projects are susceptible to problems such as low productivity, poor safety, inferior working conditions, insufficient quality, lack of timely communication and coordination amongst project stakeholders, and rising litigation. The adoption of lean construction (LC) Principles within the manufacturing and other industries had led to notable improvement and resulted in improved time-to-market, reduced production cost, improved quality of the product and active customer involvement. The study appraised the readiness assessment of Nigerian construction firms to adopt LC principles. The method of study involved a critical exposition of related literature, and VERDICT readiness assessment model. A structured questionnaire was issued to a sample size comprising 72 firms drawn from a finite population of 199 Nigerian construction firms operating in Abuja, Nigeria. The result of the study revealed that Nigeria construction firms have management readiness to adopt LC principles, but do not have process/project, people and technology readiness to adopt LC principles. The study concludes that Nigeria construction firms are not yet ready to adopt LC Principles. The study recommends developing a framework for LC principles adoption, continuous awareness campaign of LC principles and its potential benefits via education and training to professional bodies, tertiary institutions offering building construction related programmes and stakeholders in the construction industry in order to build well equipped industry to operate in line with global best practices, deliver projects successfully and more efficiently to satisfy clients' needs.

Keywords: adoption, construction firms, construction industry, lean construction, Nigeria, readiness

[1]jidous4ril@yahoo.com; o.olamilokun@niqs.org.ng
[2] tfawale@gmail.com

Olamilokun, O. and Fawale, T. S. (2017) Readiness of Nigerian construction firms to adopt lean construction principles *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1160-1170

INTRODUCTION

Globally, the construction industry plays a key role in the economy of both developing and developed countries, contributing between 4-14% of the GDP whilst generating vast amount of employment and wealth. However, until today, several countries are still facing numbers of contingent problems that were bounded to be resolved since the past time. The chronic problems of construction *are well* known such as low productivity, poor safety, inferior working conditions, insufficient quality, lack of timely communication and coordination amongst project stakeholders, and rising litigation (Koskela, 2000 & LePatner, 2007). The phenomenon of the poor performance and conditions in construction had long been witnessed and recorded by academics and practitioners throughout the world regardless in developed countries e.g. England (Eaton, 1994) or in developing countries e.g. Chile (Serpell *et al*., 1995). Thus, the UK Government initiated reports such as the Latham Report (1994) and the Egan Report (1998), both of which recommended the improvement of the construction industry's business performance.

The Nigerian construction industry is not also free from such problems. It has severally been characterized as inefficient with low productivity and lack of capacity to deliver and satisfy its clients. Oyewobi *et al.* (2011) attributed the drop in the Nigerian construction industry's contribution to GDP between 1980 and 2007 to poor performance and low productivity. Similarly, Idrus and Sodangi (2007) asserted that the Nigerian construction industry produces nearly 70% of the nation's fixed capital formation, yet its performance within the economy has been, and continues to be, very poor. Among other criticisms facing the industry are time and cost overruns (Kuroshi & Okoli, 2010; Ameh & Osegbo, 2011; Ogwueleka, 2011), inadequate planning and budgetary provisions, contract sums inflation, inefficient and poor service delivery (Kolo & Ibrahim, 2010).

According to Dulaimi and Tanamas (2001), the adoption of lean techniques to construction eliminates non-value steps i.e. waste and better meet client's demands and dramatically improves the Architectural/ Engineering/ Construction (AEC) process and products. Interestingly, unlike Nigeria this has been used with significant benefits in countries like Singapore (Dulaimi & Tanamas, 2001); UK (Common *et al*. 2000); Brazil (Silva & Cardoso, 1999); Chile (Alarcon & Ashley, 1999) and so on. Consequently, it becomes imperative for the Nigerian construction industry, which has been described as a 'sleeping giant' and having no capacity to deliver due to inefficiency and poor service delivery among other problems (Kolo & Ibrahim, 2010), to exploit the widely acclaimed benefits of lean construction in order to practice in line with the global best practices and achieve the continuous improvement needed by its players in the industry.

According to Olamilokun et. al. (2016), the major problem of Nigerian construction industry is that industry (consulting firms) fails readiness to adopt modern techniques to eliminate or minimize waste, and improve value for money and effectively satisfy the needs of the clients. Hence, there is the

need to carry out the level of readiness of the construction firms for the adoption of lean construction principles by the stakeholders' organizations to determine the level of readiness of the entire construction industry. This thus creates the question 'are the construction firms read to adopt LC principles'? Hence this research.

This paper aimed to appraise readiness assessment of construction firms to adopt lean construction principles for achieving continuously deliver value for money and effectively satisfy the needs of the clients.

LITERATURE REVIEW

Lean construction principles

Lean construction has been defined in several ways by different authors. The most popular definition by Koskela*et al*. (2002) states that lean construction is a way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements. In the context of the construction industry, another definition states that lean construction is a holistic facility design and delivery philosophy with an overarching aim of maximizing value to all stakeholders through systematic, synergistic, and continuous improvements in the contractual arrangements, the product design, the construction process design and methods selection, the supply chain, and the workflow reliability of site operations (Abdelhamid, 2004).

According to Koskela (2000) and Thomas et al., (2002), lean construction includes: practice of just-in-time (JIT), use of pull-driven scheduling, reduction of variability in labour productivity, improvement of flow reliability, elimination of waste, simplification of the operation, and the implementation of benchmarking. Lean construction is a concept that incorporates other concepts from the construction management industry. These concepts include Total Quality Management (TQM), Last Planner System (LPS), Business Process Re-engineering (BPR), Concurrent Engineering (CE), Product Circles (PC's), Teamwork and value based management etc. (Harriss and McCaffer, 1997).

Benefits of lean construction principles

Broadly speaking, lean construction has led to significant improvement in the performance of construction industry professionals especially in design, construction and facility management. Michigan State University (MSU) reap double benefits of lean construction as a client and on its own self-performed works, by saving on time and money and improved quality of projects, building relationships with the service providers, and providing value to the end users who otherwise are often not involved in the entire process. The following are some of the benefits of lean construction as reported by Mossman, (2009):

- More satisfied clients.

- Productivity gains.
- Greater predictability.
- Shorter construction periods.
- Operatives able to make better money.
- Sub-contractors able to make better money.
- Improved design.
- Reduced costs, less waste.
- Improved safety and health.
- Improved quality, fewer defects.

Also, a case study taken in USA in 1998 shows remarkable benefits of implementing LC (Garnett *et al*., 1999): Office construction times reduces by 25% within 18 months; Schematic design reduces from 11 weeks to 2 weeks; Turnover increases of 15-20% (Pacific Contracting); Satisfied clients looking to place repeat orders; Reduction of project costs.

Readiness assessment models

Readiness refers to a measure of the capability to adopt a new paradigm prior to its implementation. Prior to adoption of a new paradigm**, s**o many readiness assessment models have been developed in recent times.

Some of these tools include the one developed by Harvard University Center for International Development (CID, 2001) called Networked Readiness Index which gauges a country's ability to make use of its Information and Communication Technology (ICT) resources. It defined readiness as the degree to which a community is prepared to participate in the networked world and its potential to be part of the networked world in the future (Kirkman *et al.,* 2002). Similarly, the Asia Pacific Economic Cooperation's (APEC) e-readiness assessment focused on government policies for e-commerce, while Mosaic global diffusion of the internet project's readiness assessment tool aimed at gauging and analysing the worldwide growth of the internet (Ruika r*et al*., 2006; Vaezi &Bimar, 2009).

On the other hand, as these tools were based on measuring the readiness of countries, governments and policies for adopting internet technologies, there are others that focused on assessing the readiness to adopt different engineering concepts and approaches. For example, SCALES (Supply Chain Assessment and Lean Evaluation System) was developed specifically for the manufacturing industry in order to assess companies' (especially SMEs) readiness for adopting lean manufacturing techniques. Furthermore, there are several other tools that were developed for Concurrent Engineering (CE) such as RACE (Readiness Assessment for Concurrent Engineering) which was developed in the West Virginia University (United States) in the early 90s. It was conceptualised in terms of two major components: Process and technology. It is widely used in the software engineering, automotive and electronic industries (Ruikar *et al.,* 2006). According to Khalfan and Anumba (2000), RACE can be modified to be used in construction and other

industries. Similar to this one is the SPICE (Standard Process Improvement for Concurrent Engineering), which was developed in the University of Salford, United Kingdom in a form of a questionnaire. It was designed to evaluate the key construction processes within construction organisations (SPICE Questionnaire, 1998). In addition, the BEACON (Benchmarking and Readiness Assessment Model for Concurrent Engineering) was created to evaluate the construction company's readiness level in implementing concurrent engineering with the aim of improving the project delivery process. Others include the Capability Maturity Model (CMM) developed for software development and evaluation, and the IQ Net readiness scorecard (Khalfan & Anumba, 2000; Ruikar *et al.,* 2006; Aminali, 2007).

Another readiness assessment tool that is of particular relevance to this research is the VERDICT (Verify End-User e-Readiness using Diagnostic Tool) developed to assess the overall readiness of end users involved in the construction industry for using e-commerce technologies (Aziz & Salleh, 2011). The VERDICT model is a combination of two e-readiness assessment models-the BEACON model and the IQ Net readiness scorecard. BEACON, as mentioned earlier, assesses the readiness of construction companies to improve its practices for implementing concurrent engineering. It consists of four elements- process, people, project and technology. IQ Net readiness scorecard is web based application developed by CISCO based on a book called Net ready. Aminali (2007) assesses the readiness of IT service providers in such a way that the companies are presented with statements which fall into four categories as leadership, governance, technology and organisational competencies, for which upon completion, they will be shown their e-readiness assessment result.

Similar methodology was adopted in developing the VERDICT model. In it, companies' e-readiness results are presented to them after responding to some statements that fall under four categories- management, process, people and technology. Ruikar *et al.* (2006) the developers of VERDICT argued that to successfully implement any technology, there is need to have the people with adequate skills, understanding of, and belief in the technology, then processes that enable and support the successful adoption of the technology, then the technology tools and infrastructure necessary to support the business functions and another key element to consider is the management buy-in and belief. Therefore, the next is the management that believes in the technology and takes strategic measures to drive its adoption, implementation and usage in order to derive business benefits from the technology (Ruikar*et al.,* 2006; Vaezi&Bimar, 2009). All the four elements have to work complementarily for any organisation to achieve readiness.

The developers claim that VERDICT can be used to assess the e-readiness of construction companies, departments within a company, or even working groups within a department. The assessment is performed by finding an average score for each of the four categories from the judgment of the respondents on the statements of the questionnaire. According to Ruikar*et al.* (2006):

- An average score greater than or equal to zero and less than 2.5 shows a red colour which indicates that urgent attention is needed to achieve e-readiness.
- An average score greater than or equal to 2.5 and less than 3.5 is amber colour which means that certain aspects need attention to achieve e-readiness.
- An average score greater than 3.5 shows a green colour which indicates that the organisation is adequately ready and matured enough for e-commerce tools.

The choice of these boundaries was based on simple average scores computed for each of the four elements in the questionnaire.

METHODOLOGY

In a study conducted by Idiake, J. E & Bala, K, (2012), the total number of registered Nigerian indigenous building developers was shown to be 1,556; 26% of which are located in Federal Capital Territory - Abuja part of the country because it's the developed state with a large concentration of Nigerian construction firms. Out of 199 questionnaires administered, 72 representing 36% of the total were returned and found appropriate for analysis. Using Yamane (1986) formula i.e

$$n=\frac{N}{1+N(e)^2} \quad \text{..... (1)}$$

Where n = required sample size;

N = the population size

e = level of precision (0.050), the sample size of the study was computed as 199.

The sample size for this study was calculated to be 199**.** Moser and Kalton (1971) asserted that, result of a survey could be considered significant if the response rate is not lower than 30-40%. In view of this, 36% response was considered adequate for analysis

The survey targeted construction firms with vast experience in construction projects majorly responsible for construction of building and civil engineering projects delivery in Nigeria. They include firms in Category A whose profit and overhead is 15%, Category B with 25% profit and overhead, Category C with 35% profit and overhead and Category D with 45% profit and overhead. The questionnaire was designed/structured based on the VERDICT readiness assessment model of Ruikar et al. (2006). Respondents were asked to choose based on a 5-point Likert rating scale, (in which 5 represented strongly agree, while 1 represented strongly disagree), the extent to which their firms conformed to the requirements of the VERDICT readiness assessment model. This was carried out to gain a practical view point, testing to see if the ideas identified and outlined were a reality in practice.

A reliability analysis using the Cronbach's alpha, was performed to determine the internal consistency and thus, the reliability of the scale used in the survey questionnaire. The study utilized a number of descriptive statistical techniques to facilitate the organization, analysis and interpretation of the data. Mean, standard deviation and relative ranking were also used.

FINDINGS AND DISCUSSION

Among the respondents, 27% was engaged in Architectural consultancy, 29% was engaged in Quantity Surveying consultancy, while 21% and 13% were engaged in structural engineering consultancy and project management consultancy respectively. The remaining 10% of the respondents was engaged in Mechanical & Electrical consultancy. The result expresses a fair representation of the major stakeholders of the Industry. Furthermore, 27% of the respondents belonged to the strategic/senior management level, 60% belonged to the middle management level, while only 8% and 5%belonged to the knowledge/lower management level and operational levels respectively**.** In addition, 34% of the respondents had 16-20 years of experience, 24% had 11-15years of experience, 22% had more than 20 years of experience, while 15% and 5% had 6-10years of experience and less than 5 years of experience respectively.

Readiness assessment of Nigerian construction firms

The table presents average scores indicating the level of readiness of each construction firms in each category i.e. management, process/project, people and technology. As outlined by Ruikar*et al.* (2006) an average score greater than or equal to zero and less than 2.5 is red, and indicates that several aspects (within a category) need urgent attention to achieve readiness; an average score greater than or equal to 2.5 and less than 3.5 is amber, and indicates that certain aspects (within a category) need attention to achieve readiness; and an average score greater than or equal to 3.5 is green, and indicates that the end-user organisation has adequate capability and maturity in these aspects and therefore is ready (in those respects).

For this study however, it is evident from Table 4.1 that; the average scores for the categories; process/project, people as well as technology, were all greater than 2.5, but less than 3.5 (amber), for all the construction firms considered in the study (Category A, Category B, Category C and Category D of construction firms in Nigeria). This clearly shows that all the construction firms in Nigeria all require attention on certain aspects to achieve management, people as well as technology readiness for adopting Lean Construction principles.

Also, as shown in Table below, for all the construction firms considered, management was the only category in which an average score greater than 3.5 (green) was obtained. This also clearly indicates that the construction firms in Nigeria have adequate capability and maturity in these aspects and it's therefore ready to adopt new innovations.

Summarised average scores indicating the level of readiness of each category in the construction firms

Construction firms	Category Name	Average Score	Situation Based on Ruikar's boundaries
Category A (15%)	Management	3.50	Amber
	Process/Project	2.77	Green
	People	3.28	Amber
	Technology	3.18	Amber
Category B (25%)	Management	3.49	Amber
	Process/Project	2.76	Green
	People	3.28	Amber
	Technology	3.23	Amber
Category C (35%)	Management	3.51	Amber
	Process/Project	2.78	Green
	People	3.30	Amber
	Technology	3.26	Amber
Category D (45%)	Management	3.50	Amber
	Process/Project	2.77	Green
	People	3.28	Amber
	Technology	3.25	Amber

Source: Field work (2016)

The Cronbach's alpha computed to measure the internal consistency among ratings of respondents as well as the reliability of the scales used for determining the readiness of Nigerian construction firms to adopting lean construction in the Nigerian construction industry, was very close to one (0.990), indicating that the scales used were reliable and the respondents understood the questions being put forward to them in the questionnaire.

The aforementioned findings corroborate the findings of Olamilokun *et al* (2016) as they suggest Nigerian Construction (consulting firms) industry have low level of awareness LC principles and not yet ready to adopt LC principles.

CONCLUSION

The paper appraised the readiness assessment of Nigerian construction firms to adopt Lean Construction principles. The VERDICT readiness assessment model developed by Ruikar*et al.* (2006) was adopted and used for the assessment. The results of the study show that the Nigerian construction firms have Management readiness to adopt lean construction principles, but needs to give attention to process/project, people and technology to achieve full readiness to adopting lean construction principles. This study therefore clearly provides the Nigerian Construction Industry with useful information on the nature of improvement needed to set the scene for effective implementation of LC principles and thus improve performance and productivity in the industry. The study also provides a basis for further research on factors inhibiting Nigerian construction firms from attaining process/project, people and technology readiness to adopt LC principles. Finally, the study recommends developing a framework for LC principles adoption, more awareness of lean construction principles and its potential benefits via education and training to professional bodies, tertiary institutions offering any building construction related programmes and stakeholders in the construction Industry in order to deliver value for money and effectively satisfy the needs of the clients (i.e. increase performance and productivity).

REFERENCES

Abdelhamid, T. S. (2004). "The Self-Destruction and Renewal of LEAN CONSTRUCTION Theory: A Prediction From Boyd's Theory". Proceedings of the 12th Annual Conference of the International Group for Lean Construction, 03-06 August 2004, Helsingør, Denmark.

Alarcon, L.F. and Ashley, D.B. (1999). Playing games: evaluating the impact of lean construction strategies on project cost and schedule. Proceedings IGLC-7, 26-28 July, University of California, Berkeley, CA, USA.

Ameh, O.J. and Osegbo, E.E. (2011) Study of relationship between time overrun and productivity on construction sites, International Journal of Construction Supply Chain Management 1 (1). Pp 56-67.

Aminali, P. (2007). "E-Readiness Assessment within the Iran's Automative Industry Case of Iran Khodro IndustrialGroup". Master Thesis, Department of Business Administration and Social Sciences, Lulea University of Technology,Lulea.

Aziz, N. M. and Salleh, H (2011). "A readiness model for IT investment in the constructionIndustry" African Journal of Business Management Vol.5 (7), pp. 2524-2530, 4 April 2011.

Common, G., Johansen, E. and Greenwood, D. (2000). A survey of the take-up of lean concepts among UK construction Companies Proceedings IGLC-8.

Dulaimi, M.F and Tanamas, C. (2001). The Principle and applications of lean construction in Singapore. Proceeding IGLC-9.

Eaton, D. (1994). "Lean production productivity improvements for constructionprofessionals". In: L.F. Alarcon, ed. Lean Construction. Rotterdam: A.A. Balkema, 279-289

Egan, J. (1998) Rethinking Construction. Construction Task Force, CIB, London, U.K

Garnett, N. A. (1999). Developing lean thinking in construction a naturalistic enquiry. Proceedings IGLC-7, 26-28 July, University of California, Berkeley, CA, USA.

Harris, F. & McCaffer, R. (1997). Modern construction Management. London: Blackwell Science.

Ibrahim, A.D and Price, A. D. F. (2006) The development of a continous improvement framework for long-term partnering relationships. Journal of Financial Management of Property and Construction 11 (3) 149-163

Idiake, J. E. and Bala, K. (2012). ―Improving Labour Productivity in Masonry Work in Nigeria‖ The Application of Lean Management Techniques In: Laryea, S., Agyepong, S.A., Leiringer, R. and Hughes, W. (Eds) Procs 4th West Africa Built Environment Research (WABER) Conference, 24-26 July 2012, Abuja, Nigeria, 677-686

Idrus, A. B. and Sodangi, M. (2007) Framework for Evaluating Quality Performance of Contractors in Nigeria. Internatinal Journal of Civil & Environmental Engineering IJCEE-IJENS Vol: 10 No: 01 pp34-39

Kado, D. (2013). "Establishing status of Nigerian building design firms based on European construction institute total quality management matrix" In: Smith, S.D and Ahiaga-Dagbui, D.D (Eds) Procs 29thAnnual ARCOM Conference, 2-4 September 2013, Reading, UK, Association of Researchers in Construction Management, 1037-1046.

Khalfan, M. M. A. & Anumba, C. J. (2000). Readiness Assessment for Concurrent Engineering in Construction, Bizarre Fruit 2000 Conference, University of Salford, 9-10 March 2000, pp. 42-54.

Kolo, B.A. and Ibrahim, A.D. (2010) Value management: How adoptable is it in the Nigerian construction industry? In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs West Africa Built Environment Research (WABER) Conference, 27-28 July 2010, Accra, Ghana, 653-63

Kirkman, G. S., Osorio, C. A., & Sachs, J. D. (2002). "The networked readiness index:Measuring the preparedness of nations for the networked world" Cambridge, MA: Center for International Development (CID), Harvard University

Koskela, L. (2000). An exploration towards a production theory and its application to construction, VVT Technical Research Centre of Finland.

Koskela, L. and Howell, G., (2002). "The Underlying Theory of Project Management is Obsolete." Proceedings of the PMI Research Conference, 2002, Pg. 293-302.

Kuroshi, P.A. and Okoli, O.G. (2010). BIM enabled system of expenditure control for construction projects. EPOC conference proceedings 2010.

Latham, M. (1994) Constructing the Team. Final Report on Joint Review of Procurement and Contractual Agreements in the UK Construction Industry, HMSO, London.

LePatner, B. B. (2007). "Broken Buildings, Busted Budgets". The University of Chicago Press.

Moser, C. A. & Kalton, G. (1971): Survey Methods in Social Investigation. Heinemann Educational, London.

Mossman, A. (2009) "There really is another way, if only he could stop … for a moment and think of it"—Why isn't the UK construction industry going lean with gusto? Lean Construction Journal 2009 pp 24 – 36.

Ogwueleka, A. (2011). The critical success factors influencing project performance in Nigeria. International Journal of Management Science and Engineering Management, 6(5): 343-349, 2011.

Olamilokun, O., Ibrahim, A. D. and Ahmadu, H. A. (2016). Readiness Assessment of the Nigerian Construction Firms to Adopt Lean Construction Principles. Proceedings of FUTA LSBU DMU Joint International Conference,21-24 March 2016, Abuja, Nigeria.

Olatunji, O. J. (2008). Lean -in- Nigerian Construction: State, Barriers, Strategies and "Go-to-Gemba" Approach.Proceedings for the 16th Annual Conference of the International Group for Lean Construction. 14-20 July, Manchester, UK.

Oyewobi, L. O., Ibironke, O. T., Ganiyu, B. O. and. Ola-Awo, A. W. (2011). Evaluating rework cost- A study of selected building projects in Niger State, Nigeria. Journal of Geography and Regional Planning Vol. 4(3), pp. 147-151, March 2011.

Ruikar, K., Anumba, C. J. and Carrillo, P. M. (2006). "VERDICT--An e-readiness assessment application for construction companies"Auto. Const., 15(1): 98-110.

Serpell, A., Venturi, A., and Contreras, J. (1995). "Characterization of waste in buildingconstruction projects". In: L.F. Alarcon, ed. Lean Construction. Rotterdam: A.A.Balkema, 67-77.

Silva, F. B. and Cardoso, F. F. (1999). Applicability of logistics management in lean construction: a case study approach in Brazilian Building Companies. Proceedings IGLC-7, 26-28 July, University of California, Berkeley, CA, USA

Thomas, H. R., Michael, J. H., Zavrski, I. (2002). Reducing Variability to improve performance as a lean construction principles. Journal of Construction Engineering and Management ASCE, 128(2): 144-154.

Vaezi, S. K. and Bimar, H.S. (2009). "Comparison of E-readiness assessment models. Scientific Research and Essay" Vol. 4 (5), pp. 501-512, May 2009.

Yamane, T. (1986). "Statistics: An Introductory Analysis" Harper Row Publisher: New York.

READINESS OF NIGERIAN CONTRACTORS TO ADOPT BUILDING INFORMATION MODELING (BIM) TECHNOLOGIES

Abdulfatai Salawu Oyebode[1] and Idowu Faruq Ayobami[2]

[1]*Department of Estate Management, College of Built Environment, Hussaini Adamu Federal Polytechnic, Kazaure. Jigawa State, Nigeria*

[2]*Department of Quantity Surveying, Ahmadu Bello University, Zaria, Kaduna State, Nigeria*

One of the major challenges facing the construction industry is the issue of fragmentation as well as numerous stages related to a construction process. Building Information Modeling (BIM) has become the new international benchmark for efficiency in design, construction and maintenance of buildings and also serves as a platform that brings about new channel of communication between project stakeholders and improvement of project outcomes. However, miniature impact of BIM technologies has been felt in the Nigerian construction industry. The aim of this study is to assess the readiness of contractors to adopt BIM technologies in Nigerian construction industry. A quantitative approach was adopted for the research. A well-structured Questionnaire was self- administered to a sample of contracting firms within FCT Abuja, Kaduna and Kano. The questionnaire sought the perception of the respondents on the factors affecting BIM adoption, and their level of readiness to adopt BIM technologies in their practices based on the four categories of readiness (management, people, process and technology). 53.4% response rate was achieved and used for analysis. Descriptive Statistics and Percentage distribution was used to establish the rate of responses for the background information of the respondents while Means and Standard deviations were used to establish the significant of the factors affecting BIM adoption in Nigeria. The readiness assessments result shows that contractors' have management, technology fully and process partially readiness to adopt BIM, but more attention needs to be given to people so as to achieve readiness to adopt BIM. It was realized that most people in the organizations have adopted a wait-and-see attitude, reflecting the industry's reluctance to change existing practices and hesitation to learn new concepts and technologies. In addition, closed organization cultures, high switching costs, and limited training and technology support contributed to the unreadiness to adopt BIM. More time and incentives are required to facilitate BIM adoption in Nigeria.

[1] fatsalbode@yahoo.com

[2] idowufaruq@gmail.com

Abdulfatai, S. O. and Idowu, F. A. K. (2017) Readiness of Nigerian contractors to adopt Building Information Modeling (BIM) technologies *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1171-1188

Keywords: adoption, Building Information Modeling, contractor, challenges, readiness,

INTRODUCTION

The delivery of building and infrastructure projects are generally complex from technical, organizational and management perspectives, as projects are executed in a non-collaborative way using the traditional design-bid-build procurement method with design separated from the construction phase (Tarmizi, 2013). When collaborative procurement such as alliancing or integrated design and construct procurement are used, there is often a lack of full team integration. As a result, project information is often difficult to generate, transmit, reuse, coordinate and so manage thereby leading to low productivity, delays and cost blowout. Furthermore, the accuracy of project information generated and communicated is less reliable and where reliable they are difficult to access. These often lead to project failure, conflict and dispute among parties and dissatisfaction of project owners and sponsors. (Eastman 2011). However, several studies have call for continuous improvement in efficiency and productivity of the construction industry from different perspectives ranging from new contractual/procurement arrangements like partnering (Ibrahim and Price, 2006); concurrent engineering (Malik et al, 2000); integrated project delivery; (Kim and Dossic, 2011) to technological innovations in design and construction processes such as 3D CAD and modelling (Isikdag and Underwood, 2010; Olatunji, et al, 2010; Abubakar et al., 2014).

According to Becerik-Gerber and Rice, (2010) BIM is seen as an enabler that may help the building industry to improve its productivity by ensuring effective communication and collaboration between all project stakeholders from inception to completion of building projects. Previous studies in countries like USA, UK, Australia, Netherlands, Singapore, Hong Kong Finland, Norway, Denmark, Hong Kong (Yan and Damian, 2010; Isikdag and Underwood, 2010; Nederveen et al, 2010; Wong et al, 2010; Sebastian and Berlo, 2011; lee, 2013) and others have adopted BIM technologies at different levels and have experienced substantial improvement in construction project delivery. However, despite the potentials and documented benefits of BIM technologies, not much has been reported regarding its implementation in the Nigerian construction industry. The contractors are usually one of the most important stakeholders in BIM adoption, therefore, there is need to investigate their readiness to know whether Nigerian construction industry can have a meaningful match towards BIM adoption in its operations. In doing this, the study identified and assessed the enablers and barriers to BIM adoption in the Nigerian construction industry, to establish their level of significance.

Building Information Modelling: Definition

Building information modeling (BIM) an intelligent model-based process that provides insight for creating and managing building and infrastructure projects faster, more economically, and with less environmental impact promises to eliminate the problem associated with the traditional approach to project coordination and management (Autodesk 2011). BIM is "a new approach to design, construction, and facilities management, in which a digital representation of the building process [is used] to facilitate the exchange and interoperability of information in digital format" (Eastman et al., 2008). In the construction industry, there is a growing interest in the use of BIM for coordinated, consistent, and computable building information/knowledge management from design to construction to maintenance and the operation stages of a building's life cycle. Although many researchers and practitioners are in agreement about BIM's potential applicability and benefits in construction, it is still unclear how BIM could be used, and what the benefits are to implementing BIM. Thus, BIM adoption and use remains a central concern of BIM research and practice.

The concept of Building Information Modelling

According to Smith & Tardif (2009) the concept of Building Information Modeling is to build a building virtually, prior to building it physically, in order to work out problems and simulate and analyse potential impacts. The heart of Building Information Modeling lies in an authoritative building information model.

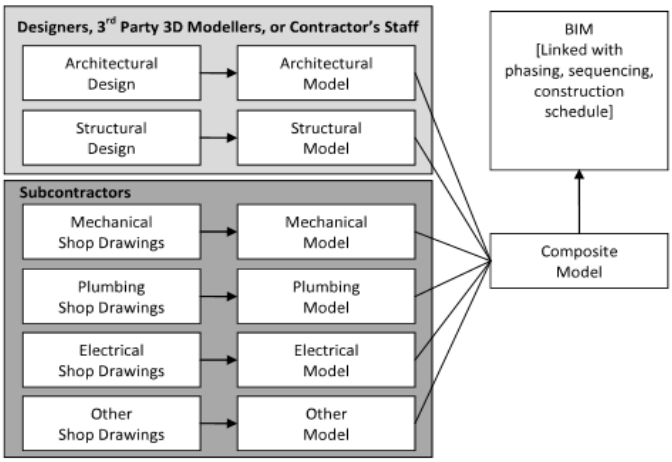


Figure1. Multiple Models in Implementing Building Information Modeling for a Single Project (AGC, 2006).

To extend the application of Building Information Modeling to integrated practice in construction, according to Eastman et al. (2008), the building information model should be used as a building model repository. A building model repository is a database system whose schema is based on an object based format. It is different from existing Project Document Management

(PDM) systems and web-based project management systems in that the PDM systems are file based and carry CAD and analysis package project files. Building model repositories are object based, allowing query, transfer, updating and management of individual project objects from a potentially heterogeneous set of applications. In this context, the integration occurs at the level of data and could also integrate with other dimensions such as the time dimension (schedule) and cost dimension, which are known as 4D and 5D modeling respectively (Zhou et al., 2009; Koo & Fischer, 2000, Dawood & Sikka, 2007; Fischer & Kam, 2001).

The application of BIM would allow construction phases to be analyzed early in the design phase which as a result could support early involvement of the contractors in design development.

The application of BIM within the design phase is summarized in Table 1.0 (Kymmell, 2008; Eastman et al., 2008; Smith & Tardif, 2009; Elvin, 2007).

Table 1

Point view	BIM use
Conceptual Design	Massing and sketching, Space planning, Environmental Analysis, and Site development
Design and Analysis	Structural Analysis, Energy Analysis Mechanical Equipment, Simulation Lighting Analysis, Acoustic Analysis, Air Flow/CFD Building Function Analysis/Clash Detection, Cost Estimation, Improving Building Performance, Experimental Design Option
Construction level Documentation	Building System Layout Drawing and document production Specification Bill of quantity
Design and Construction Integration	Collaboration between design and construction, Early identification of long lead-time item and shortening procurement schedule, Value engineering Constructability analysis, Construction Sequencing/4D analysis 5D analysis

Aim and objectives of the research

Aim

The aim of this study is to assess the readiness of contractors to adopt BIM technologies in Nigerian construction industry.

Objectives

1. To explore relevant literature on the concept of BIM.
2. To identify Barriers/Drivers to BIM adoption in Nigerian Construction Industry.
3. To assess Barriers/ Drivers to BIM adoption.
4. To evaluate the level of readiness of Nigerian contractors for BIM adoption

BARRIER AND DRIVERS OF BIM ADOPTION

Many of the recent BIM-related studies emphasize the development of an application technology based on BIM, and the need to utilize BIM through case studies (Park et al. 2011; An et al. 2009; Froese and Yu 1999; Tulke et al. 2008). However, there are few studies that suggest BIM utilization methods or that deduce the impeding factors for BIM utilization (Choi 2010; Lee et al. 2007, 2009; SmartMarket Report 2012). Moreover, although influential factors are systematically listed, many of them focus on the technological aspects of BIM improvement methods. Many factors contribute to slow adoption and implementation of ICT in the construction industry. The prominent factors of resistance to implement ICT in the construction industry are the people and the culture in the construction industry. Some organizations are reluctant to change their business process because they are afraid that by changing their business process at a cost, it will jeopardize their established process because they cannot accept the uncertainty. Also, some people in the organisation feel that the technology will take over their roles, resulting in great anxiety towards changes especially when it involves new technology (Gardner et al., 1993; Li et al., 2000; Davis & Songer, 2008). This shows that the level of readiness for change is still low and this contributes to the lag in adopting and implementing ICT in the construction industry.

Beside the factors of people and culture, the absence of proper planning on implementing the new technology is another factor that the majority of construction industry players are still unable to gain the benefits from. Li et al. (2000) and Mui at al. (2002) believed many companies invest in technology advancement because they simply followed other companies that successfully implemented ICT without doing feasibility studies and the majority of companies adopt and implement ICT in ad-hoc manner, without planning and evaluation. They are unaware of the problems that might arise, the right strategies to use, and why they need that technology, while Yusuf & Othman (2008) added that a lack of training and limited numbers of expert users in the area of ICT in construction industry worsens the current situation. Meanwhile, Wade & Hulland (2004) viewed that some organizations failed to adopt and adapt to the rapid changing of ICT technologies, practices, process, and expertise in their organizational processes. Alshawi & Ingiringe (2003) and Peppard et al. (2007) believed that benefits from utilization of ICT do not come automatically because some of the benefits required more time to mature and the process of evolving from their current practice into an "unknown environment", therefore, there is a time gap between the early investment and income. The application of BIM in the construction industry has been slow due to the following obstacles (Choi 2010; Lee et al. 2007, 2009; SmartMarket Report 2012): Unclear and invalidated benefits of BIM in ongoing practices; Lack of familiarity with adopting this new technology; Lack of supporting education and training for use of BIM; Lack of supporting resources (software, hardware) to use. BIM tools; Lack of effective collaboration between project stakeholders for modeling and model utilization; Unclear

roles and responsibilities for loading data into a model or databases and maintaining the model; and Lack of sufficient legal framework for integrating owners' view in design and construction. Several barriers have been identified to be the barricade and stumbling-blocks impeding successful implementation of BIM in the industry, Abubakar et al. (2014), Isa (2015); and Usman (2015) categorised and identified the barriers to the adoption of BIM to includes; Process barriers: Lack of Awareness of the technology, Lack of knowledgeable and experienced partners, Lack of Trained Professionals to handle the tools, High Cost of Training, Clients are not requesting the use of BIM on projects, Lack of Enabling Environment (government policies and legislations) to guide implementation, No proof of financial benefits, Legal and Contractual Constraints, Social and Habitual Resistance to change, and also Technology barriers: Frequent Power Failure, High Cost of Integrated software/Models for all professionals, Lack of Standards to Guide Implementation, Poor Internet Connectivity, and Lack of awareness and understanding of the technology among others.

BIM adoption in the Nigerian construction industry

Little studies are available on the level and status of BIM implementation in Nigeria. Studies by Abdullahi, Ibrahim, and Mohammed (2011); Abubakar et al. (2013); Abubakar, Ibrahim, Bala, and Kado (2014); Usman (2015); and Isa (2015) are among the few investigations carried out on issues related to BIM implementation in Nigeria. Abubakar et al (2013) examined the readiness of Nigerian Building Design firms to adopt BIM using four readiness components (management, people, process and technology) and the study reported various readiness levels across the different categories of firms, with some firms fully ready in some components, while critical attention is needed in others for full readiness to be attained. Similarly, the Nigerian Public Sector (specifically, Federal Ministries and Departments and Parastatals) have demonstrated some level of preparedness for BIM adoption in some readiness components, the Nigerian public sector is also not fully ready for BIM implementation. Usman (2015) assessed the readiness of the Nigeria public sector (Federal Ministries and Departments and Parastatals) to implement BIM in its project delivery process.

Table 2: Readiness of Nigerian Public Sector to Adopt BIM Project Delivery Process

Sectors	Readiness Parameter	Readiness Status
Overall	Management	Ready
	Process	Ready
	People	Not ready
	Technology	Ready
Ministries	Management	Ready
	Process	Ready
	People	Not ready
	Technology	Ready
Agencies	Management	Ready
	Process	Not ready
	People	Ready
	Technology	Not ready

Source; (Usman 2015)

Results of the study show that the federal ministries of Nigeria have achieved management, process as and technology readiness but need to put in more efforts to improve people's readiness.

In addition, the agencies considered in the study have management and people's readiness but do not have process and technology readiness. Table2; below shows the readiness status of Nigeria Public Sector.

READINESS ASSESSMENT MODELS

Table 3: Summary of readiness assessment model

Models/ Criteria	CMMI (SEI, 2009)	SPICE (Alshawi, 2007)	GPIS (Alshawi, 2007)	IS Competency Framework (Peppard and Ward, 2004)	BIMMi (Bilal, 2008)	Verdict (Ruikar, 2006)	BEACON (Khalfan et al., 2001)
1. Description and the usage	**Capability** Maturity Model Integrated consists of best practice which can be used to improve process within a project, a division, or an organisation . **The** assessment is looking for the maturity and capability of the process and it has 5 maturity and 6 capability level **3** models available which concentrates on Product and service developmen t, Service establishme nt, management , and delivery and Product and service acquisition	**Standardised** Process Improvement for Construction Enterprises is a systematic step by step process improvement framework for the construction industry **Consist** of 5 level of maturity based on the presence of key process in each level **The** assessment is carried out by determining the implementati on of key process by the organisation	**General** Practitioner Information System is general IT/IS model that focused on recipient organisation **Used** to assess the readiness of organisation to uptake Information Technology/Inf ormation System **Consist** of 6 level of maturity (level 1-6). **The** assessment must be carried out prior to system implementation to identify the readiness gap	**IS Competenc y** framework identified six domains of IS competencie s. **The Framework** is based on resource-based view is premised on the crucial importance to view IS competencie s from an organisation al perspective. **The framework** links strategy of both business and IS with IT supply and business exploitation **The focus** is given on the ability of each six domains which is translated into several competency set for each domain	**Building** Information Maturity Index is BIM readiness assessment specifically design to measure the maturity, capability, and organisation al scale of BIM. **Consist** of 5 level of maturity (Initial, Defined, Managed, Integrated, optimised). **Can** be used for 12 organisation al scale (ex: evaluating international standards) to organizational Members (BIM competencie s of an individual)	**Verify** End-User e-Readiness is an e-readiness model that assess the readiness of organisati on to adopt e-commerce tools, such as web based collaborati on tools. **Can** be used to assess the e-readiness of constructi on companies , departmen t (s) within a company or even individual work groups within a departmen t. **Consist** of 3 level of readiness Red= Critical, Amber=le ss critical, Green=e-ready	**Benchmarking** Readiness Assessment for Concurrent Engineering is a concurrent engineering readiness assessment model. **It** is conducted before the introduction of CE within an organisation. **Adapted** from Readiness Assessment for Concurrent Engineering Model (RACE), which is used in manufacturing, **Consist** of 5 level maturity which are Ad-hoc, repeatable, characterized, managed and optimizing

Table 3 cont'd: Summary of readiness assessment model

2. Key Element and category	**Initial Managed** Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management **Defined** Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Mgmt. Risk Management Decision Analysis and Resolution **Quantitatively Managed** Organizational Process Performance	**Initial Planned and Tracked** Brief and scope of work management Project Planning Project tracking and Monitoring Subcontract management Project change management Health and safety management Risk management Project team coordination **Well defined** Organisation process definition Organisation process focus Integrated design and construction management Construction life cycle engineering Training programme Peer reviews **Quantitatively controlled** Quality Management Quantitatively process management **Continuously Improving** Process change management (CM) Technology CM Defect prevention	**People** Head of IT Staff Skill **Process** Generic Practice **IT Infrastructure** Systems **Environment** Culture Leadership Structure	**Strategy** Business Strategy Technology Innovation Investment Criteria Information governance **Define the IS contribution** Prioritization IS strategy alignment Business process design Business performance improvement Systems and process innovation **Define the IT Capability** Infrastructure development Technology analysis Sourcing strategies **Exploitation** Benefits planning Benefits delivery Managing change **Deliver solutions** Applications development Service management Information	**MATURITY Technology** Software Hardware Network **Process** Leadership Infrastructure Human Resource Product and Services **Policy** Contractual Regulatory Preparatory **CAPACITY Stage 1** Object Based Modelling **Stage 2** Modelling Based Collaboration **Stage 3** Network Based Integration **ORG. SCALE Micro** Organisation **Meso** Project Teams **Macro** Markets	**People** Head of process (Change Management) Role and responsibilities Work Environment Culture People Capability **Process** Business Process Client The use of e-commerce tool in process **Technology** System Infrastructure IT policy **Management (top level)** Strategy Support and Commitment Awareness Performance measure	**Process** Management systems Process focus organisational Arrangement Strategy Deployment Agility **People** Teams in an organisation Discipline Team leadership and management Team Formation and Development **Project** Facility Design Quality Assurance Client Focus **Technology** Task Support Integration Support Information Sharing Co-ordination Support Communication Support

Table 3 cont'd: Summary of readiness assessment model

	Quantitative Project Management **Optimizing** Organizational Innovation and Deployment Causal Analysis and Resolution			n asset management Implementation management Apply technology Business continuity and security **Supply** Supplier relationships, Technology standards, Technology acquisition, Asset&cost management, IS/IT staff development			
3. Assessment method	Interview and questionnaire	Interview	Interview	Interview	Is to be defined	Software prototype using Questionnaire form	Questionnaire
4. Status	Commercial	Research Prototype	Research prototype	Research Prototype	On-going research prototype	Research prototype	Research prototype
5. Can be used for BIM?	Yes but certain modification is required before applying it to assess BIM readiness in organisation	Yes but the focus is limited on the process improvement only	Yes since it focus on general application of IT/IS in any type of organisation	Yes since it focus on general application of IT/IS in any type of organisation but requires some adjustment.	Yes since it is purposely developed for BIM application in construction	Yes but certain modification is required before applying it to assess BIM readiness in organisation	Yes but major modification is required before applying it to assess BIM since the main focus is on CE

Source; Ahmad. T. (2013)

Many readiness assessment models have been developed in recent times. According to Ruikar et al. (2006), each tool gauges how ready a society or economy is to benefit from Information Technology (IT) and e-commerce. Vaezi and Bimar (2009) observed that the range of tools use widely varying definitions for e-readiness and different methods of measurement. Aziz and Salleh (2001) also asserted that there is no specific definition for the concept of readiness. Some tools assess the readiness of countries and economies to implement internet technologies on a global platform, while others are more focused on measuring the readiness of specific sectors to adopt the technologies. See Table3.

Table 3 further expounds on each of the available assessment models to assess organisations readiness along with their criteria; the number 1(one)

item under the Model/Criteria is "Description and the Usage", this gives more information of the first model which is "CMMI (SEI, 2009)" and further explain the capability of that model and its levels of maturity. The number 3(three) item under these criteria also explain the "Assessment method", being it a questionnaire or an interview. The number 4(four) item under these criteria explain the "Status", it confirms if the status is a commercial, or Research prototype and finally whether such model could be used for BIM assessment or not.

RESEARCH METHOD

Research methodology includes research methods as well as the logic behind the methods used in the context of the research study. The chosen research approach was quantitative in nature, including a comprehensive review of relevant literature was undertaken to assess the concept, barriers and drivers to Building Information Modeling (BIM) in the construction industry with particular emphasis on the Nigerian.

A Non-random sampling also known as purposive, selective or subjective sampling is a technique where the units that are investigated are based on the judgment of the researcher. The main goal of purposive sampling is to focus on particular characteristics of a population that are of interest, which will best enable you to answer your research questions

For this research, Non-random sampling technique known as purposive sampling was adopted in selecting the contracting organisations, taking into considerations the likelihood that not all contracting organisations will be experienced enough to provide reliable answers to the questions raised in the questionnaire. The sample size was deduced to 103 by using Yamane (1986)'s formula for calculating sample size i.e.

n= $N1+(e)2$

Where;

n = required sample size

N = the population size

e = level of precision (0.050)

The questionnaire was of two sections (Sections A, and B). Section A was used to obtain information regarding organisations profiles which has influence on the readiness of such organisations to adopt BIM technologies. The factors identified in the study were abstracted from literature review (drivers/facilitators of the adoption and the barriers to the adoption which was also divided into two subcategories by Eastman et al (2011) as process barriers and technology barriers.) Section B was aimed at assessing the level of readiness of the Nigerian Contracting organisations for adopting BIM technologies, based on the four key elements of readiness (management, process, people and technology) identified by Ruikar et al (2006), and was assessed by the respondents on a five-point Likert scale,

where 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree and 5 = strongly agree.

The research follows a deductive approach to draw conclusions by collecting absolute numerical quantitative data values that were statistically analysed.

The responses obtained under this section were used to draw inferences; using the Descriptive Statistics on SPSS 16.0 (which includes mean scores for the contracting organisations) based on the intervals of measurement of the VERDICT model. This study was finally analysed with Verdict (Ruikar, 2006) based on its obvious clarification as summarized by Table 3. This table under the Description and the usage of Verdict (pg. 11) explained that Verdict Consist of 3 level of readiness Red = Critical, Amber = less critical, Green = Ready. Furthermore, the assessment is performed by finding an average score for each of the three categories from the judgment of the respondents on the statements of the questionnaire. According to Ruikar et al, (2006)

Table 4: Theoretical framework to explore BIM readiness criteria

ELEMENTS	CATEGORY	READINESS CRITERIA (to explore...)
PROCESS	PROCESS CHANGE STRATEGY	The degree to which an organisation has developed a documented methodology for changing its business process
	BIM IMPLEMENTATION MANAGEMENT	The presence of good management practice to incorporate BIM within the business process
	POLICY	The suitability of current contract and project delivery method for BIM use
MANAGEMENT	BUSINESS STRATEGY	The formulation of business strategy which identifies the most advantageous uses of BIM
	MANAGEMENT COMPETENCY	The management competency and support on the use and implementation of BIM
	LEADERSHIP	The management leadership to drive BIM implementation
PEOPLE	ROLES AND RESPONSIBILITY	The creation and justification of BIM associated roles and responsibility by the organisation
	SKILL AND ATTITUDE	The skill and attitude set that is required by the staff to implement BIM
	TRAINING AND EDUCATION	The educational/training program and deliverables to support the BIM implementation
	WORK ENVIRONMENT	The characteristics of good work environment to support BIM implementation
TECHNOLOGY	HARDWARE	The ICT hardware tools and infrastructure to implement BIM
	TECHNICAL SUPPORT	The software and hardware technical support to assist BIM implementation
	SOFTWARE	The type of software use and the justification of selecting the software

Source; Ahmad. T. (2013)

- An average score greater than or equal to zero and less than 2.5 shows a red colour which indicates that urgent attention is needed for to achieve readiness.
- An average score greater than or equal to 2.5 and less than 3.5 is amber colour which means that certain aspects need attention to achieve readiness
- An average score greater than 3.5 shows a green colour which indicates that the organisation is adequately ready and matured enough for commerce tools.

The choice of these boundaries was based on simple average scores computed for each of the four elements in the questionnaire using SPSS 16.0.

DATA ANALYSIS TECHNIQUES

The administration of the questionnaire began in February 2017 and completed in March 2017. A period of four weeks was allowed for the administration of the Questionnaire; however, all the completed questionnaires were retrieved by the fifth week. A total of 103 questionnaires were administered to the contracting organisations, which targeted at contractors. A total of 55 were returned form the respondents representing 53.40%. However, going by Moser and Kalton (1971)'s assertion that the result of a survey could be considered significant if the response rate is not lower than 30-40%, the number of questionnaires completed and returned were therefore considered adequate for analysis.

Table 5; Detail of Questionnaires Administered and Returned

	NO SENT	NO RETURNED	RESPONSE RATE (%)
CONTRACTORS	103	55	53.40

Source: Questionnaire Survey, February-March 2017.

Table 6 below; presents the extent of agreement of respondents with the barriers which could militate against the adoption of BIM. The barriers to the adoption of BIM are considered under two headings as classified by Eastman et al; (2011) i.e. process and technology barriers. The barriers were ranked based on mean score under each heading with SPSS 16.0, it can be concluded that Nigerian contractors consider all the barriers as factors which hinders the adoption of BIM.

Section A of the questionnaire considered the profiles of the organisations in terms of their disciplines, professional qualification, position in organizations, years of experience, and numbers of employee, and annual turnover. These were considered relevant for the research because they can be related to the organisations' ability to adopt any innovative practice like the use of Building Information Modeling tools in building design and construction.

Table 6; Barriers to the Adoption of BIM

Barriers	Mean	Std. Deviation	Rank
PROCESS BARRIERS			
Lack of Awareness of the technology	4.23	0.87	1
Lack of knowledgeable and experienced partners	4.15	0.90	2
Lack of Trained Professionals to handle the tools	4.03	0.67	3
Clients are not requesting the use of BIM on projects	3.82	1.05	4
Lack of Enabling Environment (Government policies and legislations) to guide implementation	3.79	0.86	5
No proof of financial benefits	3.64	1.09	6
Legal and Contractual Constraints	3.62	1.09	7
Social and Habitual Resistance to Change	3.59	1.09	8
High Cost of Training	3.56	1.05	9
TECHNOLOGY BARRIERS			
Frequent Power Failure	4.18	1.12	1
High Cost of Integrated software/Models for all professionals	4.08	1.22	2
Lack of Standards to Guide Implementation	3.97	1.04	3
Poor Internet Connectivity	3.79	0.89	4

Table 6 shows the barriers to the adoption of BIM are considered under two headings as classified by Eastman et al; (2011) i.e. process and technology barriers. The barriers were ranked using their respective mean score under each heading, it can be concluded that Nigerian public clients consider all the barriers as factors which hinders the adoption of BIM. As shown in Table 6, lack of awareness of BIM technologies and lack of knowledgeable and experienced partners were indicated by the respondents as the most important process barriers to the adoption of BIM technologies with mean scores of 4.23 and 4.15 respectively. These were followed by lack of trained professionals to handle the tools with a mean score of 4.03, while the least important barriers as reported by the respondents is social and habitual resistance to change and high cost of training with a mean score of 3.59 and 3.56 respectively. Considering the technology barriers for adopting BIM, frequent power failure and high cost of integrated software/models for all professionals were identified the most significant with a mean score of 4.18 and 4.08, followed by lack of standards to guide implementation and poor internet connectivity with a mean score of 3.97 and 3.79 respectively. However, this is also in line with the survey conducted by Abubakar et al., (2014) and Usman (2016).

Table 7 shows the information relating to respondents in this study. As shown in the Table, out of the 55 responses received, 28% were Architects, 21% were Engineers, 36 were Quantity Surveyors, 9% were Developers and 6% were others who participated in the study.

Table 7 Disciplines of Respondents

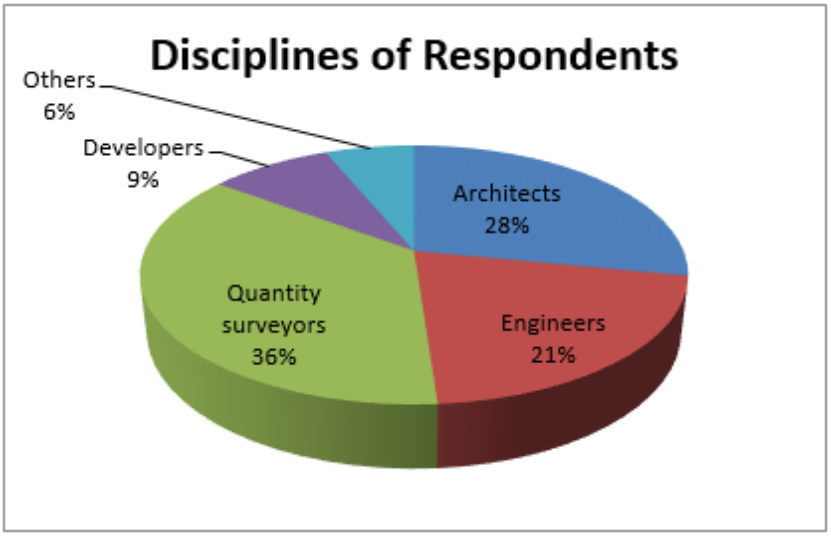


Table 8 shows the mean (average) scores indicating the level of readiness of the units of organization in each category i.e. management, process, people and technology. As outlined (above) by Ruikar et al. (2006) an average score greater than or equal to zero and less than 2.5 is red, and this indicates that several aspects (within a category) need urgent attention to achieve readiness; an average score greater than or equal to zero and less than 2.5 shows a red colour which indicates that urgent attention is needed for to achieve readiness, and less than 3.5 is amber, and indicates that certain aspects (within a category) need attention to achieve readiness; and an average score greater than or equal to 3.5 is green, and indicates that the end-user organization has adequate capability and maturity in these aspects and therefore is ready.

The table 8, below illustrations that the Management has an average score of 3.56 (greater than 3.5) which indicates that the end-user organization has adequate capability and maturity in these aspects and therefore is ready, the Process and People has an average score of 3.44 and 3.39 respectively (less than 3.5) which indicates that certain aspects (within a category) need attention to achieve readiness, and Technology has an average score of 3.73 which (is greater than 3.5 as indicated that its green) further indicates that the end-user organization has adequate capability and maturity in these aspects and therefore is ready. This shows that the Managements and Technology are ready to adopt BIM technology while the People and Process still need attention to also get ready as to have full (all components) readiness. The result findings by Usman (2016) shows that Nigerian clients' (ministries) have management, process and technology readiness to adopt BIM, but needs to give more attention to people so as to achieve readiness to adopt BIM. Furthermore, the agencies have management and people's readiness but needs to give more attention to process and technology to achieve readiness to adopt BIM, so therefore, Nigerian public clients shows a fair level of readiness to BIM which indicates that certain aspects (within a category) need attention to achieve readiness, as shown in Table 2. While study by Abubakar et al., (2014) discovered that in the readiness of the firms

to adopt BIM technologies in their practices, the results revealed that all the groups seem to be ready for the adoption, with slight variations in their levels of readiness. In management readiness, 'others' group has the highest mean score of 3.80, followed by Architectural, Mechanical, Electrical, and Structural Engineering firms with respective mean scores of 3.46, 3.37, and 3.27, and Similar results were obtained in the other three categories i.e. process, people and technology readiness.

Table8: Table Summarizing Average Score in Each Category

Unit of Organization	Category Name	Average Score	Situation Based on Ruikar's boundaries
Contractors	Management	3.56	Green
	Process	3.44	Amber
	People	3.39	Amber
	Technology	3.73	Green

CONCLUSION

This study reveals that the level of awareness and knowledge of BIM is increasing within the contractors' organization. It can be concluded from the survey that Nigerian contractors consider and agree with the existence of all the barriers and drivers as factors influencing the adoption of BIM. However, so far, the facilitators of BIM adoption in Nigeria will be enhanced and the barriers significantly reduced, then the Nigerian contractors are ready to harness the potentials of Building Information Modeling in their services. Based on the barriers, as mentioned in the study that the readiness assessment is based on four components; Management, Process, People, and Technology. Barrier based on PROCESS towards implementation of BIM in contracting organisation, includes lack of awareness of the technology, lack of knowledge and experienced partners and lack of trained professionals to handle the tools are ranked respectively with the help of mean score on SPSS. TECHNOLOGY Barrier includes, Frequent power failure, this is one of harassment attitude in the Nation, "having a similitude of a lantern that light its neighbourhoods while it's bottom remain in darkness" and this is because corruption has become our swimming – costume. Furthermore, high cost of integrated software/models for all professional. The readiness assessments result shows that contractors' have management, technology fully and process partially readiness to adopt BIM, but more attention needs to be given to people so as to achieve readiness to adopt BIM. The Nigerian contractors' shows a fair level of readiness to BIM which indicates that certain aspects (within a category) need attention to achieve readiness. Lastly, regarding the contracting organization's readiness, most organizations have adopted a wait-and-see attitude, reflecting the industry's reluctance to change existing practices and hesitation to learn new concepts and technologies. In addition, closed organization cultures,

high switching costs, and limited training and technology support contributed to the unreadiness to adopt BIM.

Recommendation

The usefulness of the models developed in this study is limited to the accuracy of the data provided by respondents in the self-administered questionnaire survey, and because of limited time and resources this study had certain limitations.

Based on the findings of this study, the following recommendations were made with a view to ensuring a successful adoption of BIM technologies in the Nigerian construction industry.

In facilitating the adoption of BIM, attention should be given to Government policy via legislation on contractors' interest in the use of BIM in their project, more time and incentives are required to facilitate BIM adoption in Nigeria and commitment and cooperation of professional bodies.

Further research should be conducted to establish the readiness levels of all other sectors of the Nigerian construction industry for the adoption of BIM. This is because the adoption cannot just be achieved by one segment of the industry, because it is a collaboration issue which needs all the segments of the industry such as contractors, suppliers and manufacturers to have a fair level of readiness if the industry is to benefit from the adoption of the BIM.

REFERENCE

Abdullahi, M., Ibrahim, Y. M., & Ibrahim, A. D. 2014, Assessing Contractors' Cash Flow Forecasting Process Capabilities Paper presented at the 3rd NMMU Construction Management Conference, Port Elizabeth, South Africa.

Abdullahi, M., Ibrahim, Y. M., & Mohammed, S. M. 2011, Assessing the Application of Building Information Modeling in Nigerian Construction Industry. Paper presented at the International Conference and Home-coming of the Department of Building, Ahmadu Bello University, Zaria, Nigeria.

Abubakar, M., Ibrahim, Y. M., & Bala, K. 2013, Readiness of Nigerian Building Design Firms to Adopt BIM Technologies. Paper presented at the 5th International Conference on Constrictions Engineering and Project Management (ICCEPM), Anaheim, California, US.

Abubakar, M., Ibrahim, Y. M., Bala, K., & Kado, D. 2014, Contractors Perception of the Barriers and Drivers of Building Information Modeling (BIM) Adoption in the Nigerian Construction Industry. Paper presented at the International Conference on Computing in Civil and Building Engineering (ICCCBE), ASCE, Florida, US.

Abubakar, M, Makarfi, Y & Bala, K. 2014, Readiness of Nigerian building design firms to adopt Building Information Modelling (BIM) technologies. A published M.Sc. thesis, Department of Building, Ahmadu Bello University, Zaria.

AGC 2006, The contractors' guide to BIM (1st Ed.). USA: Associated General Contractors of America.

Ahmad. T. 2013, Organizational readiness to implement building information modeling: A framework for design consultants in Malaysia. (M.Sc.), University of Salford Manchester, Salford, M5 4WT, U. K

Autodesk Inc., 2013, Autodesk quantity takeoff. Available at: http://usa.autodesk.com/adsk/servlet/pc /index ?id=10354648&siteID=123112 (20 April 2016).

Autodesk Inc., 2015, Autodesk quantity takeoff. Available at: http://usa.autodesk.com/adsk/servlet/pc/index?id=10354648&siteID=123112 (20 December 2016).

BuildingSMART 2010, Constructing the Business Case: Building Information Modelling, British Standards Institute UK.

Building SMART International Ltd., 2012, Building SMART - International home of open BIM. Available At: www.buildingSMART-Tech.org (18 April 2016).

Eastman, C., Teicholz, P., Sacks, R., & Liston, K. 2008, BIM handbook: a guide to building information modelling for owner, managers, designers, engineers, and contractors. New Jersey: John Wiley and Sons, Inc.

Eastman, C., Teicholz, P., Sacks, R., & Liston, K., 2011, BIM handbook: a guide to building information modelling for owner, managers, designers, engineers, and contractors. (2nd ed.) New Jersey: John Wiley and Sons, Inc.

Ibrahim, A.D and Price, A. D. F. 2006, The development of a continuous improvement framework for long-term partnering relationships

Isa, M. 2015, Developing a Roadmap for the Implementation of Building Information Modeling (BIM) in the Nigerian Construction Industry. (M.Sc.), Ahmadu Bello University, Zaria, Nigeria.

Madugu, A. A., Abdullahi, M., & Musa, U. 2016, Developing Information Requirement Model for BIM-Based Quantity Take-off Using Building and Engineering Standard Method of Measurement 3(BESMM 3). Paper presented at the International Conference of Nigerian Building and Road Research Institute, Abuja, Nigeria.

Makarfi. Y. and Abdullahi. M. 2016, Introduction to Building Information Modeling. Paper presented at a 3 – day workshop/ annual general meeting of the Nigerian institute of quantity surveyors, Port-Harcourt.

McGraw Hill Construction 2013, McGraw Hill Smart Market Report on Interoperability National Building Information Modelling Standard (2007). U.S National Building Information Modeling Standard: Version 1-Part 1, Overview, Principle and Methodologies. U.S: National Institute of Building Science.

Kolo, B.A. and Ibrahim, A.D. 2010, Value management: How adoptable is it in the Nigerian construction industry? In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs West Africa Built Environment Research (WABER) Conference, 27-28 July 2010, Accra, Ghana, 653-63

Ruikar K, Anumba CJ, Carrillo PM 2006, VERDICT--An e-readiness assessment application for construction companies. Automation in Construction, 15(1): 98-110

Sacks, R, Radosavljevic, M, and Barak, R. 2010, Requirements for building information modeling based lean production management systems for construction. Automation in Construction 19 (2010) pp.641–655

Lee. S, Jungho. Y, and David. J. 2014, BIM Acceptance Model in Construction Organizations. Journal of Management in Engineering, © ASCE, ISSN 0742-597X/04014048(13)

Usman, J. 2015, Assessing the Readiness of the Client Sector to Adopt BIM Technologies in their Project Delivery Process. (BSc), Ahmadu Bello University, Zaria, Nigeria

RETHINKING DESIGN SOLUTIONS TO HOMELESSNESS: A REVIEW OF PLANNING SPACE STANDARDS

Cynthia O Adeokun[1] and A. Pearl Opoko[2]
[1] *Colman Architects Ltd., 27 Harcourt Street, London, W1H 4HP, United Kingdom*
[2] *Department of Architecture, College of Science and Technology, Covenant University, Ota, Nigeria.*

A review of national space standards in Ghana, Kenya, Nigeria, and South Africa was conducted in response to the challenge of urban homelessness and the lack of affordable housing. Whilst innovative efforts in relation to the (re)use of building materials, construction costs, construction finance and governmental policies all have an impact on the production of affordable housing units, the reality is that the informal sector is a major' provider' of housing for people on low or intermittent income, yet is rarely viewed as a source of valuable information, nor as part of the strategy for increasing the production of affordable housing. Space standards for residential buildings from the national building codes and one informal settlement in each of the four case study countries were analysed. A small sample of twenty residential floor plans from the Nigerian and Kenyan informal settlements was also analysed. The results from the analyses suggest that modifications to space standards can help increase the production of affordable housing units. The paper proposes a flexible space planning approach within the building codes which would allow for consultations with target populations, rather than a rigid application of the space standards which can result in accommodation that is not affordable for the people it is meant to house.

Keywords: affordable homes, homelessness, shelter, space standards

INTRODUCTION

Shortages in the supply of affordable housing are often discussed in relation to the formal housing sector however this study focuses on the need to increase housing provision in response to homelessness in the African urban context, by taking the role of the informal sector into consideration. Homelessness in everyday language and in many research studies generally refers to unemployed people sleeping and living rough on the streets but often fail to consider '*hidden*' homelessness. Tipple and Speak (2005) in their

[1] lola.adeokun@yahoo.co.uk
[2] akunnaya.opoko@covenantuniversity.edu.ng

Adeokun, C. O. and Opoko, A. P. (2017) Rethinking design solutions to homelessness: a review of planning space standards *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1189-1210

extensive analysis of homelessness in seven developing nations revealed that while there is agreement that the lack of shelter constitutes homelessness, homelessness also includes people who have shelter but, have little control over their space. This includes people who sleep on the sofas of friends/relatives, in shops/lock-up kiosks where they work, and people who stay in temporary structures in precarious conditions. These situations can be quite temporary, lasting just a few days or more prolonged; lasting months. This less obvious (hidden) homelessness includes people living in informal settlements, often without access to basic amenities. Benjamin De La Pena in The Next City (2013) paints a disturbing picture of this daily reality stating that *"Health is precarious, children are at risk and violence is a daily event...These slums are a stark reminder to many cities that, despite their booming economies, economic and social inequality seems endemic and intractable"*.

Efforts to provide more affordable housing for people on low incomes generally focus on: - a) reduction in construction costs, b) cheaper financing process, c) review of government policies in terms of government-funded housing units, d) use of cheaper building materials, and e) recycling of building materials. Attempts to reduce construction costs typically address housing inputs - land costs, building materials, labour, equipment, finance, regulatory documentation and professional fees- however land access in urban areas is a contentious issue in countries with high urban populations and large informal settlements such as Nigeria, Ghana, Kenya and South Africa. Accessibility to cheaper financing is a major problem in most African countries, while attempts to develop cheaper building materials have met with limited success. According to Opoko (1998), research development in Nigeria for instance produced some innovative materials with high promise of cost reduction, but these materials met with resistance due to status/stigma, lack of standards and a lack of interest from investors and professionals. The re-use of building materials for affordable housing is also rarely explored in many African countries, with the exception of makeshift (incremental) housing provided by very low-income households for themselves.

In countries such as Britain, there have been a clamour for higher planning space standards and regular review exercises as part of efforts to increase housing production (Williams, 2009; University College London, 2010). Some studies in Nigeria have also identified space adequacy as one of the determinants of housing satisfaction (Ukoha and Beamish, 1996, 1997), and space (floor area) is a major consideration by British households in their choice of a home (Crosby, 2016). These studies however relate to formal housing occupied by middle/high income households, whose perceptions are conditioned by their socio-economic status and aspirations. Turner (1976) in his studies of informal settlements demonstrated that the value of a house varies across socio-economic classes therefore housing tends to positively evolve over time to better and more acceptable standards. Unfortunately, the relationship between national planning space standards and the production of affordable housing especially for informal settlement

inhabitants in Africa has rarely been analysed, and progressive aspects of informal settlement housing are overlooked in formal housing policy. Also, most African countries, as part of the legacy of their colonial past, have adapted foreign space standards often without the strong benefit of indigenous empirical research. Agbola (nd) and UN (2016) argue that current space standards are alien, and inconsistent with the socio-economic context of the urban poor in Nigeria (and in many African countries).

A review of space standards is therefore advocated because invariably, standards prescribe minimum space requirements for functional space, and the cost of housing (for rental & ownership) is to a large extent a function of floor space, with estate surveyors traditionally valuing lettable space on the basis of floor area (m^2/$ft.^2$) (Opoko 1998). A review of space standards could also benefit from 'lessons' from socially viable informal settlements to achieve a more participatory process, and to create units that are 'fit for purpose'. This position is highlighted in a short article titled *'How Cities can get rid of Slums by supporting them'* by William Cobbett in The Next City (2013); suggesting that data from informal settlements/slums can help improve housing units targeted at informal settlement inhabitants.

Therefore, the main research question that this paper addresses is whether a review and modification of space standards encapsulated in formal building codes, based on floor area data from informal settlements can improve the production of truly affordable housing. The decision to choose Ghana, Nigeria, Kenya, and South Africa for the review was based on the high urban populations and the number of informal settlements present in these countries. In order to assess the nature of the relationship between space standards and affordable housing production, space standards from the national building codes of the four countries, and informal settlements in the four countries were analysed. The literature review presents an overview of housing strategies adopted in the four countries in response to housing shortages, and the varying degree of success achieved, while the discussion section focuses on the relationship between building codes and space use in specific informal settlements. Finally, recommendations were made about how space standards could be modified, to help increase the production of affordable housing.

LITERATURE REVIEW

An overview of housing shortages and government attitudes towards informal settlements is presented here. Currently, four of ten Africans live in urban areas, and available data for urban Africa in 2001 revealed a rent-to-income ratio for African cities of 39.5% and house price-to-income ratio at 12.5, the second highest and the highest ratios in the world respectively (UN-HABITAT, 2011). Addo (2014) and UN-HABITAT (2010) highlight how housing scarcity in Ghana has become a national development crisis with the housing market being too expensive. Consequently, around 90% of urban housing in Ghana is informal and not constructed under any building code, with many of the residents in the informal sector being 'invisibly'

homeless. According to The Next City (2013), very few people do not have a place to sleep, because *"The family house system in urban Ghana…is the social safety net that prevents homelessness from being much of a problem in Ghana." p.51.* Although overcrowding is worsening, those who have to improvise by renting space in kiosks and even in courtyards, often do not see themselves as homeless; making for a nuanced conversation about the concept of homelessness. The vast proportion of population growth in Kenya is also in informal settlements according to Next City (2013) and the majority of the dwellings constructed, similar to the Nigerian and Ghanaian contexts have evolved outside of building codes. Government responses to such housing have ranged from neglect to slum clearance characterised by eviction & demolition and in rare cases, to urban renewal. Of interest is that rarely is any substantial compensation paid to victims of slum clearance, some of whom end up in the streets. For example, in 2000, about a million residents of Rainbow Town, Port Harcourt, Nigeria were rendered homeless when their homes were demolished. Similar demolition exercises later that year also displaced about 50,000 residents in Abuja, Nigeria (SERAC, 2007). The locations of some informal settlements make them vulnerable to landslides, floods, health hazards, are usually poorly served in terms of roads, water, electricity, waste disposal, healthcare and other social amenities.

Efforts to provide large-scale mass housing in response to these struggling conditions in informal settlements (save a few exceptions) have had very limited success. In contrast to many South American countries with large informal settlements, the majority of the African response (with notable exceptions such as some North African countries, Kenya, South Africa and Botswana) for a long period has been in the form of slum clearance programmes as opposed to slum upgrades [Addo, (2014), UN-HABITAT, (2011), UN-HABITAT, (2007),]. Slum upgrades have generally proven to be more participatory although not unmitigated successes according to Inter-American Development Bank (2013), and UN-HABITAT, (2011) and sometimes tackle the realities of hidden homelessness, whilst slum clearance programmes often resulted in considerable reduction of housing stock; forcing many poor households into full scale homelessness. Both Nigeria and Kenya have been involved in large-scale forced-evictions in recent decades, with very little financial and housing support provided for those displaced via slum clearances, but Ghana and a few other African countries, have had a little more success with reducing slum populations (UN-HABITAT, 2011).

Access to land legally is incredibly challenging for informal settlement dwellers with security of tenure constantly threatened, consequently hindering residents from improving their houses even if they could afford to do so. In Nigeria, the land use decree, which regulates access to urban land, has been bedevilled with bureaucracy, abuse and multiple charges that invariably increase housing costs and push the poor to the fringes of cities in search of cheaper land. A strong preference for conventional imported building materials or materials produced locally with a high percentage of

imported components also makes the provision of affordable housing units complicated; a situation similarly found in Ghana and Kenya. Difficulties in accessing foreign exchange and the unstable investment climate in Nigeria have reduced levels of importation; forcing some manufacturing companies to close down. The result of these problems is the scarcity of good quality materials, high construction costs, proliferation of substandard materials, and a loss of skilled labour to other informal sectors such as the use of motorcycles for commercial transportation (*okada* business) in search of daily sustenance.

Access to cheap housing finance via mortgages is severely limited in Ghana, Kenya and Nigeria. For example, most Nigerians are unable to access house building funds/mortgages, via mortgage banks such as the Federal Mortgage Bank of Nigeria (FMBN), even though the (Nigeria) national housing fund scheme was introduced via the NHF Act of 1992, and contributions to the fund rose to ₦191.9bn in March 2016 from 4.14 million registered contributors (The Punch April 30, 2016). As of 2015, only 1.5 per cent of contributors had benefited from the scheme (The Punch June 8, 2015), and although these are available at interest rates lower than open market rates, they are severely unaffordable for low-income households; a condition similar to what exists in Ghana and Kenya. Although the degree of mortgage penetration in South Africa is better, all African countries have achieved less than 10% mortgage penetration (Nguena, Tchana, and Zeufack, 2015).

Efforts to increase government provided low-cost housing units in all four case study countries from the 60s to the 80s have added very modestly to the housing stock, and huge housing shortages remain. South Africa has had commendable success through the Reconstruction and Development Programme (RDP), but there is still considerable backlog (UN-HABITAT, 2011). From the 1980s onwards, the 'enabling' approach became the dominant global housing sector model and entailed only providing financial and legislative support. Nigeria broadly embraced this strategy, but between 1980 and 1983 only achieved just over a quarter of its target. Other attempts to increase the provision of low-cost housing via housing cooperatives also had limited success in Nigeria and Kenya, although Kenyan Housing cooperatives have had better success (Adeokun, Adewale and Oloke, 2014). Currently, the focus seems to have shifted to Public Private Partnerships, however, there is general acknowledgement that enabling the market failed to provide affordable housing for the predominantly low-income households in the rapidly urbanizing parts of the world like Nigeria and other African countries (UN, 2016).

Efforts to reduce construction costs, find cheaper building materials, recycle building materials, reduce financing costs, regularise land access and the use of slum clearance options have led to little progress in increasing affordable housing provision, and have also hampered efforts to reduce hidden homelessness. Informal settlements or multi-household tenement dwellings provided by private landlords remain the main source of accommodation for the urban poor, and it is against the 'backdrop' of these

failures that this study reviewed the national space standards that underpin most formal efforts to provide affordable housing.

The idea that some flexibility in the application of space standards may help increase the production of cheaper housing is slowly gaining traction in some countries. For example, the concept of 'Micro living apartments' in the U.S.A. and the UK government's relaxation of planning regulations which would allow flats smaller than the stipulated minimum of 37m^2 to be built in certain instances, all relate to the idea that a reduction in the floor area may assist in the quest for cheaper dwellings. Micro flats in the U.K. range from 16 m^2 for a studio flat to about 25m^2 for a 1-bedrrom flat, for single occupancy according to Booth (2017). This size reduction has been criticised by the Royal Institute of British Architects (RIBA) and by some architects, while one of the first examples of a residential block of Micro-flats in North-West London has been described as 'rabbit hutches' or 'dog kennels' (Booth, 2017). However, the huge housing shortage in the UK may mean that a degree of flexibility in the application of national space standards is necessary. In the article *'Can tiny houses ease the housing crisis or are they a risk to health?'* by Morris (2016), analysing the American concept of Micro-flats and its appropriateness for the UK, the conclusion is that micro-flats at best only serve as a temporary solution, and are totally unsuitable for family life. Nonetheless, it is argued in this paper that such 'temporary' solutions have some relevance especially as a response to homelessness and can be a 'stepping stone' to something better. As such, a carefully considered flexible approach to the use of standards may help increase the numbers of affordable housing produced.

Standards in this study refer to documents that become mandatory when a regulatory agency enforces its use through the relevant Act and Regulations, and space standards are defined as *'a set of framework which dictates fixed internal space minimums'* (Ishak, Ariffin, Sulaiman and Zailani, 2016). Agbola (nd) identified two types of planning standards namely, prescriptive and descriptive, noting that planning standards are usually mandatory and inflexible. Building standards cover development processes which include planning, design and construction and are also mandatory. Both planning and building standards typically define housing intensity development in terms of plot sizes, number of buildings per unit area, land rates and occupancy rates that directly influence housing production. It is argued that the issue of inflexibility referred to in Ishak et. al. (2016) definition above could hinder efforts to increase low-cost housing production. Interestingly, the UN (2016) report remarked that expensive rules are counterproductive as they drive the majority into the informal sector and noted that where regulations have been relaxed to encourage residential construction, benefits have accrued for lower income groups, providing additional support for this review.

METHODOLOGY

A mixed methods approach was adopted because of the need to combine a review of literature on housing and homelessness issues identified, with spatial data from house floor plans and activity layouts. The first stage combined a desktop review of national building codes for residential buildings in the four case study countries - Ghana, Kenya, Nigeria and South Africa- with the review of one informal settlement in each of the countries. The building code and informal settlement reviews focussed on the living room, bedroom, kitchen, toilet and bathroom. The second stage involved the analysis of a small sample of ten floor plans each from the informal settlements in Nigeria and Kenya, providing twenty floor plans in total. The floor plans and floor area information for the Nigerian sample were obtained from a measured survey of houses in the settlement and the Kenyan house plans are from a secondary source (Unpublished thesis, Diang'a, 2011). The floor areas were approximately determined using a metric grid superimposed over the plans to derive an overall floor area for each unit and for key activities, where the dwelling consisted of only one habitable room (Kenyan sample). These were compared with the floor area from the building codes to ascertain the percentage of floor area reductions that had occurred in the samples. This helped to determine the degree of reduction of the stipulated floor area that would retain functionality, yet reduce the construction costs of an affordable unit, by using basic descriptive statistics.

DISCUSSION OF THE CASE STUDIES

A brief history of building codes in Ghana, Kenya, Nigeria and South Africa

This section discusses the history of the national building code in the four countries in relation to the key spaces. The second part presents one informal settlement in each country.

A brief history of building codes in Ghana

Building Regulations in Ghana have been in use by various municipal administrations since the 1940s, and in 1960, the then West African Building Research Institute (WABRI) published a Part III of the Code dealing with structural loadings. The Building and Road Research Institute (BRRI) of the Council for Scientific and Industrial Research (CSIR) produced a draft document to tackle the shortcomings of earlier documents, resulting in Parts 3 and 4 of the Draft Code in 1977 and Parts 1, 2 and 5 by 1988 (The Draft Ghana Building Code, 2012). The National Building Regulations (L.I.1630) was enacted in 1996, and according to Ametepey, Ansah and Edu-Boaundoh (2015), the District Planning Authority (DPA) is mandated by the L.I. 1630 to implement regulations on behalf of every local authority via a qualified building inspector who oversees and inspects daily work on buildings, erections and installations to ensure compliance with the regulations. Ametepey et. al. (2015) stated that the Ghana Building Code (1988) by the BRRI was reviewed in 2012, and a draft Ghana Building Code

produced, but while the 2012 document is of immense importance and relevance, it lacks legal authority as far as the compliance regime is concerned and suffers from poor adherence. Kpamma and Adjei-Kumi (2013) also reported that long delays - up to a year - often occur in the process of obtaining approval, which should, ideally take about 3 months, due to a variety of issues. The minimum floor area from Ghana's National Building code for the five key domestic spaces is in Table 10.

Table 10: Floor area guidelines in the Ghana Building Code

Type of Room	Minimum Standard Size, Ghana Building Code (m^2)
Living (inclusive of dining area)	16.72
3 Bedrooms	27.87 (11.15m^2 – main bedroom) and 8.36m^2 for other bedrooms. (No information on occupancy rates available).
Kitchen	7.43
Bathroom	3.00
Toilet	n/a (included in the bathroom)
Total area for rooms (excl. Corridors etc.)	55.02 (38.3; in a 1-bed flat).

Source: Ghana's National Building Code, (2012)

Informal Settlements: The case of Old Fadama, Accra, Ghana

Old Fadama is a slum settlement that grew out of the uprising in northern Ghana dating back to the 1990s. Its inhabitants (refuges) in the south (Accra) were to be resettled in the north however this never happened and over time expanded as many urban poor continued to settle there. An area of 77 acres of land, and housing about 80,000 residents; it is one of the world's leading destinations for electronic waste. Inhabitants of Accra's settlements (Old Fadama inclusive), have organized to fight off eviction efforts, and incremental improvements - often achieved through collaboration between locals and grassroots coalitions- and are helping to legitimize the slums in the eyes of officials.

There is very little floor area data available for this settlement (or for any other settlement in Ghana) but Benzoni (2013) stated that it is not uncommon for up to 20 people to sleep inside a shop/kiosk of about 3-4m^2 resulting in a floor area of just 0.2m^2 per person in such circumstances. For instance, 94% of the migrants in Old Fadama do not have toilet facilities while 75% live in temporary structures according to a study reported in Migrating out of Poverty RPC (2013). In response to these struggles, Addo (2014) recommended that 'innovative' housing forms such as multi-habited dwellings should be developed in urban Ghana, to meet the budget of low-income households, asserting that, culturally, economically and socially, urban low-income households live in multi-habited dwellings to take advantage of low costs, informal social relations and family networks that exist in such living arrangements. The basic space area information of 0.2m^2 per person reported in this settlement, whilst not representative of settlements in Ghana, is nevertheless indicative of dire conditions-

rudimentary shared toilet and bathing facilities, no demarcated kitchen and no separation between living and sleeping rooms, and is a far cry from the basic standards indicated in Table **10**. The basic space area is just 1.7% of the size of the bedroom area stipulated in the building code. As such, up to a 15% reduction of the national space standards floor areas would constitute marked improvement on these living conditions.

A brief history of Building Codes in Kenya

The first by-laws for building development control were introduced in Kenya by the Colonial Government in 1926, applicable primarily in Nairobi. These were later replaced by the Nairobi City Council By-laws (Building) in 1948 that then included town planning and zoning requirements. The current building code, which is a replica of the then British Building Regulations, was adopted in 1968. A review was attempted in 1995, after the collapse of The Sunbeam Building in Nairobi, Kenya, which led to a series of recommendations that unfortunately were not implemented (National Planning and Building Authority, Kenya, 2009).

Table 11: Floor area guidelines in the Kenya Building Code

Type of Room	Minimum Standard Size Kenya (smallest permanent building- m^2)	Minimum Standard Size (Tenement House- m^2)
Living (inclusive of dining area)	14	-
3 Bedrooms	21 ($7m^2$ for a single room - occupancy rate calculated at $3.5m^2$ per person)	-
Kitchen	Not specified.	$3.75m^2$ for house up to $45m^2$, $4.5m^2$ for house btw 45-$70m^2$. $5.5m^2$ for house over $70m^2$.
Bathroom	Not specified.	
Toilet	Not specified.	
Total area for rooms	35 (smallest permanent building	

Source: National Planning and Building Authority, Kenya (2009).

A major review exercise was commissioned in 2009, which culminated in the current 2009 edition. The section of the building code that deals with floor areas of domestic dwellings (Volume 2: Part B) is similar to the South African building code, and provides generic guidance for habitable rooms and is presented below in Table 11.

It is worth noting that Kenya's national building code makes specific adjustments for floor area requirements in tenement houses but fails to indicate a minimum floor area for a generic habitable room, as shown in Table 11.

Informal Settlements: - The Case of Mathare Valley, Nairobi, Kenya

Mathare Valley is the oldest and second largest slum in Nairobi and is part of a group of slums referred to as Mathare (Darkey and Kariuki, 2013), about 5 kilometres from Nairobi's Central Business District. It is situated in a disused quarry that is 2 km long and 300m wide, with about 600,000-800,000 inhabitants. About two thirds of the housing stock are temporary structures (tin sheds, timber shacks, etc.), while a third are more permanent formal structures (blocks of flats, 3 to 8 floors high). The typical size of the formal 1-room dwelling according to Diang'a (2011) and Spatial Collective (2014) is similar to the size of typical tin shacks in the settlement – about 9m^2 (3m x 3m), although Diang'a (2011) reports that some of the rooms in the informal structures were up to 4m x 4m. This equates to a space allocation of 2.57m^2 per person with about 3.5 persons per household, according to Spatial Collective (2014) based on their survey of 980 households in Mathare Valley and 2.25m^2 per person according to Diang'a (2011) based on an average of 4 persons per household in a study of 285 households. The similarity in floor area allocation between the informal and formal structures indicates that some 'lessons' were drawn from the informal structures and applied to the more durably built dwellings, as opposed to simply using the national code. This according to Diang'a (2011) was driven by a strong desire to keep the rent of the formal structures very affordable, but 73% of the households in his study were unsatisfied with the strict adherence to 9m^2 floor area in the formal structures because it resulted in restricted flexibility for activities in the single rooms. The floor areas per person recorded by Spatial Collective (2014) and Diang'a (2011) are 27% and 36% smaller respectively than the building code stipulation of 3.5m^2 of habitable space per person. A small sample of ten dwellings from Mathare Valley from Diang'a (2011) was analysed and because the households only have a single habitable room, there is a huge reliance on 'zoning' parts of the single room for different activities or the use of temporal separation to conduct several activities using the same spatial area. The layout and floor plans of six (6 nos.), 1-room dwellings from the informal Mathare Valley are shown in Figure 1 and Figure 3 respectively. The layout and floor plans of four (4nos.), 1-room dwellings from the formal pilot scheme in Mathare Valley are shown in Figure 2 and Figure 4 respectively.



Figure 1: Layout of single-room apartment; Informal Mathare Valley [Source: Diang'a (2011)]



Figure 2: Layout of part of the formal pilot scheme, Mathare Valley [Source: Diang'a (2011)]

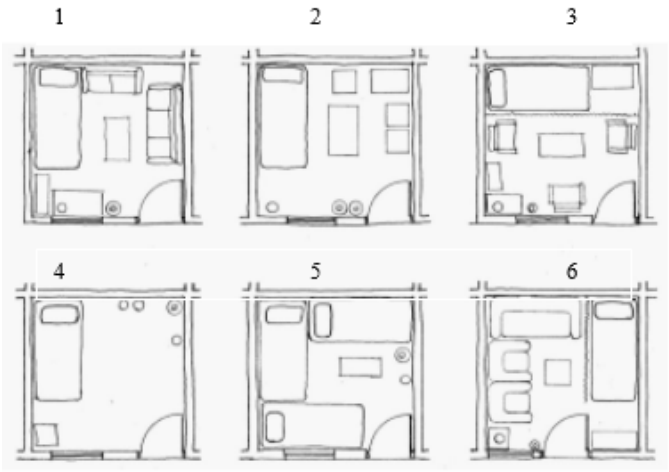


Figure 3: Layout of Six (6nos.) 1-room dwellings, Informal Mathare Valley [Source: Diang'a (2011)]

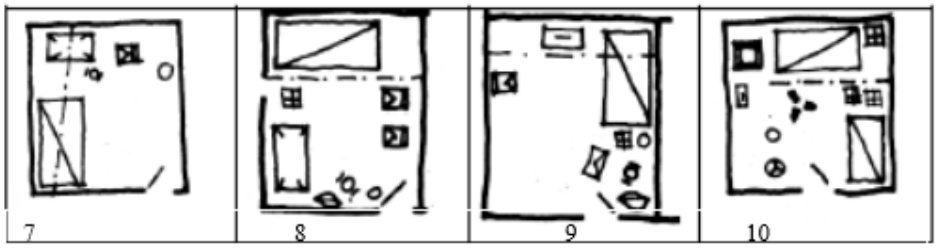


Figure 4: Layout of four (4nos.) 1-room dwellings, Formal Mathare Valley [Source: Diang'a (2011)]

The summary of the activity floor areas extracted from the ten floor plans is presented in Table 3, and shows that the mean floor areas for the living room and bedroom in Mathare Valley are about half the size of the habitable area stipulated in the building code in Table 2.

Table 12: Floor area of functional spaces (activity area) in selected accommodation in Mathare Valley

Building No.	Living Area of the room (includes dining **(m²)**	Sleeping Area of the room **(m²)**	Cooking/ Implements storage * **(m²)**	Bathroom * **(m²)**	Toilet *(m²)	Number of households sharing kitchen/toilet/ bathroom
1	6	2.5	1.13	-	-	Not known
2	5.25	3.75	-	-	-	Not known
3	6.3	2.7	-	-	-	Not known
4	7	2	-	-	-	Not known
5	2.8	6.2**	-	-	-	Not known
6	6	3	-	-	-	Not known
7	6.6	4.25	-	-	-	Not known
8	8.96	3.84	-	-	-	Not known
9	10.8	2	1.2	-	-	Not known
10	6.18	6.08	-	-	-	Not known
Mean Size of Space (m²)	**6.63 (53% smaller than building code floor area)**	**3.01 (57% smaller than building code floor area)**	**1.17 (n/a**			

* Shared Facilities, ** Spaces where activities rotation occurs within the same physical space in the room.

Whilst it would be useful to test the idea on a much larger sample, the sample demonstrates clearly that space allocations in Mathare Valley are significantly smaller than the building code stipulations. This, coupled with the residents' dissatisfaction with the current room sizes, means up to a 15% reduction of the building code's stipulated floor area per person is a real improvement on the Mathare dwellings and likely to retain good flexibility of space use.

A brief history of Building Codes in Nigeria

In Nigeria, space standards are regulated at three different levels; - the National level (Building Code), State level (Building Regulations) and Local government level (Building Byelaws). The evolution of the Nigerian National Building Code started in 1987 and involved consultations and active participation of relevant stakeholders including Building Industry professional bodies. It was however adopted in 2006 with the aim of setting minimum building design and construction standards that promote quality, safety and proficiency in the Nigerian building industry. The code became necessary in view of: (i) The absence of planning in Nigerian towns and cities; (ii) Incessant collapse of buildings, fire infernos, built environment abuse and other disasters, (iii) Dearth of referenced design standards for professionals, (iv) Use of non-professionals and quacks, (v) Use of untested products and materials and (vi) Lack of maintenance culture. The 2006 issue has not been updated since. With regard to residential buildings, the stipulated room dimensions include minimum floor areas of $14m^2$ for at least one bedroom and $10.8m^2$ each for every other bedroom, and not less than 3.0m in any dimension. This compares favourably with the UK guidelines of 2.75m and 2.55m width for at least one double (or twin) bedroom (www.gov.uk/dclg, 2015). The Building code stipulated floor area for key spaces in domestic dwellings are given in Table 4.

Table 13: Floor area guidelines in the Nigeria Building Code

Type of Room	Minimum Standard Size, Nigeria Building Code (m^2)
Living (inclusive of dining area)	18.00
3 Bedrooms	36.00 (largest bedroom $14m^2$) 2 persons per room.
Kitchen	6.00
Bathroom	3.00
Toilet	2.00
Total Floor Area	65.00

Source: Federal Republic of Nigeria (2006).

Informal Settlements: The case of Ayobo Area, Lagos, Nigeria

Ayobo is a large informal settlement in mainland Lagos which over the years has evolved into a cohesive community, comprising of permanent and temporary structures. The majority of the dwellings are rental accommodation however it has a significant minority of owner-occupied (often permanent) structures. Most of the owner-occupied structures are multi-household dwellings similar to the rental units, providing the homeowner with the ability to sublet as a source of income. In recent times,

there have been attempts by government to integrate informal settlements into mainstream urban development. A major reason has been the drive for increased revenue by Local Government Areas and service providers for electricity and waste management on one hand and political support by politicians. In Ayobo, there is evidence of road rehabilitation as fulfilment of promises made during political campaigns. A generally more favourable stance of the government in recent times appears to encourage house owners to improve their housing units however there is no financial subsidy or incentive provided to assist them. Noticeable improvements including conversion of the popular multi-household tenement house types to self-contained units as part of a gradual settlement upgrade process. An example of a typical multi-household tenement house (*face-me-I-face-you* house) in Ayobo is given below in Figure **5**, where each household rents one or two rooms and share the amenities with other households. This is the most common house type in low-income areas where durable housing is available (usually of blockwork or mud bricks with cement mortar and corrugated iron roofs). Table 5 shows typical floor area of habitable rooms in Ayobo based on a small sample of 10 dwellings.

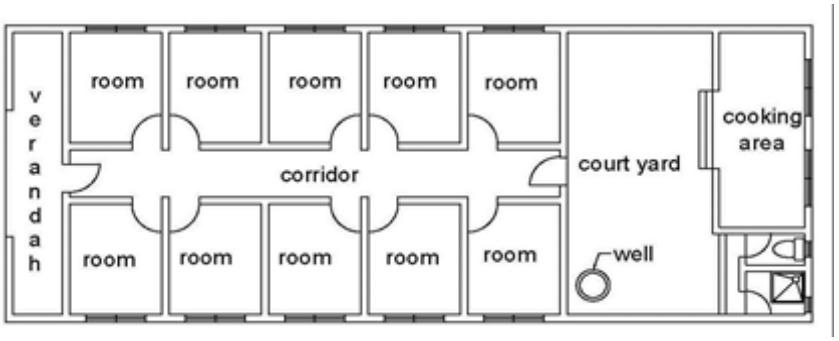


Figure 5: Typical Face-me-I-face-you multiple household dwelling in Ayobo, Nigeria [Source: Opoko (2012)]

Table 14: Table showing floor areas for key spaces from 10 dwellings in Ayobo, Lagos, Nigeria.

Building No	Living (inclusive of dining area) (m^2)	Bedroom (m^2)	Kitchen (m^2)*	Bathroom (m^2)*	Toilet (m^2)*	Number of households sharing kitchen/toilet/bathroom
1	12.96	10.80	4.80	1.54	1.54	1
2	11.60	9.00	9.60	1.28	1.28	4
3	10.80	10.40	12.00	1.35	1.35	5
4	12.00	10.80	12.50	1.36	1.20	6
5	10.80	10.56	11.80	1.20	1.20	5
6	14.00	12.96	6.00	2.00	1.80	2
7	12.80	12.00	11.55	1.80	1.62	4
8	16.00	12.40	7.50	2.40	2.40	1
9	12.00	10.60	11.40	1.80	1.80	6
10	11.70	12.00	5.00	2.00	2.00	1
Mean Size o Space (m^2)	12.47 (31% smaller than building code floor area)	11.15 (20% smaller than building code floor area)	9.22 (54% smaller than building code floor area)	1.67 (44% smaller than building code floor area)	1.62 (19% smaller than building code floor area)	-

* The kitchen, bathroom and toilet space are shared by several households.

The review of the ten dwellings in Ayobo based on the mean floor areas revealed that all the key spaces apart from the kitchens are significantly smaller than the stipulated floor areas in the building code (see the percentage reductions in Table **14**). This means that a 5-15% reduction of the floor areas stipulated in the building code would still result in improved conditions in Ayobo. However, shared spaces need to comply with the building code or be bigger to retain a high degree of functionality and comfort.

A brief history of Building Codes in South Africa

The South African National Standards is backed legally by the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977) and the current version, The South African National Standard (SANS 10400-C:2010) comprises of 20 parts and Part C, Section 4.2 deals with residential floor space standards that are generic, with references to minimum floor area for a 'habitable room'. However, an interesting caveat in its annex makes reference to what is in essence a 'Starter' house; in this case referred to as a 'Core' house. This seems to be a response to the need for affordable housing but its classification as 'temporary' suggests that it is meant to evolve into a more substantial accommodation. It however allows for initial access to housing which would otherwise be unaffordable with a larger gross floor area. Annex B, page 8, of Part C of the building code states that: -

"The plan areas given are very small but this is necessary in the interests of providing affordable housing. In the case of certain types of self-help housing, such as the "core house", the first stage will, by definition, be small and will seldom consist of more than a single room plus toilet facilities. The fact that such a building would be regarded as a temporary building should ensure that it will eventually progress to something more reasonable in size".

Additional guidance is given in the form of overall floor areas, which is: i) 27 m^2 in the case of permanent category 1 (residential) building, or ii) 30 m^2 in the case of any other permanent (residential) building. The summary of these standards is given in Table 15.

Table 15: Floor area guidelines in The South Africa Building Code

Type of Room	Minimum Standard Size Category 1 building (m^2)	Minimum Standard Size (Category 1 house) (m^2)	Minimum Standard Size (Core House)
Living/Dining	12 (incl. dining room)	-	
3 Bedrooms	18 (based on 6m^2 per person per bedroom)	-	6m^2 (Single occupancy)
Kitchen	6.00	3.75m^2 for house up to 45m^2, 4.5m^2 for house btw 45-70m^2. 5.5m^2 for house over 70m^2.	n/a
Bathroom	n/a		No minimum requirement
Toilet	n/a		No minimum requirement
Total for Rooms	36 (not inclusive of bathroom and toilet)	27	No minimum standard requirement

Source: South African National Standards (2010)

Standards and Informal Settlements, The case of Diepsloot in Johannesburg, South Africa

Diepsloot is a post-apartheid low-income township built in 1994 by the then new democratic government to absorb slum dwellers from a less formal settlement in the Johannesburg area and is a mixture of formal subsidised housing development and informal buildings, to the north of Johannesburg (Himlin, Engel & Mathoho, and PLANACT (nd). It is one of the few places north of Johannesburg targeted at meeting the housing needs of the poor, and has experienced several phases of formal relocations to the township from other parts of the city. According to Himlin et. al. (nd), Diepsloot was once considered a model example for low-income housing development, due to its fast-paced delivery, however, planned development processes have not kept pace with population growth. As a result, over three quarters of its residents live in the informal parts. Meanwhile, high-income development has encroached from the south, limiting available space for development (Mahajan, (2014). This mixture of formal durable housing and informal shacks is now a bustling community with close to 200,000 inhabitants (Johannesburg Development Agency, 2012), covering about 5 km^2. The area comprises of about 6000 formal units and over 17,000 informal shacks according to Himlin et. al. (nd), quoting Dlamini (2005). The formal part was designed initially on a one house per plot basis however the city authorities have conceded the need for higher densities to meet the existing backlog, advocating typologies that would support densification and access to economic opportunities.

A study of Diepsloot by Architects' Collective (2012) is reported here in lieu of actual floor plans because their study 'tested' the existing formal housing typologies and proposed improved typologies that drew heavily on the dynamics of the informal part of the township, by comparing space use in the informal parts with the formal housing one house per plot typologies which ranged from 8-36m^2 dwelling units. The size of the larger formal units is not dissimilar from the size of category 1 residential buildings in the building code (27m^2), but they ended up proposing alternative typologies that were bigger (55-75m^2), but are based on multiple household dwelling models. These proposed typologies had the option for ownership and rental tenures, the capacity for expansion over time and allowed for subletting and small-scale enterprise. The proposed typologies were able to house a significantly larger population than currently accommodated in a comparable area, and tap into the idea of multi-household living with a smaller floor area per person, cheaper accommodation, direct access to social interactions and an enabling environment for income-generating activities.

The case for flexible Building Codes for 'Starter' Homes

Magigi and Majani (2005) and Madeddu, Gallent and Mace (2015) both support the adoption of context-sensitive flexible standards based on existing situations with some limitations regarding health and safety considerations, arguing that a balance between flexible regulation and innovations in design is often the more effective route to achieving greater functionality in new housing. Bertaud **(**2014) makes a similar point but from

a different angle, stating that *'the higher the housing standards set by regulations, the larger will be the number of households living in informal neighbourhoods'*. These three papers are consistent with the proposal in this paper that a carefully calibrated flexibility in building codes is needed, partly based on informal settlement data, to achieve a reduction of floor area (lettable area), which has a reducing effect on construction costs and should help increase the production of affordable housing units. Additional support is found in Addo (2014) highlighting of the relevance of multi-habited dwellings for urban Ghana to help low-income households take advantage of low costs and informal social relations.

Adebayo and Iweka (2014) stated that The UN-Habitat recommends a minimum of 7.0 square metres per person (habitable room) to ensure sufficient privacy and good health. In Lagos State, where Ayobo is situated, the State's public health Byelaw of 1972 recommends room occupancy of two persons per room for a standard room size of 12.0 square meters. It is noted that the minimum floor area per person of habitable space in three of the four case studies is slightly below the UN-Habitat recommendation. Only Kenya adopted $7m^2$ per single occupancy, South Africa recommends $6m^2$ per person, Nigeria's requirement works out at $6m^2$ per person and the information for Ghana could not be extrapolated as no information on occupancy was available, although it is safe to assume that the bedrooms will operate at a minimum of 2 persons per bedroom. The summary of the floor areas for the five key spaces in the four national codes are presented in Table 7. There are strong similarities between Ghana and Nigeria's more generous codes and some similarities between Kenya and South Africa's codes which were 47% and 60% respectively smaller than Ghana and Nigeria's total floor areas, due to their inclusion of recommendations for core/tenement/temporary housing.

The comparison of the data from the units sampled in Mathare Valley and Ayobo is presented in Table 17. All the Ayobo samples are permanent structures, and sometimes the household has access to more than two habitable spaces, but all the Mathare samples are single-room units. This point to varied possibilities in informal settlements, and buttresses the point made about learning from them. Both informal settlements are not based on their respective building codes as Mathare Valley dwellings and Ayobo dwellings are 60% and 35% respectively smaller than the total area for rooms in their respective building codes.

The comparison of the data from the units sampled in Mathare Valley and Ayobo is presented in Table 17. All the Ayobo samples are permanent structures, and sometimes the household has access to more than two habitable spaces, but all the Mathare samples are single-room units. This point to varied possibilities in informal settlements, and buttresses the point made about learning from them. Both informal settlements are not based on their respective building codes as Mathare Valley dwellings and

Ayobo dwellings are 60% and 35% respectively smaller than the total area for rooms in their respective building codes.

Table 16: Comparison of the building codes in the four countries

Type of Room	Minimum Standard Size GHANA (m)²	Minimum Standard Size NIGERIA (m)²	Minimum Standard Size SOUTH AFRICA (m)²	Minimum Standard Size KENYA (m)²
Living/Dining	16.72	18.00	12 (incl. dining room)	14(incl. dining area)
3 Bedrooms	27.87	36.00 (6m² per person)	18 (6m² per bedroom)	21 (7m² per single occupancy)
Kitchen	7.43	6.00	6.00	n/a
Bathroom	3.00	3.00	n/a	n/a
Toilet	n/a (incl. in bathroom	2.00	n/a	n/a
Total for Rooms	65.00	65.00	27	35

Table 17: Comparison of the average floor areas for the five key spaces (Mathare and Ayobo samples)

Type of Room	Average Size Mathare Valley sample KENYA (m)²	Average Size Ayobo sample NIGERIA (m)²
Living/Dining	6.63	12.47
3 Bedrooms	3.01	11.15
Kitchen	1.17	9.22
Bathroom	-	1.67
Toilet	-	1.62
Total for rooms	10.80 (60% smaller than Kenya Building Code	36.13 (35% smaller than Nigeria Building Code

A study by Agbola (nd) identified elements of the regulations in the Nigeria National building code such as: floor areas of rooms; height of walls; plot coverage; and housing density that could be modified to significantly reduce construction costs without jeopardising human functions, health and safety. His computations in Table 18 were based on the building and sub-division regulation in Oyo, Ondo, Kaduna and Kwara States (in Nigeria) and Neufert's Architects Data handbook, and achieves a reduction of 30% of the floor area of a 3-bedroom flat. The suggested size by Agbola (nd) compares

favourably with the four building codes (Table 7) and improves on existing conditions in the informal settlements (Table 17), yet we suggest that Agbola (nd) suggested sizes could be further adjusted. There are concerns in some quarters that increased density can result in overcrowding, but according to Morgan and Cruickshank (2014) referencing Rogers, Brown, Burdett, Burton, & Cherry (2005), higher densities do not necessarily equate to smaller internal spaces if an appropriate typology of housing is adopted, if handled carefully using evidence from the informal settlements.

Table 18: Minimum floor area from the Nigeria Building Code and Agbola's Suggested Reductions

Type of Room	Minimum Standard Size Nigeria Building Codes (m²)	Suggested Size (Agbola) in m²	Reduction (m²)
Living/Dining	18.00	12.00	6.00
3 Bedrooms	36.00	27.00	9.00
Kitchen	6.00	4.00	2.00
Bathroom	3.00	1.20	1.80
Toilet	2.00	1.50	0.50
Total for Rooms	65.00	45.70 (30% smaller than Nigeria building code)	19.30

Source: Agbola (nd)

CONCLUSIONS AND RECOMMENDATIONS

Few studies have empirically analysed floor areas and space use in informal settlements, but the Kenya and South Africa case studies would suggest that this type of exercise goes hand in hand with improved ability to produce more affordable units. Data about home-based enterprises in informal settlements as reported in Adeokun and Ibem (2016) and Architects' Collaborative et. al. (2012) is often available as a by-product of other housing studies and should be considered in a building code review. Informal settlement databases would be useful at the state/municipal levels. Starter homes should be incorporated into building codes thereby making a distinction between core housing and more spacious floor area allocations. The ideas explored in this paper need further testing using larger samples of informal settlement dwellings in further research, to refine the proposed up-to 15% reductions in floor area for starter homes, which currently improves on the data from all four settlements. Finally, the ability to deliver more affordable units is predicated on improvements in all aspects of housing inputs, including the flexible space standard approach outlined here.

ACKNOWLEDGEMENTS

The authors want to express their gratitude to the participants of the previous Ayobo and Mathare Valley studies, whose dwellings have yielded valuable information in this study.

REFERENCES

Addo, I. A. (2014). Urban Low-Income Housing Development in Ghana: Politics, Policy and Challenges, Chapter 6, In Amado, M. P., ed., *Urban Planning: Practices, Challenges and Benefits*.

https://www.researchgate.net/publication/262314907_Urban_Low-Income_Housing_Development_in_Ghana_Politics_Policy_and_Challenge.

Addo, I. A. (2013). Perceptions and Acceptability of Multihabitation as an Urban Low Income Housing Strategy in Greater Accra Metropolitan Area, Ghana. Urban Forum (2013) 24, 543–571, DOI 10.1007/s12132-013-9192-2

Adebayo, A. K. and Iweka, A. C. O. (2014). Dwelling Space Deficits in Nigeria's Large Cities: evaluation of mass housing units in Lagos, *Architecture Research*, 4(1A), 27-33.

Adeokun, C.O.; Adewale, B.A. & Oloke, O.C. (2014) *Reworking traditional fund raising institutions for affordable housing provision: a review of Nigerian and Kenyan case-studies* In: Laryea, S. and Ibem, E. (Eds) Proceedings 8th Construction Industry Development Board (cidb) Postgraduate Conference, 10-11 February 2014, University of the Witwatersrand, Johannesburg, South Africa, 1-7.

Adeokun, C.O. and Ibem, E. O. (2016). Home-based Enterprises: Implications for Housing and Urban Planning in Nigeria. *Journal of Architectural and Planning Research, 33(1),71-89.*

Agbola, T. (nd) Planning laws, building standards and the politics of illegality in human settlements: a case study from Ibadan, Nigeria.

Ametepey, S. O., S. K. Ansah and K. B. M. Edu-Bouandoh (2015). Assessing Factors Affecting Implementation of the National Building Regulations (L.I.1630) in Ghana, *Public Policy and Administration Research*, 5(2), 66-73.

Architects' Collaborative and Poulsen, L., Deckler, T., Graupner, A., Toffah, T., Trangoš, G., Davids, S., Lubelll, C. (2011-2012). Diepsloot Housing & the Informal City, *The South African Informal City Series*, Retrieved on 23/04/17 from: http://informalcity.co.za

Benzoni, S. (2013). CROWDED HOUSE; Accra Tries to Make Room for a Population Boom, *Informal City Dialogues*, 4(6), Next City.

Bertaud, A. (2014). Housing Affordability: Top-down design and spontaneous order. Stern Urbanization Project Report, Marron Institute of Urban Management, New York University, December 16, 2014.

Booth, R (2017). 'Dog kennel' flats in Barnet will be 40% smaller than Travelodge room' The Guardian Newspaper (UK), 27th March 2017,

https://www.theguardian.com/society/2017/mar/27/dog-kennel-flats-barnet-house-smaller-than-travelodge-room?CMP=share_btn_link

Crosby M. (2015). Space Standards for Homes. Royal Institute of British Architects. London.

Darkey, D., Kariuki, A. (2013). A Study on Quality of Life in Mathare, Nairobi, Kenya, *Journal of Human Ecology*, 41(3): 207-219.

Diang'a, S. O. (2011). Unpublished thesis, "Regularizing informal settlements for sustainable

Housing development for the urban poor: the case of Nairobi, Kenya" University of KwaZulu Natal. Durban, South Africa.

Federal Republic of Nigeria (2006). National Building Code, Johannesburg: LexisNexis, Butterworths.

Himlin, R., Engel, H., Mathoho, M., PLANACT (nd). *An Executive Summary on Land Use Management and Democratic Governance in the City Of Johannesburg, Case Study: Kliptown & Diepsloot*. Johannesburg: Cubes and PLANACT.

Ishak, N. H., Ariffin, A. R. M., Sulaiman, R. and Zailani, M. N. M. (2016). Rethinking Space Design Standards Toward Quality Affordable Housing In Malaysia. *MATEC Web Conference, 66, (00112) 1-11.*

Inter-American Development Bank (2013). Evaluation of Slum Upgrading Programs, Literature Review and Methodological Approaches, *Institutions for Development Sector*, technical Note No. IDB-TN-604. November 2013.

Johannesburg Development Agency (nd). *A report on Diepsloot; Ready for Development*. Johannesburg: The Bus Factory.

Kpamma E. Z., and Adjei-Kumi, T. (2013). Construction Permits and Flow of Projects within The Sunyani Municipality, Ghana, *Proceedings IGLC-21, July 2013* | Fortaleza, Brazil.

Madeddu, M., Gallent, N., Mace, A., (2015). Space in new homes: Delivering functionality and liveability through regulation or design innovation? *Town Planning Review*, 86 (1) 73-95.

Magigi, W., Majani, B. B. K. (2005). Planning Standards for Urban Land Use Planning for Effective Land Management in Tanzania: An Analytical Framework for its Adoptability in Infrastructure Utility and Facility Provisioning in Informal Settlements. *FIG Working Week 2005 and GSD-8,* 16-21, Cairo, Egypt. April 2005.

Mahajan S. (2014). Economics of South African Townships Special Focus on Diepsloot, Washington D.C., USA.: World Bank Group.

Migrating Out Of Poverty RPC (2013).

Website:
http://migratingoutofpoverty.dfid.gov.uk/files/file.php?name=migrating-out-of-poverty-flyer-dec13.pdf&site=354

Morgan, M., Cruickshank, H. (2014). Quantifying the extent of space shortages: English dwellings, *Building Research & Information*. *DOI: 10.1080/09613218.2014.922271*

Morris, S. (2016). 'Can tiny houses ease the housing crisis or are they a risk to health?, In The Independent newspaper(UK) of 15th March 2016.

National Planning and Building Authority, Kenya (2009). Planning and Building Regulations, Vol 2, Section B, BB99-BB102, pp45-48, Ministry of Housing, Kenya.

Next City (2013). The Informal City Reader, Philadelphia, USA: The Rockefeller Foundation,

Nguena C., Tchana, F. T., Zeufack, A. G. (2015). Housing Finance and Inclusive Growth in Africa: Benchmarking, Determinants and Effects. Article submitted for *African Economic Conference (AEC) 2015* on "*Addressing Poverty and Inequality in the Post 2015 Development Agenda"* Kinshasa, Democratic Republic of Congo, November 2-4, 2015

Opoko, A. P. (1998): Framework for Widespread Utilisation of Alternative Building Materials. In DPBHD 1998 Memorandum to the *National Council on Works- proceedings of the 13th National Conference of Chief Architects of the Federation of Nigeria,* Federal Secretariat, Uyo, Nigeria.

(www.gov.uk/dclg, 2015).

Social and Economic Rights Action Center (SERAC) (2007). Pushing out the poor: forced evictions under the Abuja masterplan, Lagos: SERAC.

South African National Standard (2010). The application of the National Building Regulations, Part C- Dimensions, Pretoria, South Africa: SABS Standards Division.

Space Collaborative (2017). Mathare Dempgraphic, Retrieved on 19/04/17 from: http://spatialcollective.com/2014/10/16/mathare-demographic/

The Draft Ghana Building Code (2012). Part 7, Housing and Small Buildings, Ghana: Ministry of Water Resources, Works and Housing (MWRWH).

The Punch June 8, (2015). Page? Only 1.5% NHF contributors get mortgage loans —FMBN, Posted by InvestAdvocate on June 8, 2015

The Punch of April 30, (2016). National Housing Fund contributions hit N192bn. InvestAdvocate (2015, June 8). Only 1.5% NHF contributors get mortgage loans —FMBN The Punch, p7.

Tipple G., Speak, S. (2005). Definitions of homelessness in developing countries, *Habitat International* 29 (2005), 337–352. DOI:10.1016/j.habitatint.2003.11.002.

Turner, J.F.C. (1976) *Housing by people. Towards autonomy in building environments, London:* Marion Byers.

Ukoha, O. M., Beamish, J. O. (1996). Predictor of Housing Satisfaction in Abuja Nigeria. *Housing and Society*, 23(3) 26-43

Ukoha, O. M., Beamish, J. O. (1997). Assessment of Resident's Satisfaction with Public Housing in Abuja, Nigeria. *Habitat International,* 21(4), 445-460.

UN (2016) World Cities Report in 2016. New York: UN.

United Nations Human Settlements Programme (UN-HABITAT), (2011). Affordable Land and Housing in Africa, *Adequate Housing Series* Volume 3.

United Nations Human Settlements Programme (UN-HABITAT), (2010). Housing as a Strategy for Poverty Reduction in Ghana, *The Global Urban Economic Dialogue Series.*

University College London (2010). A report on Housing standards: evidence and research, for CABE.

Williams, K. (2009). Space per person in the UK: A review of densities, trends, experiences and optimum levels. *Land Use Policy*, 26 (Supplement 1), 83-92.

REVIEW OF CRITICAL SUCCESS FACTORS FOR THE IMPLEMENTATION OF TOTAL QUALITY MANAGEMENT IN THE CONSTRUCTION INDUSTRY

Ansah, S. K.[1], Aigbavboa, C. O.[2] and Thwala, W.[3]

[1]*Department of Building Technology, Cape Coast Technical University, Cape Coast, Ghana*

[1, 2, 3]*Department of Construction Management & Quantity Surveying, University of Johannesburg, Johannesburg, South Africa*

Total Quality Management (TQM) is a philosophy that involves every organization in the industry in the effort to improve performance. The concept is an integrative management principle for continuously improving the quality of products and processes to achieve customer satisfaction. To achieve this concept required a clear establishment of Critical Success Factors (CSFs). However, lack of clear establishment of CSFs for the implementation of TQM in the construction industry has led to failure of the system. In the pursuit of performance excellence in the construction industry and with an increasing awareness of construction quality, construction firms have no option than to implement TQM with clear CSFs. This paper therefore identifies and establishes the critical success factors for the implementation of Total Quality Management in the construction industry. Desk study and Delphi survey approach was adopted for this study. Based on the examination of existing literature and comprehensive analysis of the Delphi survey, the paper proposes eight (8) critical success factors of TQM for the construction industry. These include Leadership and Top Management, Supplier Quality Management, Quality System Evaluation, Client Focus and Involvement, Company Vision and Plan Statement, Product Selection and Design Management, Construction Process Management and Improvement, Construction Employees Involvement and Motivation. Hence to ensure successful implementation of total quality management in the construction industry, attention therefore should be given to the identified critical success factors in this study.

Keywords: total quality management, critical success factors, construction industry

[1] skansah@hotmail.co.uk

[2] caigbavboa@uj.ac.za

[3] didibhukut@uj.ac.za

Ansah, S. K., Aigbavboa, C. O. and Thwala, W. (2017) Review of critical success factors for the implementation of total quality management in the construction industry *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1211-1224

INTRODUCTION

Globally, much research has been conducted in the field of TQM implementation in the construction industry but yet there is lack of consensus and understanding of its critical success factors (CSF's). Different authors have differing views on the concept of TQM and its basic elements since its inception in 1920. However, most agree that TQM is a philosophy or approach to management focusing on continuous improvement, customer focus, systematic process management, supplier partnership, and teamwork (Vuppalapati, Ahire and Gupta, 1995., Kanji and Asher, 1996., Koh and Low, 2010, Agha (2011)

According to Steingard & Fitzgibbons (1993) TQM can be defined as a set of techniques and procedures used to reduce or eliminate variation from a production process or service-delivery system in order to improve efficiency, reliability, and quality. It integrates fundamental management techniques, existing improvement efforts, and the technical tools under a disciplined approach focused on continuous improvement (Department of Defense, 1988). Kanji and Asher (1996) posited that, TQM is a continuous process of improvement for individuals, groups of people, and whole firms; it encompasses a set of four principles (delight the customer, management by fact, people-based management, and continuous improvement) and eight core concepts (customer satisfaction, internal customers are real, all work is process, measurement, teamwork, people make quality, continuous improvement cycle, and prevention). TQM can also be defined as the application of quality principles for the integration of all functions and processes within the firm (Ross, 1993). There is another definition of TQM, which is a management approach for an organization, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction and benefits to all members of the organization and to society (ISO 8402, 1994). Flynn, Schroeder and Sakakibara (1994) defined TQM as: An integrated approach to achieving and sustaining high quality output, focusing on the maintenance and continuous improvement of processes and defect prevention at all levels and in all functions of the firm, in order to meet or exceed customer expectations. Ho and Fung (1994) however argued that, TQM is a way of managing to improve the effectiveness, flexibility, and competitiveness of a business as a whole. It is also a method of removing waste, by involving everyone in improving the way things are done. Vuppalapati, Ahire and Gupta (1995) on the other hand posit that TQM is an integrative philosophy of management for continuously improving the quality of products and processes to achieve customer satisfaction. Hackman & Wageman (1995) systematically reviewed the three quality gurus' (Deming, Juran, & Ishikawa) propositions about TQM. According to their review results, the following five interventions are the core of TQM: Explicit identification and measurement of customer wants and needs; creation of supplier partnership; use of functional teams to identify and solve quality problems; use of scientific methods to monitor performance and identify points of high leverage for performance improvement; use of process management

heuristics to enhance team effectiveness. Each of these interventions is in turn, supported by a wide array of techniques and critical success factors (CSFs). According to Metri (2005) CSFs are a guide for construction organizations contemplating on TQM initiatives. Hence, for a successful implementation of TQM, it is imperative that construction companies understand the TQM constructs and its critical success factors (CSF's).

Over the past few decades, quality gurus such as Deming (1986), Juran (Juran and Gryna, 1993), Crosby (1979), Feigenbaum (1991), and Ishikawa (1985), the primary authorities of TQM have developed certain propositions in the field of TQM, which have gained significant acceptance throughout the world. Their insights provide a good understanding of the TQM philosophy, principles, and practices. After careful study of their work, it has been found that these quality gurus have different views about TQM, although some similarities can be found. It was also found that the three quality award models also provide a framework for identifying a range of intangible and tangible processes that influence the firm's TQM implementation and the end results. These models provide a solid foundation for this research. But it was obvious that there are some gaps in their conceptual framework that have failed to capture the critical success factors for the implementation of TQM in the construction industry. Lack of clear establishment of these CSFs for the implementation of Total Quality Management (TQM) in the construction industry has led to failure of the system. This study is therefore undertaken to establish the critical success factors to serve as a guide for construction organizations contemplating on TQM initiatives. If these critical success factors are clearly established and implemented, it will lead to a successful implementation of TQM in construction industry. It is therefore imperative that construction companies understand the TQM constructs and its critical success factors (CSF's).

Objective of the Study

The objective of this study is to identify and establish the critical success factors for the implementation of Total Quality Management in the construction industry.

LITERATURE REVIEW

Lack of Consensus of Total Quality Management Concept and Constructs

Although much research has been conducted in the field of TQM implementation, no universally accepted TQM concepts and constructs presently exist. Actually, researchers have different ideas about TQM concept. The concept is still a subject of debate (Easton and Jarrell, 1998), still a hazy and ambiguous concept (Dean and Bowen, 1994). So far, TQM has come to mean different things to different people (Hackman and Wageman, 1995). Asian Institute of Technology (AIT), defines TQM as "a philosophy that strengthens the culture to foster continuous organisational improvement through systematic, integrated, consistent effort involving

everyone and everything, focusing primarily on total satisfaction of internal and external customers, where employees work together in teams with process ownership, guided by a committed top management, which takes a proactive participation" (Nukulchai, 2003). Also, according to Wessel & Burcher (2004), the British Quality Association defines TQM as "an all-embracing business management philosophy focusing on completely fulfilling customer requirements with a maximum of effectiveness and efficiency". Another definition of TQM, which is used by the Department of Defence in USA, is a philosophy and a set of guiding principles that represent the foundation of a continually improving organization (Tingey, 1997).

The above definitions define the TQM as a philosophy but from different point of view. British Standard described the TQM as the management philosophy aimed to achieve organisation objectives. While, the Asian Institute of Technology (AIT), defined the TQM as the philosophy aiming to satisfy the customers. The critical phrases in British Quality Association definition towards TQM is a management philosophy aiming to meeting the customer requirements. Therefore, the common word towards TQM concept is a *philosophy*.

The British Railway Board defines TQM as "the process, which seeks to meet and satisfy customer requirements throughout the whole chain of internal and external customers and suppliers" whereas the Royal Mail defines it as "A comprehensive way of working throughout the organisation, which allows all employees, as individuals and as teams, to add value and satisfy the needs of customer". The critical word toward the TQM definition is the *process and way of working*.

A definition by the US Department of Defence that succinctly captures the essence of the concept is: TQM utilizes both quantitative (technical) methods and human resource (behavioural) practices to improve material and service inputs, intra-and inter organisational processes, and to sharpen the focus on meeting customers' needs (Singh and Smith, 2004).

Zairi argues that total quality management can be defined by several parameters, such as leadership, attitudes, systems, continuous improvement and customer supply chains. He explains that leadership is perhaps the most important ingredient in the total quality management philosophy, as has been addressed by pioneers such as Deming, Juran and Crosby. A company's ambitions and desire to succeed is a reflection of the company's leadership which is implemented through a series of actions and initiatives. Total quality management is not about achieving certain standards of competitiveness or introducing new techniques, concepts, methodologies and technologies. It is about changing attitudes and behaviour towards doing business where parameters are set by the customer or negotiated with the customer. Zairi (1991: 42) argues that total quality management looks for continual improvement in the areas of cost, reliability, quality, innovation, efficiency and business effectiveness. These definitions clearly indicate that TQM has come to mean different things to

different people. This study therefore identifies constructs that will be brought together to form TQM definition and also help to better understanding the TQM concept in the construction industry. The three quality award models provide an insight into the practical way of applying TQM, as well as a solid foundation for this research. In this study, TQM could therefore be defined as follows: *A management philosophy for continuously improving overall performance of organization based on Leadership and Top Management, Supplier Quality Management, Quality System Evaluation, Client Focus and Involvement, Company Vision and Plan Statement, Product Selection and Design Management, Construction Process Management and Improvement, Construction Employees Involvement and Motivation.*

Critical Success factors (CSFs) for Total Quality Management Implementation

To successfully implement TQM, it is important to identify the factors required for the implementation process. Saraph et al (1989) defined CSFs as critical areas of managerial planning and action that must be practiced to achieve effective quality management in a business unit. These factors may be constructs with latent variables which cannot be measured directly, but can still be assessed indirectly from their manifestation. Saraph et al. (1989) in a pioneering study developed a quality management instrument, identifying eight (8) critical success factors of TQM: Role of divisional top management and quality policy, Role of quality department, Training, Product/service design, Supplier quality management, Process management/operating, Quality data and reporting and Employee relations. Their study had considerable influence on later studies, and subsequent research has resulted in the development of different frameworks and constructs based on varying perceptions and objectives (Zhang, 2000). Although these frameworks or models have different TQM approaches, they all lay emphasis on leadership, strategic planning, customer and market focus, human resources focus, process management, continuous improvement, supplier management and business results in one way or the other (Conca et al 2003).

Constructs or elements of critical success factors identified in frameworks for TQM point to two categories of factors: soft and hard dimensions of TQM (Kanji., 1995; Powel., 1995; Dow et al., 1999; Oakland., 2000). — Hard components of TQM concentrate on the tools and techniques, systems and the supplementary measurement and control of the work process, ensuring conformance to performance standards and the reduction of variability whereas — soft components relate to areas behavioural concerns such as increasing customer orientation, employee management, organizational and quality culture. These dimensions are interrelated and are together are very important for the successful implementation of TQM.

Choi and Eboch (1998) studied the TQM paradox using management of process quality, human resources management, strategic quality planning, and information and analysis as the constructs of TQM implementation. Black and Porter (1996) identified ten critical factors of TQM: People and customer management, supplier partnership, communication of

improvement information, customer satisfaction orientation, external interface management, strategic quality management, teamwork, operational quality planning, quality improvement measurement systems, structure for improvement, and corporate quality culture. In Powell's 1995 study, the following elements were identified as TQM framework: Executive commitment, adopting the philosophy, closer to customers, closer to suppliers, benchmarking, training, open organization, employee empowerment, zero-defects mentality, flexible manufacturing, process improvement, and measurement. Ho and Fung (1994) identified ten TQM elements: Leadership, commitment, total customer satisfaction, continuous improvement, total involvement, training and education, ownership, reward and recognition, error prevention, and cooperation and teamwork. Waldman (1994) identified eight key TQM elements as: Top management commitment to place quality as a top priority, a broad definition of quality as meeting customers' expectations, TQM values and vision, the development of a quality culture, involvement and empowerment of all organizational members in cooperative efforts to achieve quality improvements, an orientation toward managing-by-fact, the commitment to continuously improve employees' capabilities and work processes through training and benchmarking, attempts to get external suppliers and customers involved in TQM efforts. Mann and Kehoe (1994) divided TQM into ten elements. They are supplier improvement, process control and improvement, internal customer focus, measurement and reporting, leadership, quality system, participation, recognition, education and training, and external customer focus.

The study by Sila and Ebrahimpour (2002) reviewing 347 articles on TQM from 1989 to 2000 identified seventy–six studies that employed factor analysis to extract factors for successful implementation of TQM. Out of these, they compiled twenty-five TQM constructs which are widely used by researchers to measure TQM implementation. Their study revealed eight common cores of the factors viz: customer focus and satisfaction, employee training, leadership and top management commitment, teamwork, employee involvement, continuous improvement and innovation, and quality information and performance. Literature also reveals that different countries have adopted similar TQM factors as criteria for quality awards under different titles (Metri, 2005). However, the criteria for all these quality awards are derived from three basic frameworks: the Malcolm Baldrige National Quality Award (MBNQA), the European Quality Award (EQA) now called European Foundation for Quality Management (EFQM) Excellence Award and the Deming Prize.

In the field of TQM implementation, there are also three commonly referenced articles written by Saraph et al. (1989), Flynn et al. (1994), and Ahire et al. (1996), respectively. Ahire et al. (1996) strongly recommended that a combination of the three frameworks be undertaken for future research on TQM. In fact, this study followed that suggestion and attempting to integrate their TQM constructs as much as possible and also incorporate the constructs identified in frameworks developed by Imbeah

and Dansoh (2011) and Adusa – Poku (2014) for construction industry in Ghana. Table 1 lists the TQM elements in the five frameworks i.e. Saraph et al. (1989), Flynn et al. (1994), Ahire et al. (1996), Imbeah and Dansoh (2011), and Adusa – Poku (2014) frameworks. The two elements "Product quality" and "Supplier performance" in the Ahire et al. framework were not included in this framework since they represented TQM outcomes. "Role of quality department" in the Saraph et al. framework was excluded in this framework since every department in any organization would be involved in quality management. "Benchmarking" and "Internal quality information usage" in the Ahire et al. framework is similar with the element of "Evaluation" in this study. "Process control" and "Cleanliness and organization" in the Flynn et al. framework are relatively the same as the element of "Process control and improvement" adopted in this study. Also "Process Management" and "Continuous Improvement" in the Adusa - Poku framework are relatively the same as the element of "Process control and improvement" adopted in this study.

Table 1 Framework Comparison

Reference	Framework
Saraph et al. framework (1989)	1: Role of divisional top management and quality policy; 2: Role of quality department; 3: Training; 4: Product/service design; 5: Supplier quality management; 6: Process management/operating; 7: Quality data and reporting; 8: Employee relations.
Flynn et al. framework (1994)	1: Quality leadership; 2: Quality improvement rewards; 3: Process control; 4: Feedback; 5: Cleanliness and organization; 6: New product quality; 7: Interfunctional design process; 8: Selection for teamwork potential; 9: Teamwork; 10: Supplier relationship; 11: Customer involvement.
Ahire et al. framework (1996)	1: Top management commitment; 2: Customer focus; 3: Supplier quality management; 4: Design quality management; 5: Benchmarking; 6: SPC usage; 7: Internal quality information usage; 8: Employee empowerment; 9: Employee involvement; 10: Employee training; 11: Product quality; 12: Supplier performance.
Imbeah and Dansoh framework (2011)	1: Top management commitment and leadership; 2: Employee welfare and commitment; 3: Employee training and development; 4: Customer focus; 5: Planning; 6: process control and process evaluation; 7: Supplier management; 8: Continuous Improvement; 9 Team Work; 10: Information analysis; 11: evaluation.
Adusa – Poku framework (2014)	1: Process Management; 2: Leadership Commitment; 3: Customer Focus; 4: Continuous Improvement; 5: Training and Development; 6: Supplier Management

"Top management commitment and leadership" in the Imbeah and Dansoh framework are relatively the same as the element of "Leadership and top management" adopted in this study. "Customer involvement" in the Flynn et al. framework and "Customer Focus" in the Ahire et al., Imbeah and Dansoh and Adusa – Poku frameworks were merged in this study. This study included three more constructs, *"*Company Vision and Plan Statement *"*Product Selection and Design Management*"" and "*Construction Process Management and Improvement*"* which were not found in their frameworks. Thus, TQM in this study consists of 8 constructs. These are Leadership and Top Management, Supplier Quality Management, Quality System Evaluation, Client Focus and Involvement, Company Vision and Plan Statement, Product Selection and Design Management, Construction Process Management and Improvement, Construction Employees Involvement and Motivation. Hence, to implement TQM in construction industry is merely to implement these constructs, which occurs through a set of practices such as using certain quality tools or techniques.

RESEARCH METHODOLOGY

The research was conducted with reference to existing theoretical literature, i.e. published and unpublished literature. This was followed up with Delphi survey method to collect data from experts (construction professionals) through email. A Delphi Study is a group decision mechanism requiring qualified experts who have deep understanding of the issues at hand (Okoli &Pawlowski, 2004). The list of experts was generated from peered reviewed conference proceedings and journal articles. It was also based on their articles written on Total Quality Management in the Ghanaian construction industry. Seventeen invitation letters were sent to the experts through email to indicate their willingness to participate in the study. Thirteen experts showed their interest to participate in the study. During the first stage of the Delphi questionnaire administration, three experts were further dropped.

The remaining ten experts concluded the survey. This number of panelists was considered adequate based on literature recommendations from scholars which have employed the technique previously. Hallowell and Gambatese (2010) suggested that since most studies incorporate between eight (8) and sixteen (16) panelists, a minimum of eight (8) is reasonable. Hallowell and Gambatese (2010) argued that the size of a panel should be dictated by the study characteristics, number of available experts, the desired geographical representation and capacity of the facilitator.

Experts in Ghana were asked to rate the impact and influence of the factors in predicting the success of Total Quality Management implementation in the construction industry. An impact scale used is shown in Table 2 below. Data obtained from the Delphi survey was analysed with Microsoft EXCEL, spread-sheet software. The output from the analysis was a set of descriptive statistics such as means, median, standard deviations and derivatives of these statistics. The results were further presented in table. The steps in

conducting Delphi survey has not been discussed in this paper due to limited space.

Table 2: Impact scale

No impact/influence		Low impact /influence		Medium impact /influence		High impact /influence		Very high impact/influence	
1	2	3	4	5	6	7	8	9	10

DISCUSSION OF RESULTS

A set of factors that were relevant to Total Quality Management were emphasised through a comprehensive review of literature. Although, most of the reviewed literature was based on studies from the developed countries, they were collectively used to examine the factors that determine the success of Total Quality Management in the Ghanaian construction industry. The influence of the factors on Total Quality Management was obtained as a product of the impact on the construction industry in Ghana.

The main factors were based on the level of influence, as categorized on the questionnaire. This was established by assessing the extent to which the listed factors will determine the Total Quality Management implementation in the construction industry. The rating was based on an ordinal scale of one to ten with one being low influence or no impact and ten being high influence or very high impact. The levels of influence and impact were obtained as a product of the consensus achieved.

By applying the Median Absolute Deviation to determine whether a factor reached consensus or not, all the eight (8) critical factors were considered by the experts to have reached consensus. Consensus was reached for four (4) attributes (Leadership and Top Management, Company Quality System Evaluation, Product Selection and Design Management, Construction Process Management and Improvement) under the critical factors that determine Total Quality Management in the construction industry, with an IQD score of 1.00 or cut-off (IQD $\leq$1) (Table 3). Seven (7) factors from the eight (8) identified critical factors that determine Total Quality Management in the construction industry were considered by the experts to have a very high influence (VHI: 9-10), with the exception of one (1) factor (Product Selection and Design Management) which had a high influence (HI: 7-8.99). These indicate that all the factors have high influence on Total Quality Management implementation in the construction industry.

Table 3: Total Quality Management (TQM) in the construction industry main factors

Total Quality Management in the Construction Industry Main Factors	$\bar{x}$	M	SD	MAD	IQD
Leadership and Top Management (LTM)	9.10	10.00	1.85	0.90	1.00
Company Supplier Quality Management (CSQM)	8.40	9.00	1.43	0.80	1.25
Client Focus and Involvement (CFI)	8.30	8.00	1.06	0.70	1.50
Company Quality System Evaluation (CQSE)	9.10	9.00	0.57	0.30	0.25
Company Vision and Plan Statement (CVPS)	8.40	9.00	1.43	0.80	1.25
Product Selection and Design Management (PSDM)	7.80	8.00	0.79	0.40	0.25
Construction Process Management and Improvement (CPMI)	8.60	9.00	0.84	0.40	0.50
Construction Employees Involvement and Motivation (CEIM)	9.00	10.00	2.21	1.00	1.25

M=Median; $\bar{x}$=Mean; σ_x=Standard Deviation (SD);|Di|=Median Absolute Deviation (MAD); IQD=Interquartile Deviation

CONCLUSION AND RECOMMENDATION

This study intended to identify critical success factors for the implementation of Total Quality Management in the construction industry. Eight critical success factors of TQM for construction industry were identified. These are: Leadership and Top Management, Supplier Quality Management, Quality System Evaluation, Client Focus and Involvement, Company Vision and Plan Statement, Product Selection and Design Management, Construction Process Management and Improvement, Construction Employees Involvement and Motivation. It is believed that attention to these factors will minimize difficulties related to the implementation of Total quality management and will enhance best performance in companies implementing Total quality management. Further research is also suggested to be carried out by using empirical fieldwork (questionnaire survey) to determine the importance, similarities and differences of the identified CSFs.

REFERENCES

Adusa-Poku, N. Y. (2014). Assessing Total Quality Management (TQM) In the Ghanaian Construction Industry: An Exploratory Study in Kumasi. *Master of Science Dissertation*. Department of Building Technology, Faculty of Architecture and Building Technology Kwame Nkrumah University of Science and Technology, Ghana

Agha, A. S. (2011). *Total quality management in construction industry*. Available at http://faculty.kfupm.edu.sa/CEM/bushait/cem515/term-papers/TQMinconstructionindustry.pdf

Ahire, S.L., Golhar, D.Y., and Waller, M.A. (1996). Development and validation of TQM implementation constructs. *Decision Sciences*, 27 (1), 23-56.

Al-Momani, A. (2007) Total quality management in construction: a case study of Jordan. In: Hughes, W (Ed) *Procs of the Inaugural Construction Management and Economics „Past, Present and Future" Conference*, 16th - 18th July 2007 University of Reading, UK, 741-752

Black, S.A. and Porter, L.J. (1996), Identification of the critical factors of TQM. *Decision Sciences, 27* (1), 1-21.

Boaden, R., and Dale, B. (1992). Total quality management in the construction industry: a preliminary analysis. *International Journal of Technology Management, 7* (4/5), 244-253.

Chini, A.R., and Valdez, H.E. (2003). ISO 9000 and the U.S construction industry. *Journal of Management in Engineering, 16* (2), 69-76.

Choi, T.Y., and Eboch, K. (1998). The TQM paradox: Relations among TQM practices, plant performance, and customer satisfaction. *Journal of Operations Management, 17* (1), 59-75.

Conca, F. J., Llopis, J., and Tari, J. J. (2003). Development of a measure to assess quality management in certified firms. Journal of Operational Research, 156, 683-697.

Crosby, P.B. (1979). *Quality Is Free*. McGraw-Hill, Inc., New York.

Dean, J.W. Jr., and Bowen, D.E. (1994). Management theory and total quality: Improving research and practice through theory development. *Academy of Management Review, 19* (3), 392-418.

Deming, W. E. (1986). *Out of the Crisis: Quality, Productivity and Competitive Position.* Cambridge University Press, Cambridge.

Department of Defense (1988). Institute of Defense Analysis, The role of concurrent engineering in weapons system acquisition. *IDA Report* R-338.

Dow, D., Samson, D., and Ford, S. (1999). Exploding the Myth: Do All Quality Management Practices Contribute to Superior Quality Performance. *Production and Operations Management*, 8, 1–27.

Easton, G.S. and Jarrell, S. L. (1998). The effects of total quality management on corporate Economist. (2000, January 15). Construction and the Internet. *The Economist*.

Feigenbaum, A.V. (1991). *Total Quality Control*. Third edition, McGraw-Hill, Inc., New York.

Flynn, B.B., Schroeder, R.G., and Sakakibara, S. (1994). A framework for quality management research and an associated measurement instrument. *Journal of Operations Management, 11*, 339-366.

Gunning, J.G. and McCallion, E.M. (2007). TQM in large Northern Ireland contracting organisations. *In*: Boyd, D (Ed) *Procs 23rd Annual ARCOM Conference*, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 577-586.

Hackman, J.R. and Wageman, R. (1995). Total quality management: Empirical, conceptual, and practical issues. *Administrative Science Quarterly*, 40 (June), 309-342.

Hallowell, M. and Gambatese, J. (2010). Qualitative research: Application of the Delphi method to CEM research. Journal of Construction Engineering and Management, 136 (Special Issue: Research Methodologies in Construction Engineering and Management):99-107.

Hassin, E., Tookey, J.E. and Vidalakis, C. (2007). Sustainable development and TQM implementation in Libya: A study of the electrical generation industry. *In:* Egbu, C.O. and Tong, M.K.L. (Eds) *Procs of the 3rd Scottish Conference for Postgraduate Researchers of the Built and Natural Environment (PRoBE)*, 20-22 November 2007, Glasgow Caledonian University, 203-215.

Haupt, T.C. and Whiteman, D.E. (2003). Deploying total quality management on construction sites: inhibiting factors. *The International Journal of Construction Management, 3* (2), 51-68.

Ho, S.K.M. and Fung, C.K.H. (1994), Developing a TQM excellence model. *TQM Magazine*, 6 (6), 24-30.

Imbeah, K.A and Dansoh, A. (2011) Critical Success Factors for the Implementation of Total Quality Management (TQM) in Real Estate development in Ghana. *In* Laryea, S., Leiringer, R. and Hughes, W. (Eds), *Procs of 5th West Africa Built Environment Research (WABER) Conference*, 19 – 21 July 2011, Accra, Ghana, 291 – 303.

Ishikawa, K. (1985). *What is Total Quality Control? The Japanese Way*. Prentice-Hall, London.

ISO 8402 (1994). *Quality Management and Quality Assurance – Vocabulary*. International Organization for Standardization, Geneve, Switzerland.

Juran, J.M. and Gryna, F.M. (1993). *Quality Planning and Analysis*. Third edition, McGraw-Hill, Inc., New York.

Kanji, G. K. (1995). Quality and Statistical Concepts in Total Quality Management. *Proceedings of the first world congress* (Ed: Kanji, G. K.), London: Chapman and Hill

Kanji, G.K. and Asher, M. (1993). *Total Quality Management Process: A Systematic Approach, Advances in Total Quality Management Series*. Carfax, Abingdon.

Khadour, L. and Darkwa, J. (2008). TQEM in the UK construction industry: some key findings from a survey. *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 239-246.

Kiwus, C.H. and Williams, T.P. (2001). Application of TQM to environmental construction. *Journal of Management in Engineering, 17* (3), 176-184.

Koh, T.Y. and Low, S.P. (2010). Empiricist framework for TQM implementation in construction companies. *Journal of Management in Engineering, 26* (3), 133-143.

Lad, J. and Beck, B. (2009). Construction Quality: The Key to Successful Capital Projects Delivery. *Pharmceutical Engineering*, 29 (6).

Love, P. E. D., Li, H., Irani, Z., and Holt, G. D. (2000). Rethinking Total Quality Management: Toward A Framework for Facilitating Learning And Change In Construction Organizations. *The TQM Magazine, 12* (2), 107–116.

Love, P.E.D., Edwards, D.J. and Sohal, A. (2004). Total quality management in Australian Contracting organisations: pre-conditions for successful implementation. *Engineering, Construction and Architectural Management, 11* (3), 189-198.

Mahmood and Mohammed (2008). A conceptual framework for the development of quality culture in the construction industry *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 247-256.

Mann, R. and Kehoe, D. (1994), An evaluation of the effects of quality improvement activities on business performance. *International Journal of Quality & Reliability Management*, 11 (4), 29-44.

McIntyre, C.and Kirschenman, M. (2000). Survey of TQM in construction industry in upper Midwest. *Journal of Management in Engineering, 16* (5), 67-70.

Metri, B.A. (2005). TQM Critical Success Factors for Construction Firms. *Management Economics, 10* (2), 61-72.

Nukulchai, W. K. (2003). *Towards Total Quality Management In Higher Education: The Experience of Asian Institute of Technology*. Asian Institute of Technology.

Oakland, J. (2000). *Total quality management – Text with cases* (2nd edition). Butterworth-Heinemann

Okoli, C. and Pawlowski, S. (2004). The Delphi method as a research tool: An example, design considerations and applications, Information Management, 42:15-29.

Pheng, L.S. and Teo, J.A. (2004). Implementing total quality management in construction firms. *Journal of Management in Engineering, 20* (1), 8-15.

Powell, T.C. (1995). Total Quality Management as Competitive Advantage: A Review and Empirical Study. *Strategic Management Journal, 16*, 15–37.

Ramachandran, V. (2010). Total quality management in construction. Edwards, G. (Ed). Available at http://www.brighthub.com/office/project-management/articles/86518.

Ross, J.E. (1993). *Total Quality Management*. St. Lucie Press, Delray Beach, FL.

Sanni, A.A. and Windapo, A.O. (2008). Evaluation of contractor's quality control practices on construction sites in Nigeria. *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 257-265.

Saraph, J.V., Benson, G.P., and Schroeder, R.G. (1989). An Instrument for Measuring the Critical Factors of Quality Management. *Decision Sciences, 20*, 810–829.

Sila, I. and Ebrahimpour, M. (2002). An Investigation of The Total Quality Management Survey Based Research Published Between 1989 And 2000. *International Journal of Quality and Reliability Management, 19* (7), 902-970.

Singh, P. J., and Alan J. R. S. (2004). Relationship Between TQM and Innovation: An Empirical Study. *Journal of Manufacturing Technology Management, 15*(5), 394 - 401.

Steingard, D.S. and Fitzgibbons, D.E. (1993). A postmodern deconstruction of total quality management, *Journal of Organization Change Management*, *6* (5), 27- 42.

Tingey, M. (1997). *Comparing ISO 9000, Malcolm Baldrige, and the SEICMM for Software: A Reference and Selection Guide.* Prentice-Hall, Englewood Cliffs, NJ.

Tutesigensi, A. and Pleim, V. (2008). Why small and medium construction enterprises do not employ six sigma. *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 267-276.

Vuppalapati, K., Ahire, S.L. and Gupta, T. (1995). JIT and TQM: A case for joint implementation. *International Journal of Operations & Production Management, 15* (5), 84-94.

Waldman, D.A. (1994). The contribution of total quality management to a theory of work performance. *Academy of Management Review, 19* (3), 510-536.

Wessel, G., and Burcher, P. (2004). Six Sigma for Small and Medium-Sized Enterprises. *The TQM Magazine, 16*(4), 264 - 272.

Zairi, M. (1991). *Total Quality Management for Engineers*. Woodhead Publishing.

Zhang, Z. (2000). Developing A Model of Quality Management Methods and Evaluation Their Effects on Business Performance. *Total Quality Management, 11* (1), 129-137.

REVIEW OF THEORIES; METHODOLOGIES AND ANALYTICAL TOOLS APPLIED IN SUSTAINABLE CONSTRUCTION RESEARCH

K. Agbesi[1], T. Adjei-Kumi[2] and F.D.K Fugar[3]
[1,2&3]*Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

The need to adopt sustainable practices at the oraganisation level in the construction industry continues to be a growing debate among researchers in terms of the theories, methodologies and approaches. Hence, the aim of the paper is to review theories, methodologies and analytical approaches applied in context of sustainability research. Through a thorough literature review, the findings point out to the fact that, there is limited use of grounded theories which underpin organization adoption of sustainable practices and most studies adopt standalone theoretical basis instead of more integrated theories in sustainability research. In addition, it was revealed that there is dominant use of empirical methods especially survey and semi-structured interview. The study contributes to the philosophical development of sustainable procurement practices. This will be useful to researchers in construction management knowledge. Future research opportunities were identified such as the development of a model that builds on multiple organizational theories for the adoption of sustainability, and application of Least Square-Structural Equation Modelling in sustainable construction research.

Keywords: adoption, analytical tools, methodologies, organisational theories, sustainability practices

INTRODUCTION

The effects of construction activities on the environment are widely recognised by practitioners and researchers (Xia et al., 2015; Zuo et al., 2012). The Construction industry accounts for one tenth of the global economy (Xia et al., 2015). The building sector consumes 30-40% of global energy requirements (Persson, 2009). Xia et al. (2015) argued that the increasing pressure on the industry has drifted its traditional unsustainable practices to adoption of a more sustainable approach. The construction industry is seen as one of the most resource-intensive industries (Akadiri et

[1] gbesie@yahoo.co.uk
[2] tadjeikumi@yahoo.com
[3] fdkfugar.cap@knust.edu.gh

Agbesi, K., Adjei-Kumi, T. and Fugar (2017) Review of theories; methodologies and analytical tools applied in sustainable construction research *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1225-1238

al., 2012). Accordingly, sustainable construction practices contribute towards the attainment of sustainable development thereby effectively improving the overall performance of the industry. Some of the benefits of sustainable practices by construction organizations include preservation of the environment and enhancing social equity, economic prosperity (Bamgbade et al. 2017). Sustainable construction involves the designing, developing, constructing and managing a project that is intended to minimise negative impacts on the environment and society (Zainul et al., 2013). Shen et al., (2016) argued that construction organisations adopt sustainability with the purpose of achieving competitive advantage by limiting its effects on the environment and advancing society need. However, construction organisations are yet to fully adopt sustainable construction practices (Glass and Dainty, 2012). Not surprising though the industry lags behind other industry in the adoption of sustainable practices (Islam et al., 2016). Glass and Dainty, (2012) argued that sustainability needs to be present, visible and integrated in the business at all levels and in all functions of construction organisation. Thus, the industry needs to double its efforts to make significant contributions towards the attainment of sustainable development practices (Murtagh and Roberts, 2014).

Sustainability related research published in internationally renowned construction journals has been growing and generated considerable interest in the academic field (Xia et al. 2015). Moreover, plethora of underlying theories, methods and analytical tools has been reported (Taticchi et al., 2013). Theories, methodologies and analytical tools used in academic research papers published in relation to sustainable construction are vital to both researchers and industry practitioners. This gives future directions to researchers to conduct related research effectively and efficiently (Yi and Chan, 2013). However, there is a lack of systematic review of organisational theories, methodological approaches, and analytical tools applied in sustainable construction research. Walker et al (2012) drew attention to three methodological challenges in sustainability research including social desirability bias associated with interviews or surveys, respondents may feel pressured to give socially acceptable opinions and clearly defining the analytical focus either the unit of measurement is at the individual or organisational level. Also, there is limited use of grounded organisational theory in sustainability researches in construction management (Meehan and Bryde, 2015; Brennan and Cotgrave, 2014; and Akadri and Fadiya, 2013). Sulistio and Rini (2015) pointed out the inadequacy of efficient framework underpinned by organisational theories to evaluate and model the adoption and implementation decision of construction organisations. Sulistio and Rini (2015) advance the development of sustainability frameworks and models.

The aims of this paper are to examine current trends in sustainability in construction related research, review theories, methodologies and tools employed, and to identify key research areas. This will enable the ongoing research to develop an organizational model for the adoption of

sustainability in construction organisations founded on suitable multiple theories. The outline of the paper starts with current sustainable trends followed theoretical perspectives, analytical approaches and methodologies. The penultimate section dwells on discussion. The conclusion, draws on the need for integrated framework underpin by grounded theories

RESEARCH METHODS

The paper systematically reviewed published works on sustainable construction practices related research. The review seeks to identify the underlying methodologies, analytical tools and theoretical perspectives applied in sustainable construction related research published in academic journals. An electronic database of "Google Scholar "and "Science direct" were search for relevant journal papers using keywords such as: "green buildings", "green procurement", sustainable procurement", "sustainable building", and "sustainable construction". Sustainable construction related papers were reviewed from 2000 to 2017; as a result, 80 papers were initially identified. 29 papers were used in the analysis of the methodologies, analytical tools and theoretical perspectives applied sustainable construction research.

CURRENT SUSTAINABILITY RESEARCH TRENDS IN CONSTRUCTION

There has been a growing interest of sustainability related research published in internationally renowned construction journals (Xia et al. 2015). Xia et al. (2015) reviewed the number and trends of sustainability related papers in 12 internationally recognised construction journals from 2000 to 2012. The results show an increasing trend in the number of sustainable construction-related papers from 30 papers in 2000 to 127 papers in 2012. According to Xia et al. (2015) the emerging areas includes; (1) sustainable project management; (2) sustainability assessment/evaluation; (3) sustainable technology/innovation implementation; (4) sustainable building/infrastructure performance; (5) government policy on sustainability; (6) enterprise sustainability; and (7) sustainability education. They further noted the various stages of implementation of sustainability practices in construction projects from feasibility, design, planning, decision-making, development, construction, material planning and management, cost management, construction supply chain management, and building operation and facility management have received its share of research. However, Meehan and Bryde, (2015) firmly believe that the construction industry has not had its fair share of studies compare to the well-developed manufacturing sector.

Moreover, researches on organisational adoptions of sustainability in the construction industry are limited (Ugwu and Haupt 2007).

THEORETICAL PERSPECTIVE OF SUSTAINABLE CONSTRUCTION RESEARCH

Sarkis et al. (2011) pointed out that early researches of sustainability were primarily anecdotal and conceptual developments presenting various thoughts and practices of sustainability. They further indicated that the anecdotal case studies stage has move to into theory building and testing. However, most of sustainability researches in construction management are not grounded on organisational theory (Meehan and Bryde, 2015; Brennan and Cotgrave, 2014; Akadri and Fadiya, 2013; Glass, 2012; Huang and Hsu, 2011), as presented in Table 1. Meehan and Bryde, (2015) did not adopt an organizational theory in their study of the level of the adoption of sustainable procurement in the social housing sector. Similarly, Brennan and Cotgrave, (2014), adopted a qualitative inquiry into the current state of sustainable development in the UK construction industry did not consider an organizational theory. Akadri and Fadiya, (2013) identified the determinants of environmentally sustainable practices in the UK construction industry without any theoretical basis. Zhou et al. (2013) also developed a sustainability performance framework for use in construction projects not underpin of organizational theory. Huang and Hsu (2011), created a state-level appraisal indicator for sustainable construction not based on an organizational theory.

However, there are few that have adopted an organisational theory as presented in Table 1. These includes innovation diffusion theory (Banihashemet al.,2017); resource based view theory (Bamgbade et al 2017); organisational learning and absorptive capacity (ACAP) perspective (Upstill-Goddard et al., 2016), Self-determination theory (Murtagh, et al., 2016); Equity theories, (Almahmoud and Doloi 2015), Leadership theory (Opoku et al., 2015); Maturity model, (Masalskyte et al., 2014) and Organisational change (Adams. and McNicholas, 2007). Masalskyte et al (2014) utilised Maturity model to develop a holistic indicative sustainability model made up of 18 sustainable practices. Oyewobi et al (2015) borrowed balanced scorecard (BSC) and business excellence model (BEM) to explore the development of an integrated model to measure sustainability performance of construction organisations. Schropfer et al. (2017) adopted social network to map the knowledge flow in sustainable project team. Murtagh, et al., (2016) explored the theory self-determination to model the relationship between motivations of architectural designers and environmentally sustainable construction design. Upstill-Goddard et al (2016) utilised organisational learning and absorptive capacity (ACAP) perspective to conceptualize the role of learning in sustainability standards implementation. Bal et al (2013) employ stakeholder engagement in achieving sustainability in the construction sector. Sim and Putuhena (2015) proposed a capacity development model builds on theory of change management.

Drawing, from the above, various studies used standalone theoretical basis instead of more integrated theories in sustainability. Moreover, these

models also provide little detail of how the triple bottom line of sustainability can be adopted into organisation's policy, strategy, and general decision making the call to develop sustainability models and frameworks based on orgarnisational theories evolving in academic research and in the construction industry. Hence researchers and practitioners believe that this call is plausible, for example Wong et al (2016) advocated for the development of models for the adoption of sustainable procurement in construction. Taticchi et al. (2013) argued for the development of integrated tools, frameworks and models tailored to industry specific triple bottom line of sustainability. Lastly, Varsei et al. (2014) advocated the use of multiple theories in the study of sustainability

ANALYSIS OF RESEARCH METHODOLOGIES IN SUSTAINABLE CONSTRUCTION RESEARCH

Common research approaches adopted by researchers to study and model sustainable practices in construction industry are literature review, case studies, survey, case studies, semi structured- interviews, action research and combination of survey and semi-structured interview. The dominant methodological approach is survey, followed by case studies and semi-structured interview as presented in Table 1. This is in line with Hahn and Kühnen, (2013) that, empirical papers accounts for 73% of sustainability research. Varnas et al (2009) adopted mixed method in the study of environmental considerations in procurement of construction contracts practices in the Swedish construction industry. Masalskyte et al. (2014) developed maturity sustainability model with 18 sustainable practices for corporate real estate management and used grounded theory approach (semi structured interview). Meehan and Bryde, (2015) applied case study and survey in the examination of the adoption of sustainable procurement in the UK social housing sector. Wong et al. (2016) applied mixed approach to determine the enablers of sustainability in public and private construction organisation. Islam et al. (2016) adopted a quantitative method in the study of sustainability practices by public and private organisations in Saudi Arabia. Bamgbade et al. (2017) developed a model to determine the Influence of organizational culture on sustainable construction among Malaysian contractors. Karunasena et al. (2016) adopted mixed method to develop a framework to integrate sustainability concepts to value planning (VP) disciplines in construction projects using statistical and content analysis.

Notwithstanding, the enormous methodological methods adopted for sustainability research, Walker et al., (2012) reiterated the need for a more rigorous method. Thus, a research method needs to address the methodological challenges such as social desirability bias associated with interviews or surveys, respondents may feel pressured to give socially acceptable opinions and clearly defining the analytical focus either the unit of measurement is at the individual or organisational level.

ANALYTICAL APPROACH IN SUSTAINABLE CONSTRUCTION RESEARCH

Table 1: Reviewed theories, methodologies and analytical approaches applied in sustainability research

Author	Title	Dominant theory	Method of data collection	Analytical approach	Journal
Zhang et al. (2000)	A framework for implementing ISO 14000 in Construction	None	Literature review	None	
Ugwu, et al. (2006)	Sustainability appraisal in infrastructure projects (SUSAIP): Part 1 Development of indicators and computational methods. .	None	survey and interviews	descriptive statistics	Automation in construction
Du Plessis (2007)	A strategic framework for sustainable construction in developing countries	None	Literature review	None	Construction Management and Economics
Shen et al (2007)	A checklist for assessing sustainability performance of construction projects		Literature review//interviews	None	Journal of civil engineering and management
Essa, and Fortune, (2008),	Pre-construction evaluation practices of sustainable housing projects in the UK	None	Survey	SPSS	Engineering, Construction and Architectural Management
Pitt et al. (2009)	Towards sustainable construction: promotion and best practices	None	Survey	Descriptive statistics	Construction innovation
Presley and Mead (2010)	Benchmarking for sustainability: an application to the sustainable construction industry	Balanced score and multi-attribute models	Literature	None	Benchmaking: An International
Tan et al (2011)	Sustainable construction practice and contractors' competiveness: a preliminary study	None	Literature review	None	Habitat international
Huang and Hsu (2011	Framework development for state-level appraisal indicators of sustainable construction	None	Survey	Max-Min fuzzy Delphi method and Fuzzy Analytical process	Civil Engineering and Environmental Systems
Glass (2012)	The state of sustainability reporting in the construction sector	None	Literature review	None	Smart and Sustainable Built Environment

Table 1 (Cont'd): Reviewed theories, methodologies and analytical approaches applied in sustainability research

Akadri and Fadiya, (2013	Empirical analysi of the determinants of environmentally sustainable practices in the UK construction industry	None	Survey	Predictive Analysis Software (PASW) Statistics 17.0	Construction innovation
Zhou et al (2013)	Sustainability performance measurement framework for PF projects in the UK	None	Survey	Statistical Package for Social Science (SPSS)	Journal of Financial Management of Property and Construction
Swan et al. (2013)	Adoption of sustainable retrofit in UK social housing	None	Survey	Descriptive statistics	Structural Survey
Brennan and Cotgrave (2014)	Sustainable development: A qualitative inquir into the current state of the UK construction industry	None	Focus group	Framework matrix function	Structural Survey
Djokoto et al. (2014)	Barriers to sustainable construction in the Ghanaian construction industry: consultant's perspectives	None	Survey	Relative Importance Index (RII)	Journal of Sustainable Development
Masalskyte et al. (2014)	Modelling sustainability maturity in corporate real estate management	Maturity model	Semi-structured interview	Grounded theory	Journal of Corporate Real Estate
Meehan and Bryde , (2015)	A field-level examination of the adoption of sustainable procurement in the social housing sector	None	Case study and survey	Factor analysis	Built Environment Project and Asset Management
Almahmoud and Doloi (2015)	Assessment of social sustainability in construction projects using social network analysis	equity theories	Survey	social network analysis	Facilities,
Opoku et al (2015)	Leadership style of sustainability professionals in the UK construction industry	Leadership theory	Survey and semi-structured interview	Regression analysis	Built Environment Project and Asset Management
Oyewobi et al (2015)	Measuring strategic performance in construction companies: a proposed integrated model	Balanced scorecard(BSC) and business excellence model(BEM)	None	None	Journal of Facilities Management

Table 1 (Cont'd): Reviewed theories, methodologies and analytical approaches applied in sustainability research

Adjarko et al. (2016)	Incorporating environmental sustainability into construction procurement at the district assembly in Ghana	None	Survey	Statistical Package for the Social Sciences (SPSS)	International Journal of Construction Engineering and Management
Oladinrin and Ho (2016)	Embeddedness of codes of ethics in construction organizations-	Embeddedness theory	Survey	Statistical Package for the Social Sciences (SPSS)	Engineering, Construction and Architectural Management
Murtagh, et al. (2016)	The relationship between motivations of architectural designers and environmentally sustainable construction design	Self-determination theory	Semi structured interview	Thematic analysis	Construction Management and Economics
Upstill-Goddard et al (2016)	Implementing sustainability in small and medium-sized construction firms: The role of absorptive capacity"	organisational learning and absorptive capacity (ACAP) perspective	Semi structured interviews	None	Engineering, Construction and Architectural Management
Wong et al.(2016)	Facilitating effective green procurement in construction projects: An empirical study of the enablers	None	Semi structured interview and survey	Factor analysis	Journal of Cleaner Production
Schropfer et al. (2017)	Mapping the knowledge flow in sustainable construction project teams using social network analysis	Social network	Case study, survey and interview	combination of descriptive statistics, cross tabulations, content analysis and Social Network Analysis	Engineering, Construction and Architectural Management
Banihashemet al. (2017).	Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries	innovation diffusion theory	Semi structured interview and survey	Partial Least Square-Structural Equation Modelling	International Journal of Project Management
Bamgbade et al. (2017)	Does government support matter? Influence of organizational culture on sustainable construction among Malaysian contractor	Resource based view theory	Survey	Partial Least Square-Structural Equation Modelling	International Journal of Construction Management

There are several analytical approaches that have been adopted by various researches in the sustainability research outcome. These include regression, factor analysis, structural equation modelling (SEM), and ANOVA. Wong et al. (2016) used factor analysis to determine the enablers of sustainability in public and private construction organisation. Islam et al. (2016) adopted multiple regression technique in the study of sustainability practices by public and private organisations in Saudi Arabia. Karunasena et al. (2016) adopted partial least squared structural equation modelling to develop a framework to integrate sustainability concepts to value planning (VP) disciplines in construction projects. The commonly used approaches are regression and factor analyses as presented in Table 1. Partial Least Square of the Structural Equation Modelling is scarcely used as shown in the research papers reviewed.

DISCUSSION AND CONCLUSION

Sustainable construction has received considerable attention in academic research and within the industry in the past two decades. This paper has provided a critical review of the trends of sustainability in the field of research. The paper identified gaps for researchers to find more useful insights into organizational theories and methodologies applied in the area of sustainability issues. The review shows the dominant methodological approach as survey, followed by case studies and semi-structured interview. More sustainable construction research adopting mixed methods approach is called for.

The results indicate adopting organisational theories in sustainable construction related research is relatively rare across in literature (Wong et al., 2016). Most of sustainability researches in construction management are not grounded on organisational theory (Meehan and Bryde, 2015). However, a number of studies have adopted established organisational theories to explore sustainable construction related research including innovation diffusion theory, resource based view theory, organisational learning and absorptive capacity (ACAP) perspective, Self-determination theory, Equity theories, Leadership theory, Maturity model, and Organisational change. Most often they are standalone theories and in few instances two theories are used in combination, such as organisational learning and absorptive capacity perspective.

Walker et al. (2012) posit that viewing sustainability from a different theoretical lens give a better understanding of this new phenomena and helps to examine the relationship between sustainable construction practices and factors such as government support and top management support which influences its implementation. There is a need for more focused theory building and testing, that draw more closely on sustainable construction practices (Johnsen, et al., 2016; Walker et al., 2012). Conelly et al. (2011) underscore the need to combine multiple theoretical perspectives to uncover rich and complex ways of explaining firm behavior on sustainable business practices.

It was also established that more analytical methods such as regression analysis, Max-Min fuzzy Delphi method and Fuzzy Analytical process, Factor Statistical Package for the Social Sciences (SPSS), Partial Least Square-Structural Equation Modelling, thematic analysis, and Predictive Analysis Software (PASW) Statistics 17.0 are used in sustainability research in construction. Partial Least Square of the Structural Equation Modelling (PLS) is scarcely used; however, in quite recent times it uses by researchers is increasing (e.g. Banihashemet al., 2017). PLS is preferable in analysing and testing data of complex theoretical models; when the objective of the is predictive of key target constructs or identification of key driver construct; exploratory in nature; models of both reflective and formative constructs; model made up of many constructs typically more than five and studies involving small samples (Rigdon 2016; Hair et al., 2014). It uses had been seen in many fields including, construction (Bamgbade et al., 2017).

The survey provides a number of opportunities for future research within construction. First, there is the need to develop a model that builds on multiple organizational theories for the adoption of sustainability to enhance the diffusion and adoption decision behaviour of construction organisations. This model should integrate the three bottom line of sustainability. More research on mixed methods and analytical approaches including Partial Least Square-Structural Equation Modelling are needed in sustainable construction research

REFERENCES

Addis, B. and Talbot, R., 2001. Sustainable construction procurement: a guide to delivering environmentally reponsible projects (Vol. 571). London: Ciria.

Adjarko, H., Agyekum, K. and Offei, I., 2016. Incorporating Environmental Sustainability into Construction Procurement at the District Assembly Level in Ghana. International Journal of Construction Engineering and Management, 5(2), pp.31-41

Almahmoud, E. and Doloi, H.K., 2015. Assessment of social sustainability in construction projects using social network analysis. Facilities, 33(3/4), pp.152-176.

Akadiri, P.O., Chinyio, E.A. and Olomolaiye, P.O., 2012. Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector. Buildings, 2(2), pp.126-152.

Akadiri, P. O. and Olaniran Fadiya, O., 2013. Empirical analysis of the determinants of environmentally sustainable practices in the UK construction industry. Construction Innovation, 13(4), pp.352-373.

Bamgbade, J.A., Kamaruddeen, A.M., Nawi, M.N.M., Yusoff, R.Z. and Bin, R.A., 2017. Does government support matter? Influence of organizational culture on sustainable construction among Malaysian contractors. International Journal of Construction Management, pp.1-15.

Banihashemi, S., Hosseini, M.R., Golizadeh, H. and Sankaran, S., 2017. Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries. International Journal of Project Management.

Bal, M., Bryde, D., Fearon, D. and Ochieng, E., 2013. Stakeholder engagement: Achieving sustainability in the construction sector. Sustainability, 5(2), pp.695-710.

Brennan, C. M. and Cotgrave, J. A., 2014. Sustainable development: A qualitative inquiry into the current state of the UK construction industry. Structural Survey, 32(4), pp.315-330.

Connelly, B.L., Ketchen, D.J. and Slater, S.F., 2011. Toward a "theoretical toolbox" for sustainability research in marketing. Journal of the Academy of Marketing Science, 39(1), pp.86-100.

Djokoto, S.D., Dadzie, J. and Ohemeng-Ababio, E., 2014. Barriers to sustainable construction in the Ghanaian construction industry: consultant's perspectives. Journal of Sustainable Development, 7(1), p.134.

Du Plessis, C., 2007. A strategic framework for sustainable construction in developing countries. Construction Management and Economics, 25(1), pp.67-76.

Essa, R. and Fortune, C., 2008. Pre-construction evaluation practices of sustainable housing projects in the UK. Engineering, Construction and Architectural Management, 15(6), pp.514-526.

Glass, J., 2012. The state of sustainability reporting in the construction sector. Smart and Sustainable Built Environment, 1(1), pp.87-104.

Hahn, R. and Kühnen, M., 2013. Determinants of sustainability reporting: a review of results, trends, theory, and opportunities in an expanding field of research. Journal of Cleaner Production, 59, pp.5-21.

Hair Jr, J., Sarstedt, M., Hopkins, L. and G. Kuppelwieser, V., 2014. Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research. European Business Review, 26(2), pp.106-121.

Huang, R.Y. and Hsu, W.T., 2011. Framework development for state-level appraisal indicators of sustainable construction. Civil Engineering and Environmental Systems, 28(2), pp.143-164

Islam, M.M., Murad, M.W., McMurray, A.J. and Abalala, T.S., 2016. Aspects of sustainable procurement practices by public and private organisations in Saudi Arabia: an empirical study. International Journal of Sustainable Development & World Ecology, pp.1-15.

Johnsen, T., Howard, M. and Miemczyk, J., 2014. Purchasing and supply chain management: a

sustainability perspective. Routledge.

Karunasena, G., Rathnayake, R.M.N.U. and Senarathne, D., 2016. Integrating sustainability concepts and value planning for sustainable construction. Built Environment Project and Asset Management, 6(2), pp.125-138.

Masalskyte, R., Andelin, M., Sarasoja, A.L. and Ventovuori, T., 2014. Modelling sustainability maturity in corporate real estate management. Journal of Corporate Real Estate, 16(2), pp.126-139.

Murtagh, N., Roberts, A. and Hind, R., 2016. The relationship between motivations of architectural designers and environmentally sustainable construction design. Construction Management and Economics, 34(1),

Oladinrin, O.T. and Ho, C.M.F., 2016. Embeddedness of codes of ethics in construction organizations. Engineering, Construction and Architectural Management, 23(1), pp.75-91

Opoku, A., Ahmed, V. and Cruickshank, H., 2015. Leadership style of sustainability professionals in the UK construction industry. Built Environment Project and Asset Management, 5(2), pp.184-201

Oyewobi, L.O., Windapo, A.O. and Rotimi, J.O.B., 2015. Measuring strategic performance in construction companies: a proposed integrated model. Journal of Facilities Management, 13(2), pp.109-132.

Persson, U., 2009. Management of sustainability in construction works. Division of Construction Management, Lund Institute of Technology.

Pitt, M., Tucker, M., Riley, M. and Longden, J., 2009. Towards sustainable construction: promotion and best practices. Construction innovation, 9(2), pp.201-224.

Presley, A. and Meade, L., 2010. Benchmarking for sustainability: an application to the sustainable construction industry. Benchmarking: an international Journal, 17(3), pp.435-451.

Rigdon, E.E., 2016. Choosing PLS path modeling as analytical method in European management research: A realist perspective. European Management Journal, 34(6), pp.598-605

Schröpfer, V.L.M., Schröpfer, V.L.M., Tah, J., Tah, J., Kurul, E. and Kurul, E., 2017. Mapping the knowledge flow in sustainable construction project teams using social network analysis. Engineering, Construction and Architectural Management, 24(2), pp.229-259.

Shen, L.Y., Li Hao, J., Tam, V.W.Y. and Yao, H., 2007. A checklist for assessing sustainability performance of construction projects. Journal of civil engineering and management, 13(4), pp.273-281.

Shen, L., Zhang, Z. and Zhang, X., 2016. Key factors affecting green procurement in real estate development: a China study. Journal of Cleaner Production.

Sim, Y.L. and Putuhena, F.J., 2015. Green building technology initiatives to achieve construction quality and environmental sustainability in the construction industry in Malaysia. Management of Environmental Quality: An International Journal, 26(2), pp.233-249.

Sulistio, J. and Rini, T.A., 2015. A Structural Literature Review on Models and Methods Analysis of Green Supply Chain Management. Procedia Manufacturing, 4, pp.291-299.

Swan, W., Ruddock, L., Smith, L. and Fitton, R., 2013. Adoption of sustainable retrofit in UK social housing. Structural Survey, 31(3), pp.181-193.

Tan, Y., Shen, L. and Yao, H., 2011. Sustainable construction practice and contractors' competitiveness: A preliminary study. Habitat international, 35(2), pp.225-230.

Taticchi, P., Tonelli, F. and Pasqualino, R., 2013. Performance measurement of sustainable supply chains: a literature review and a research agenda. International Journal of Productivity and Performance Management, 62(8), pp.782-804

Terouhid, S.A., Terouhid, S.A., Ries, R. and Ries, R., 2016. Organizational sustainability excellence of construction firms–a framework. Journal of Modelling in Management, 11(4), pp.911-931.

Testa, F., Annunziata, E., Iraldo, F. and Frey, M., 2016. Drawbacks and opportunities of green public procurement: an effective tool for sustainable production. Journal of Cleaner Production, 112, pp.1893-1900.

Ugwu, O.O., Kumaraswamy, M.M., Wong, A. and Ng, S.T., 2006. Sustainability appraisal in infrastructure projects (SUSAIP): Part 1. Development of indicators and computational methods. Automation in construction, 15(2), pp.239-251.

Upstill-Goddard, J., Glass, J., Dainty, A. and Nicholson, I., 2016. Implementing sustainability in small and medium-sized construction firms: the role of absorptive capacity. Engineering, Construction and Architectural Management, 23(4), pp.407-427.

Varsei, M., Soosay, C., Fahimnia, B. and Sarkis, J., 2014. Framing sustainability performance of supply chains with multidimensional indicators. Supply Chain Management: An International Journal, 19(3), pp.242-257.

Walker, H., Miemczyk, J., Johnsen, T. and Spencer, R., 2012. Sustainable procurement: Past, present and future. Journal of Purchasing and Supply Management, 18(4), pp.201-206.

Wong, J.K.W., San Chan, J.K. and Wadu, M.J., 2016. Facilitating effective green procurement in construction projects: An empirical study of the enablers. Journal of Cleaner Production, 135, pp.859-871

Xia, B., Zuo, J., Wu, P. and Ke, Y., 2015. Sustainable construction trends in journal papers. In Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate (pp. 169-179). Springer Berlin Heidelberg.

Yi, W. and Chan, A.P., 2013. Critical review of labor productivity research in construction journals. Journal of Management in Engineering, 30(2), pp.214-225.

Zainul Abidin, N., Yusof, N.A. and Othman, A.A., 2013. Enablers and challenges of a sustainable housing industry in Malaysia. Construction Innovation, 13(1), pp.10-25.

Zhang, Z. H., Yin Shen, L., Love, P.E. and Treloar, G., 2000. A framework for implementing ISO 14000 in construction. Environmental Management and Health, 11(2), pp.139-149

Zhou, L., Keivani, R. and Kurul, E., 2013. Sustainability performance measurement framework for PFI projects in the UK. Journal of Financial Management of Property and Construction, 18(3), pp.232-250.

Zhu, Q., Sarkis, J. and Lai, K.H., 2008. Confirmation of a measurement model for green supply chain management practices implementation. International journal of production economics, 111(2), pp.261-273.

RISK MANAGEMENT FRAMEWORK FOR BUILD OPERATE AND TRANSFER (BOT) INFRASTRUCTURE PROJECTS IN NIGERIA

Baba Shehu Waziri[1] and Yusuf Mohammad Isa[2]
[1] Department of Civil and Water Resources Engineering, University of Maiduguri, Nigeria
[2] Department of Building, Modibo Adama University of Technology, Yola, Nigeria

The use of concession agreement such as the Build-Operate-Transfer (BOT) for infrastructure development is becoming considerably popular in both developed and developing countries. However, the successful implementation of BOT depends largely on understanding the contexts and types of risks associated with these types of agreements. This study presents a robust evaluation framework for assessing critical risks of BOT projects in Nigeria. Risk factors were identified and investigated through literature survey and subjected to experts' scrutiny for modification and adoption. Ten (10) experts, two (2) each from the offices of developers, lenders, contractors, government and academics were consulted for review and modification of the identified risk factors. 120 structured questionnaires were randomly administered to professionals in the offices of government agencies, developers, lenders and contractors for rating the criticality and impact of the adopted risk factors based on a 5- point likert scale. Descriptive statistics (Criticality Index) was employed to evaluate the impact of the risk factors. The results revealed that risk factors with the highest (CI) that require utmost attention are change in government policies (4.3593), unfavourable business environment (4.2093), project company default (4.2093), time performance risk (4.1239), cost performance risk (4.0814), excessive development cost (4.0581), instability in government (4.0116) and insufficient funds to finance projects (4.0116). A project risk framework was developed by classifying the risk factors into political, procurement, financial and revenue, legal, development, construction and operating risks. The framework provides stakeholders with the understanding of key risk factors for effective implementation of BOT projects in Nigeria.

Keywords: risk management, build operate and transfer, infrastructure, framework, Nigeria.

[1] shehuwaziri@yahoo.co.uk
[2] Yusufisa06@yahoo.com

Waziri, B. S. and Isa, Y. M (2017) Risk management framework for Build Operate And Transfer (BOT) infrastructure projects in Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1239-1253

INTRODUCTION

The challenges of meeting the huge infrastructure needs of most developing countries occasioned by population explosion and budget constraints have influenced most government agencies to shift from the conventional procurement systems to more innovative types of procurement. One popular option for meeting these infrastructure demands and improvement in service level has been private investment through concession agreements such as the Build Operate and Transfer (BOT). The use of BOT types of contract for infrastructure development has gained considerable acceptance and is becoming popular in many countries around the world. The BOT arrangement enables clients to have access to funds for the delivery of capital projects through financing partnership between a private and public agency (public private partnerships) with the parties receiving concession on planning, design, financing, execution and management of projects (Lekan *et al*., 2013; Al- Azemi and Bhamra, 2014; Garole and Jarad, 2016).

Public private Partnership (PPP) such as the BOT has been employed in the last few decades as an alternative procurement route for infrastructure development all over the world. Governments across the world embrace it as a procurement strategy for the provision of infrastructure due to financial constraints and increased demand for such important services by the citizens (Dankara, 2014). BOT has been successfully deployed in the development of mega infrastructure projects such as power, engineering, telecommunication and transportation in many countries like USA, Japan, Indonesia, Malaysia, Singapore, India, Canada and UK among others (Lekan *et al.,* 2013).

In Nigeria, the provision of infrastructure through the public private Partnership (PPP) cannot be termed as a success story, neither is it a total failure (Sanda *et al.,* 2013). Several projects were successfully executed through PPP while others failed to be actualized owing to problems of inadequate legal framework, lack of development finance, inadequate technical among others (Babatunde *et al.,* 2012 and Egboh and Chukwuemeka, 2012). The study attempts to develop a robust risk management framework for the implementation of BOT projects in Nigeria with the view to providing the necessary understanding of the context and types of risk inherent in such projects.

PUBLIC PRIVATE PARTNERSHIP (PPP)

PPP involves a contract between a public sector authority and a private party, where the private party provides a public service and assumes substantial financial, technical, and operational risk (Mohammed, 2012). In a number of PPP arrangements, the cost of using the service is borne exclusively by the users of the service and not by the taxpayer, while in some (notably the public Finance Initiative, PFI), the cost of providing the service is borne wholly or partly by the government. PPP is basically sought as alternative delivery arrangement to address some of the funding problems

challenging the traditional procurement system. Dankara (2014) observed that in the last few decades, PPP came up as an alternative route of procurement for infrastructure development in both the developed and the developing world. PPP has been used extensively and have over the years gain considerable acceptance in many parts of the world (Garole and Jarad, 2016).

PPP arrangements are basically employed to address the issue of financial constraints to execute the much needed infrastructure as a result of mismanagement, misappropriation and corruption in the public sector. They are also employed to remove responsibility of funding investment from government and to relieve short term public finance. It also introduces competition thereby ensuring the public sector best value for money and provides opportunity for innovation in the provision of public service.

Several types of PPP arrangements have been utilized, BOT being the commonest and the most popular (Garole and Jarad, 2016). Based on the original BOT, different variants have evolved and are being utilized in many countries including; Build Own Operate (BOO), Build Lease Transfer (BLT), Build Own Operate and Transfer (BOOT), Build Transfer Operate (BTO), Design Build Finance Operate (DBFO), Rehabilitate Own Operate (ROO) and Rehabilitate Operate Transfer (ROT) among others.

In Nigeria, the provision of infrastructure through the traditional procurement approach have been observed to be challenged by plethora of factors including inadequate planning, poor execution, political interference, poor management and lack of accountability and transparency which necessitated the search for alternative routes that led to the adoption of PPP (Babatunde *et al.,* 2012).

CONCEPT OF BUILD OPERATE AND TRANSFER PROCUREMENT

BOT is a project financing mechanism where the public partner with private sector in executing capital projects. Lekan *et al.* (2013) referred to BOT as a mechanism that helps a private entity to obtain a concession from the public to finance, design, construct and maintain a facility. The typical BOT arrangement has a complex structure comprising of multiple independent agreements among various parties including government agency, private company (concessionaire), contractors, suppliers, lenders (bank), equity investors, operators and financial advisers. Concession is normally granted by the government to the private sector through an agreement which enables the concessionaire to design, finance, construct and operate the facility. The concessionaire thereafter retains the title of ownership during the concession period which ranges between 10 and 30 years after which the title of ownership is transferred to the government (Tiong, 1995; Jeffereies and Chen, 2003; Lekan *et al.,* 2013 and Garole and Jarad, 2016). The typical BOT mechanism would provide for concession agreement, loan agreement, shareholder agreement, construction contract, supply contract as well as operation and maintenance agreement among others (Lekan *et al.,* 2013).

Based on the conventional BOT, diverse variants have evolved over the years in many countries including Build-Own-Operate-Transfer (BOOT), Build-Own-Operate (BOO), Build-Transfer-Operate (BTO), Build-Lease-Transfer (BLT), Build-Own-Operate-Maintain (BOOM), Design-Bid-Finance-Operate (DBFO)among others (Garole and Jarad, 2016; Patel, 2013).

Structure of BOT

Lengthy concession period and the existence of numerous agreements between various parties having different objectives are the typical characteristics of BOT contracts resulting in a complex structure with a high risk portfolio. The key stakeholders of a typical BOT contract are:

i. Government agency: The government agency is the statutory body that initiates, approves, monitors and controls the project to safeguard public funds and interests (Mubin and Ghaffar, 2008). The government department identifies, advertise, tenders and award the contract to a suitable sponsor to carry out the function of construction, operations and maintenance of the infrastructure. The government agency or the line ministry is usually referred to as the primary party.

ii. The sponsor: this is a party who responses to the invitation of the government and prepares, the proposal to construct, finance, and operate the project.

iii. Construction contractor: the construction contractor is responsible for delivering the project on time, within a budget and to a desired standard. The contractor takes on construction and completion risks.

iv. Operation and Maintenance Contractor: the operation and maintenance contractor would sign a contract with the sponsor for safe operation and subsequent maintenance of the facility with the anticipation of making profit for operating the infrastructure more efficiently than an equivalent government run project (Mubin and Ghaffar, 2008).

v. Financial Investors: these are banks and other lending institutions who provide loans to enable the sponsor implement the project. They also provide standby loan facility for cost overrun not captured by the contract.

vi. Equity Investor: equity investment usually is up to 20% of the cost of the project (Mubin and Ghaffar, 2008). The investor may also require a return of 18% to 20% to compensate for risks inherent in the infrastructure project.

vii. Technical, legal and other consultants are also parties of BOT agreements.

Risk Factors of BOT

The identification and classification of critical risk factors provides for a useful tool for analyzing the potential impact and consideration of appropriate strategies of mitigating their effects (Xenidis and Angelides, 2005). The classification of critical risk factors of BOT projects with the view to developing strategies for their management has been a subject of many studies across the world (Wang *et al.,* 2004; Schaufelberger, 2005; Akintoye, *et al.,* 2005; Sach*et al.,* 2007; Zhang *et al.,* 2008; Lekan*et al.,* 2013; Patel, 2013; Mane and Pimplikar, 2013; Chan *et al.,* 2015; Garole and Jarad, 2016). Tiong (1995) categorized risks associated with BOT into technical, political, and financial risks and concluded that political risk has the highest impact on the implementation of BOT projects. Akerele and Gidado (2003) revealed that from the myriad of risks factors associated with PPP arrangements, they identified and classified the risks into political risk, inflation risk, currency risk, regulation risk, completion risk, availability risk, operating risk, technology risk, market (demand) risk and resources risk. The study observed that political and regulation risks are the highest in terms of severity index. Thomas *et al.,* (2006) noted that private infrastructure under BOT have complex risk portfolio due to several factors such as lengthy payback period, lumpiness of huge investment, high developmental efforts and upfront cost, length of term of loan, susceptibility to political and economic risk, low market value of security package and complex construct mechanism involving many participants with diverging interest. Mohammed *et al.* (2012) classified risk into four categories of political risk, construction risk, operating risk and market and revenue risk. The study indicated that instability in the political system and change in policy affects the effective achievement of BOT projects significantly. Lekan *et al.* (2013) in their study of evaluating risk's cost implication from the perspective of concessionaire and professionals revealed that the common risk associated with projects expected are inflation, variation to works, changes in judgment policy and fluctuation nature of foreign exchange.

Patel (2013) identified a procedure for risk identification and its management based on the perception from the Indian construction industry players. The study revealed that time constraints and experience of the project manager are crucial for identification of the level of risk for large and complex projects. The study further suggested the integration of time and cost management with the identification process. Renuka *et al.,* (2014) discovered critical risk factors and assessment techniques through comparative study of various international projects. The review indicated that early project risk identification and assessment during the bidding and incorporated in the bidding package would assists in better estimation of budget and schedule. The study recommended a simple analytical tool for each project task for the assessment of risk swiftly for effective analysis. Chan *et al.* (2015) identified and evaluated typical risks associated with PPP projects in China. The study revealed that completion risk, inflation and price change risks have higher impact on Chinese PPP water projects while government corruption and imperfect law and supervision system and change in market demand have lower impact. The result of the investigation

would to a large extent assist in improving the efficiency of privatization in public utility service.

Garole and Jarad (2016) observed that infrastructure projects in developing countries are characterized by some typical risk factors due primarily to variables of legal systems, market situations and climate. Garole and Jarad (2016) investigated the risk factors of road projects in India and identified delay in approval, change in law, cost overrun, dispatch constraints, land acquisition and compensation, enforceability of contract, construction schedule, financial closing tariff adjustment and environmental risk as the key risk factors.

BOT projects are usually characterized by more risks than other traditional projects due primarily to different objectives and interest that are expected by a vast range of stakeholders (Chen *et al.,* 2015). The complexity of the projects under such financing mechanism is further compounded by the unique features, external uncertainties and multidisciplinary characteristics involved as well as the public agencies and stakeholders participation (Thomas *et al.,* 2006). Therefore it is imperative to properly identify and classify the risk factors with the view to developing a framework for effective project implementation.

Risk Management of BOT

Risk analysis and management is a highly desirable task for successful implementation of BOT projects which largely depends on the understanding the contexts and contents of the contract. Mubin and Ghaffar (2008) observed that the private sector in many developed countries is not well positioned to take on mega projects on their own. This circumstance provides for investors, lenders and operators to interplay in handling mega projects. Furthermore, the complexity of projects finance for BOT usually involves competing and conflicting interests between various parties especially lenders and shareholders, which adds to the risk inherent in such contacts. To effectively control the level of such risks and mitigate its effects, proper risk management is desired.

Various risk management models and frameworks have been suggested for the analysis and management of risk in BOT in many countries (Mubin and Gaffar, 2008; Jaskowski and Biruk, 2011; Mane and Pimplikar, 2013; Schafelberger, 2005; Fadun, 2013). Risks are as a result of plethora of factors some peculiar to some countries while some are common to all, hence the need to have a robust framework for identification and management. Typical risk management process involves risk identification, risk classification, risk breakdown structure, probability and impact factor determination, identification of critical risks, development of strategy and monitoring progress.

RESEARCH METHODS

Risk factors associated with BOT projects in Nigeria were obtained through the survey of relevant literature in published journals, factsheets, reports and other relevant national and international documents. The risk factors

were scrutinized by ten (10) experts, two (2) each drawn from the offices of developers, lenders, contractors, government and academics who have considerable experience and knowledge on the subject matter. The instrument was further modified and adopted based on the suggestions of the experts. The modified questionnaire consisted of 45 risk factors which provides for rating of the factors based on a five (5) point Likert scale ranging from "very critical" to "not critical". The population of the study involved professionals in the offices of government agencies, concessionaires, developers and lenders in Lagos, Port Harcourt, Kaduna and Abuja where ample PPP Projects have been realized under the BOT financing option. One hundred and twenty (120) questionnaires were randomly distributed (30 for each category of respondents) out of which 98 (81.6%) were returned and 86 corresponding to 71.6%were found to be fit for analysis. The information obtained were analysed to obtain criticality index (CI) and Mean Deviation (MD) of each risk factor based on the perception of the respondents.

RESULTS AND DISCUSSION

Profile of Respondents

The profile of the respondents for the survey is presented in Figures 1,2,3,4 and 5.

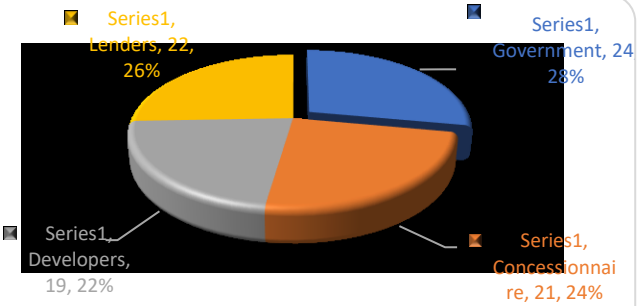


Figure 1. Categories of Respondents

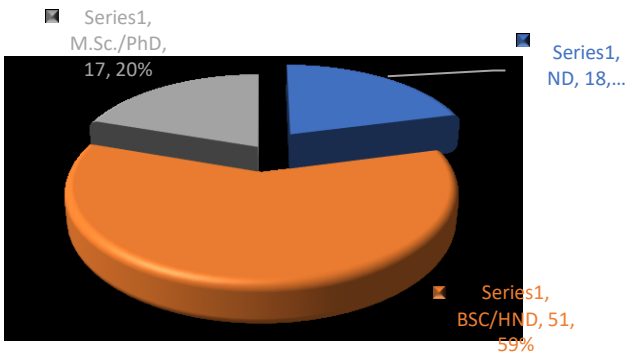


Figure 2. Educational Qualfication

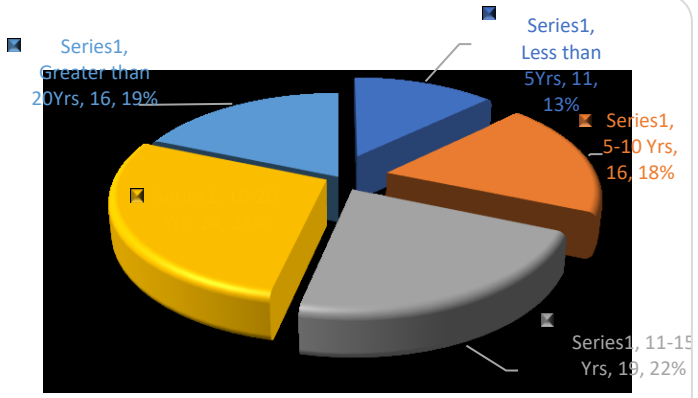


Figure 3. Work Expirience

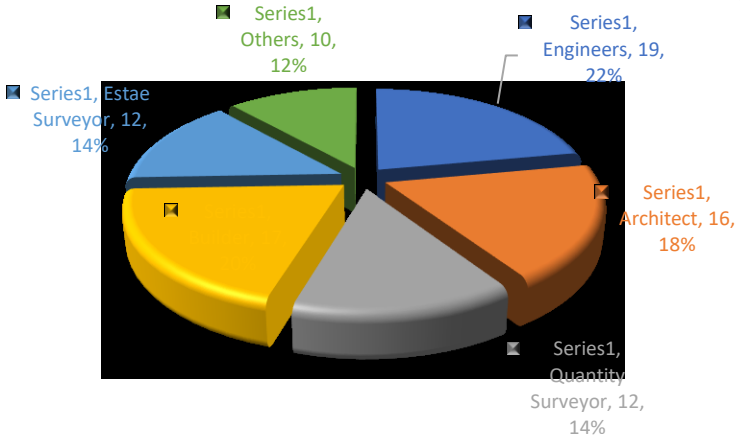


Figure 4. Profession of Respondent

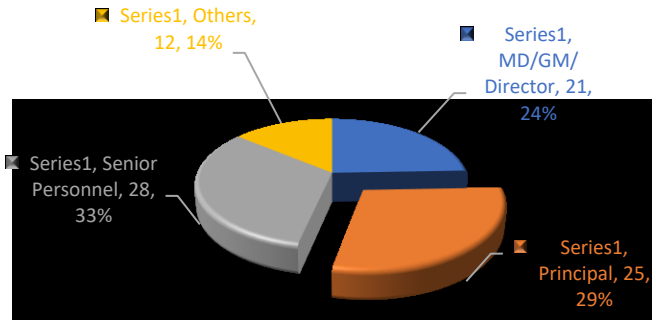


Figure 5. Position of Respondent

The demographic profile of the respondents revealed that 28% of the respondents are from government establishments whereas 24%, 22% and 26% are from the offices of concessionaires, developers and lenders respectively. The profiles further revealed that majority (59%) are first

degree holders and 20% either have master or Ph.D. degree. The results also show that majority of the respondents occupy management positions as principals, deputy directors or directors in their organizations. This result indicates that the information obtained from this category of respondents can be considered adequate.

Criticality Index of Risk Factors

The criticality index of risk factors under the categories of political risk, financial and revenue risk, legal risk, operating risk, construction risk, procurement risk and development risk are presented in Table 1. The views of the different groups of respondents showed agreement and similarity in earlier study (Waziri, 2016) which informed the combined analysis of their responses.

From the results, the risk factors with the highest CI under the categories of political, procurement, development, financial and revenue, construction, operating and legal are change in government policies, lack of experience in similar projects, excessive development cost, unfavourable general business environment, project company default and nonexistence of legal and regulatory system respectively. These are the risk factors that require utmost attention from clients and sponsors. However, looking at the indices irrespective of their categories, the risk factors with high CI are; change in government policy (4.3593), unfavourable business environment (4.2093), project company default (4.2093), time performance risk (4.1239), cost performance risk (4.0814), excessive development cost (4.0581), instability in government (4.0116) and failure to raise funds to finance the project (4.0116).

Change in government policy is a critical risk factor which impacts the effective implementation of BOT projects in Nigeria. This is in consonance with the studies of Akerele and Gidado (2003), Lekan *et al.* (2013) and Vosoughi and Vosoughi (2015) in which change in policies in respect of infrastructure projects and instability in government were identified as a critical risk factors for effective conception and implementation of BOT projects. Government's opinion in terms of policies relating to a project is critical for pulling government's effort toward implementation such project.

Unfavourable general business environment tends to discourage private sector investment thereby defeating the quest for public private partnership mechanism necessary for infrastructure project development. General business environment relates to the economic environment such as currency devaluation, foreign exchange fluctuation, fluctuation in interest rates, and inflation. These risks affect the cost of debt service and the real value of the project revenue.

Project company default is another critical risk factor of BOT projects in Nigeria that is requiring attention. Several factors are responsible for the nonperformance of project firms in the country; therefore, it is necessary to consider firms with tract record of performance for capital projects. This is in agreement with the study of Garole and Jarad (2016) which showed that

the effectiveness and efficiency of the private company is crucial toward realizing BOT projects in developing countries.

Table 1: Criticality Index of Risk Factors

Risk Factors	Criticality Index	MD	Rank
Political Risk			
Termination of concession	3.8721	0.2425	3
Adverse action of the government	3.5465	0.0831	5
Instability in government	4.0116	0.3821	2
Outbreak of hostilities (wars, riots and terrorism)	3.1163	0.5133	6
Lack of commitment to concession contract	3.5698	0.0598	4
Strong public opposition	2.9651	0.6645	7
Change in government policy	4.3953	0.7658	1
Procurement Risk			
Lack of experience in handling the project	3.8837	0.2542	1
Lack of expertise	3.5465	0.0831	4
Changes in project specifications	3.7558	0.1262	2
Expensive and lengthy tendering process	3.3605	0.2691	8
Lack of integrity in the tendering process	3.6977	0.0681	3
Flaws in contractual documentation	3.3953	0.2342	7
Delay in settling claims	3.4302	0.1993	6
Complicated negotiations	3.4535	0.1761	5
Development Risk			
Excessive development cost	4.0581	0.4286	1
Delays in design approval	3.6047	0.0249	2
Changes in design during construction	3.5814	0.0482	3
Delay in feasibility study	3.5349	0.0947	4
Unfavourable local conditions	3.3953	0.2342	5
Financial and Revenue Risk			
Failure to raise finance for the project	4.0116	0.3821	2
Unfavourable general business environment	4.2093	0.5797	1
Changes in demand of the facility over concession period	3.4767	0.1528	7
Change in economic policies	3.6628	0.0332	4
Inflation risk	3.7093	0.0797	3
Currency risk	3.7093	0.0797	3
Resources risk	3.5814	0.0482	6
Foreign exchange	3.5930	0.0365	5
Construction Risk			
Cost performance risk	4.0814	0.4518	2
Production target slippage	3.6047	0.0249	4
Time performance risk	4.1279	0.4983	1
Quality performance risk	3.7326	0.1030	3
Variation	3.7326	0.1030	3
Default by concessionaire	3.6047	0.0249	4
Force majeure	3.7326	0.1030	3
Labour shortage	3.2209	0.4086	5
Material unavailability	3.2791	0.3505	5
Inclement weather	2.9535	0.6761	6
Operating Risk			
Project company default	4.2093	0.5797	1
Labour risk	3.4419	0.1877	3
Error in operation and maintenance cost estimate	3.5814	0.0482	2
Unavailability of quality personnel to operate facility	3.1628	0.4668	4
Inappropriate operating methods	3.1628	0.4668	5
Legal Risk			
Nonexistence of legal and regulatory system	3.6047	0.0249	1
Changes in general legislation affecting the project	3.5930	0.0365	2

Time performance risk essentially affects the successful implementation of infrastructure project within time frame and projected cost. Akerele and Gidado (2003), Jefferies and Chan (2015) and Chan *et al.* (2015) indicated that many PPP projects had failed due largely to construction completion (schedule) risk. Moreover, delays in completion of concession projects will certainly lead to shortened operation life which reduces the investors' income. However, if a project could not start operation as scheduled, the private company would not have sufficient cash flow to pay for the debt and charges on borrowed funds resulting in an extension of operation time which increases operation cost and reduces profit (Chan *et al.,* 2015). Since BOT investors rely on income from the completed project to recover their investment, any delay in completion will certainly delay the generation of revenue.

Cost performance risk is a critical risk that should be focused upon while engaging in BOT projects. Cost performance of infrastructure projects is an accepted criterion for measuring success. It is however affected by numerous factors which stakeholders should focus on for effective project implementation.

Some private investors are not too enthusiastic about bidding for a BOT project due to Excessive Development cost which they may never recover. Therefore it is imperative for decision-makers to pay more attention to this risk factor because its effect on project viability is more critical and risk management techniques are required in order to mitigate and/or minimize its effects.

Instability in government results in cancellation or revision of contracts. In developing countries, it is extremely important to militate against political risks, since major political changes often occur. Before the implementation of BOT project, it is absolutely necessary for the promoter to conduct a thorough political risk profile to minimize the risk. The competence in carrying out detailed and comprehensive feasibility study, economic and risk assessment study would ensure the promoter to be in better position in obtaining domestic equity finance for funding the BOT project.

Capability of the company in raising capital for the BOT project is reflected on the share price. The equity investors and other long term investors will only agree to provide the amount of funding for BOT project when the promoter has proven financial capability of the project over its entire lifespan.

Risk Management Model

The proposed risk management framework is presented in Figure 5. From the investigation of the types of risk in BOT projects in Nigeria the following procedure is suggested for identification, analysis and management of risks with priorities to those with high criticality index.

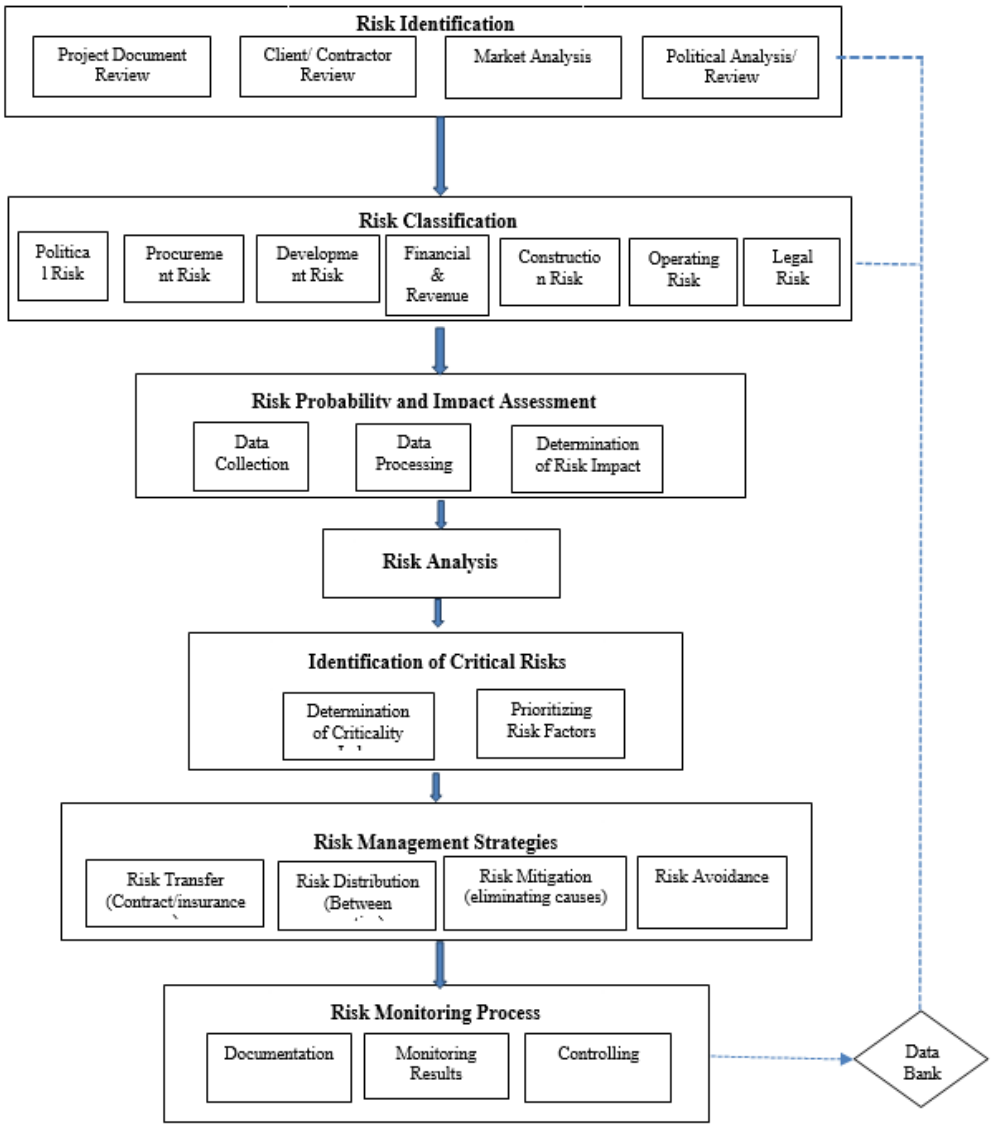


Figure 5: Risk Management Model for BOT Projects

Step I: List all risks associated with proposed BOT infrastructure.

Step II: Classify risk according to categories of political, procurement, development, construction, operating, financial, legal, e.t.c.

Step III: For each identified risk outline corresponding mitigating actions and identify available actions in sequences on the basis of effectiveness.

Step IV: Determine the criticality of each risk factor and rank the risks according to their critical index.

Step V: For each risk and its corresponding mitigating action, negotiate for its incorporation and improve on the concession agreement and other agreements as much as possible to ensure that all risk are covered.

Step IV: Allocate risk to relevant parties according to the principle that risk must be borne by parties capable of controlling it.

Step VI: Monitor the results of risk management as the project progresses

CONCLUSION AND RECOMMENDATIONS

The decision to invest in BOT projects requires thorough analysis and management of risks occasioned by the existence of several parties with different objectives and amount of interlocking agreements involved. The study identified forty five risks factors associated with BOT in Nigeria under the categories of political, procurement, financial and revenue, development, construction, operating and legal risk. Critical risks inherent in BOT projects were established based on their criticality index to provide stakeholders with adequate information and knowledge of the general business environment for investment in infrastructure projects. The study indicates that successful implementation of BOT largely depends on political stability and government policies in respect of the projects. Furthermore, from the results, risk management framework for evaluating the risks during the preliminary stages, before proceeding with the project was developed. The framework serves as a risk analysis and management tool for both private and public sector to establish decisions to minimize or eliminate risk in BOT projects in Nigeria.

Further studies in the area of software development for handling complex risk analysis and management for BOT in the country is recommended.

REFERENCES

Akerele, D and Gdado, K. (2003). The Risks and Constraints in the implementation of PFI/PPP in Nigeria: In Greenwood D.J. (ed). 19th Annual ARCOM Conference3-5th September, 2003.University of Brighton 1:379- 387

Akintoye, A., Bing, L., Edward, P.S. and Hardcastle, C. (2005). Critical Success Factors for PPP/PFI Projects in the UK Construction Industry. "Construction Management and Economics" 23(1), 459-471

AL-Azemi, K. and Bhamra, R. (2014). Risk Management forBuild, Operate and Transfer (BOT) Projects in Kuwait. "Journal of Civil Engineering and Management" 20(3),415-433

Babatunde, S.O., Opawole, A. and Akinsiku, O. E. (2012). Critical Success Factors in Public Private Partnership (PPP) on Infrastructure Delivery in Nigeria. "Journal of Facilities Management"10(3), 212-225.

Chan, A.P.C., Lam, P.T., Wen, Y., Aneyew, E.E., Wang, S. and Ke., Y. (2015). Cross Sectional Analysis of Critical Risk Factors of Public Private Partnership Water Projects in China. "Journal of Infrastructure Systems"21(1): 0401-0431

Dankara, B.N. (2014). Assessing the Effectiveness of PPP procurement Model for Infrastructure Development in Nigeria. Unpublished M.Sc. Thesis Submitted to the School of Postgraduate Studies, Ahmadu Bello University Zaria.

Egboh, E. A. and Chukwuemeka, E. (2012). Public Private Partnership in Nigeria: The challenge of Human Relation Management. "Arabian Journal of Business and Management Review" 1(5).

Fadun, S.O. (2013). Risk Management and Risk Management Failure: Lessons for Business Enterprise. "International Journal of Academic Research in Business and Social Sciences"2(3),225-239

Garole, A.P. and Jarad, G.P. (2016). Risk in Build Operate and Operate BOT infrastructure Projects. A case study of Shirwal-Lonad-Phaltan-Baramati Road Project. "International Journal of Recent and Innovation Trends in Computing and Communication"4(1),192-197

Jaskowski, P. and Biruk, S. (2011). The Conceptual Framework for Construction Projects Risk Assessment. RT &A. 2(3):27-35

Jefferies and Chan (2003). Identifying Risk Factors of BOOT Procurement: A case Study of Stadium Australia. "Australian Journal of Construction Economics and Building"4(1),11-20

Lekan, A., Opeyemi, J. and Olayinka, O.C. (2013). Performance of Build Operate and Transfer Projects Risks Cost Implications from Professionals and Concessionaires Perspective. "European International Journal of Science and Technology" 2 (3),239-250

Mane,S. and Pimplikar, L. (2013). Risk Assessment of BOT projects. International "Journal of Computational Engineering Research". 3(8),63-69

Mohammed I.Y. (2012). Public-Private-Partnership: An Overview. (2012). "Journal of Social Science and Public Policy"4(1),8-12

Mohammed, I.Y. Bala, K and Kunya, S.U. (2012). Risk in Build Operate Transfer Projects in Nigeria. "Journal of Environmental Sciences and Resources Management" 4(2012),29-39

Mubin, S. and Ghaffar, A. (2008). BOT Contracts: Applicability in Pakistan for Infrastructure Development. "Pakistan Journal of Engineering and Applied Sciences" (2008),33-46

Patel, k. (2013). A study of Risk Assessment and its Management in India. "American Journal of Civil Engineering". 1(2),64-67

Renuka, S.M. Umarani, C.S. andKamel, S. (2014). A Review on Critical Risk Factors in the Lifecycle of Construction Projects. "Journal of Civil Engineering Research" 4(2A),31-36

Sach, T. and Tiong, L.K.R. and Wang, S.Q. (2007). Analysis of Political Risk and Opportunities in PPP in China and Selected Asian Countries Survey Results. "Chinese Management Studies" 1(12), 26-148

Schaufelberger, J.S. (2005). Risk Management on Build Operate and Transfer Projects. Construction Research Congress, Paper 7547: 1-10

Thomas, A.V. Khalidini, N.K. and Ganesh, L.S. (2006). Modelling and Assessment of Critical Risk Factors in Build Operate and Transfer BOT Road Projects. "Construction Management and Economics" 24: 407-427

Tiong, L.K.R. (1995). Risks and Guarantees in Build Operate and Transfer tender. "Journal of Management in Engineering" 121(12),183-188

Vosoughi, V and Vosoughi, P. (2015). Survey, the Necessity of Use and Risk Identification in BOT Contracts. Cumhumet University, "Faculty of Science Journal" 36 (6), 290-796

Wang,S.Q., Tiong, L.K.R., Ting, S.K. and Ashley, D. (2000). Evaluation and Management of Political Risk in Chinas Build Operate and Transfer. "Journal of Construction Engineering and Management" 126(3),242-250

Wang, S.Q., Dulaini, M.F. and Aguria, Y.M. (2004). Risk Management Framework for "Construction Projects in Developing Countries", 2004(21):232-252

Waziri, B.S. (2016). Risk Factors Assessment of Build-Operate-Transfer (BOT) Projects in Nigeria. "" ATBU Journal of Science Technology and Education" 4(4): 47-59

Xenedis, Y. and Angelides, D. (2015). The Financial Risk in BOT Projects. Construction "Management and Economics" 23(4),431-441

Zhang L.J., Arthur, P.J.M. and Tao. F. (2008). Public Private Partnerships in China's Urban Water Sector. "Environmental Management" 41(6),863-872

SOCIO-ECONOMIC DETERMINANTS OF HOUSING SATISFACTION AMONG MIDDLE-INCOME HOUSEHOLDS IN OWERRI, NIGERIA

Chinwe Ugochi Okpoechi[1]
Department of Architecture, Federal Polytechnic Nekede Imo state Nigeria

Housing provision in Nigeria has not only been plagued by insufficiency in numbers, but also by inadequacies in quality. Housing quality is a predictor of housing adequacy. Adequate housing is housing that is in congruence with a family's needs and social status. Achieving this balance creates the possibility of residents experiencing satisfaction with their housing. Housing satisfaction must therefore be viewed as a critical element in housing provision, as it can substantially impact on the overall well-being of housing residents. This study addresses housing satisfaction among the middle-income in Nigeria, and the roles if any, socio-economic factors play in housing satisfaction among this income group. A total of 344 middle income households drawn from multi-stage sampling, were studied. Data collection was through administration of a structured questionnaire, and physical appraisal of housing formation in the study area. The socio-economic variables tested in the study are Income, Family size, Family structure, Level of education, Nature of employment, and Socialisation habits. Logistic regression test, with the logit dichotomous model was used for the analysis. The results of the study show that the socio-economic characteristics which significantly affect housing satisfaction among the middle-income group in Nigeria are Income, Nature of employment, and Socialisation habits. The other socio-economic variables could be accommodated by residents in their housing, if these three were adequately considered from inception. It is the conclusion of this study that housing design for this income group must place emphasis on affordable, cost-effective, and space-efficient housing, which will truly reflect good quality environments, and increase residents' satisfaction with their housing.

Keywords: housing satisfaction, mass housing, middle-income, Nigeria, socio-economic

INTRODUCTION

The Federal Government of Nigeria has over the years, made efforts to provide housing for its population, particularly the low and middle-income groups. Government intervention in mass housing in Nigeria dates back to pre-independence era (Onibokun, 1975; Aribigbola, 2000). Post-

[1] chinweokpoechi@yahoo.com

Okpoechi, C. (2017) Socio-economic determinants of housing satisfaction among middle-income households in Owerri, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1254-1273

independence forays into mass housing by the government have included the formation of National Council on Housing in 1971, instituting the Federal Mortgage Bank of Nigeria (FMBN), and establishment of housing corporations across the different regions in the country (UN-HABITAT, 1993). Further interventions were in the form of the National Housing Policy of 1991; revised in 2006, the campaign for Housing for all by the year 2000, among others.

Private property developers on their part have followed up, heeding the call for housing for all, by developing housing schemes targeting mainly the middle and high-income groups. One of such projects is the 324-units of residential houses in ELIM housing estate Enugu, commissioned on 11th July 2014, financed by Federal Mortgage Bank of Nigeria (FMBN) using the resources of the National Housing Fund (NHF) Scheme, and in partnership with a private sector developer. These housing schemes, visible in almost every urban area in the country, make up the public housing stock, as they are usually prototype buildings arranged in housing estates, and open to public acquisition and use.

Mass housing estates are typically developed along broad income stratifications, to capture a range of residents that fall within the stated categories. However, in spite of seeming income similarities among residents, different families have their peculiarities bordering on socio-economic factors, which often translate to functional requirements that demand serious considerations in their housing designs. It is obvious that in mass housing development, the possibility for housing designs to be tailored to the specific individual needs of every one of the housing residents, does not exist, in part due to the sheer numbers of housing units to be provided, in addition to the apparent anonymity of the eventual residents at the point of inception of the housing development. These factors notwithstanding, for mass housing to adequately meet the needs of its residents, it is important that mean functional housing design needs for each income category are established. These functional requirements should expectedly reflect the socio-economic characteristics of the population to be housed.

Presently, it appears that determination of the housing design needs for each group of consumers, based on the understanding of their socio-economic characteristics, usually does not precede the development of the schemes, judging by the resultant dislocation of some of the schemes, like the Festac and Shagari schemes in Lagos and across the country (Njoku, 2014). Improper articulation of housing schemes can result in inadequate housing which can lead to dissatisfaction among housing residents. This dissatisfaction is oftentimes expressed in unauthorised and poorly planned alterations to the houses, poor maintenance, and overall deterioration of the housing neighbourhoods, which can have implications for the general welfare of the residents.

Development of future housing schemes can only benefit from research which highlights specific issues affecting housing residents, rather than

from generalised statements harping on the inadequacies in the schemes. Generalised appraisals usually provide little factual evidence of the nature of the inadequacies in the existing housing schemes. It is important therefore that there is proper understanding of the various factors that play on housing residents as they interact with their houses, which could lead to either satisfaction or dissatisfaction. This paper addresses the issue of housing satisfaction among the middle-income in Owerri Nigeria, and how socio-economic factors peculiar to this income group interplay to affect residents' perceptions of satisfaction with their housing. This was done by firstly determining the socio-economic characteristics of this income group, followed by an appraisal of current housing formation in terms of the housing unit, and neighbourhood facilities and services. Determination of housing satisfaction was then based on the interplay of socio-economic characteristics of housing residents on the physical quality of their current housing and neighbourhood infrastructure. This is in line with the position espoused by Aigbavboa and Thwala (2013) that satisfaction as a concept can be assessed based on the post-usage evaluation of the product or service form which satisfaction is sought. Analyses of this information provides a basis for understanding the socio-economic factors that affect housing satisfaction among middle-income mass housing residents in Owerri. This information will also prove relevant in future estate developments, as it addresses issues of lifestyle preferences of the target group of any housing scheme, and can therefore be utilised for improved housing quality.

CONCEPTUAL FRAMEWORK

The significant, yet complex role housing plays in human development makes it imperative that housing occupants are satisfied with their housing. Satisfaction with housing indicates a high degree of agreement between actual housing situation and desired housing requirements (Vera-Toscano and Ateca-Amestoy, 2007). Housing satisfaction is very important, as shown in studies by Kellekci and Berkoz (2006), which showed that satisfaction towards the housing environment reflected residents' reaction not only to the physical and environmental components of housing, but also to the social factors and economic conditions around them. High dissatisfaction rates have a high potential of posing a negative impact on the overall well-being of a family (Husna and Nurizan, 1987). This argument provides the conceptual underpinning of this research, such that satisfaction with housing situation is seen as a reflection of the adequacy of the housing to its residents, and an indicator of societal order and well-being.

HOUSING NEED IN NIGERIA

The influence of housing on people's lives and well-being is well documented (Scottish Government, 2010; Barnes, Butt, and Tomaszewski, 2008; Evans, Wells, and Moch, 2003; Vandivere, Hair, Theokas, Cleveland, McNamara and Atienza, 2006). Housing has been identified as the central focus of everyday living, thereby raising the possibility that housing could act as a

pathway through which social and economic change can be effected. Over the years, there has been a lot of emphasis on mass housing delivery as a solution to the housing problems in Nigeria. This is predicated on the notion that every human being has a right to live in a home, as contained in Article 11(1) of the International Covenant for Economic, Social and Cultural Rights declaration, which recognizes the right of everyone to an adequate standard of living for himself, including adequate housing and a continuous improvement of his living conditions (United Nations General Assembly, 1966). In line with this philosophy, the United Nations placed an obligation on governments to carry out policies that would ensure adequate provision of housing for the entire population, including the urban poor, by instituting the Global Strategy for Shelter to the year 2000 (UN General Assembly, 1988).

Housing need however goes beyond availability of housing to include the design quality of housing development. The effects of housing quality on various aspects of life have been researched and documented (MORI Social Research Institute, 2002). Spiker (2011) identified a clear connection between bad housing design, and social problems like vandalism and build-up of refuse in the neighbourhood. Oladapo (2006) sees adequate housing as the foundation for stable communities and social inclusion, while Gilbertson et al (2008) observed a significant association between housing conditions and physical and mental health of an individual.

Despite efforts to make adequate housing available to the generality of the Nigerian population, various issues relating to quality and appropriateness of the housing to the target group have grossly undermined the success of the schemes. Some of the challenges identified in mass housing in Nigeria include poor design and construction quality (Olotuah, 1997; Agbola & Olatura, 2003), inadequate knowledge of the nature and scope of the country's housing problems (Olotuah and Taiwo 2015), and a narrow concept of the housing need (FGN, 1990 in Ayedun & Oluwatobi, 2011).

HOUSING SATISFACTION

Evaluation of existing housing provides necessary information to improve the design and development of future housing projects (Preiser, 1989). The concept of housing satisfaction over time has become the most widely used indicator for assessing the performance of housing (Adriaanse, 2007; Kellecki & Berkoz, 2006). Evaluating housing satisfaction as a basis for assessing housing performance is important because households judge their housing conditions based on the actual housing situation and norms, and are likely to express higher levels of satisfaction if their current housing situation meets the norms (Teck-Hong, 2012).

Housing satisfaction as defined by Galster (1987 p.93), is the "perceived gap between a respondent's needs and aspirations, and the reality of the current residential context". Housing satisfaction can also be described as the degree of contentment experienced by housing residents with regard to their housing situation (Mcgray and Day, 1997). As posited by Djebarni and Al-

Abed (2000), housing satisfaction, beyond physical and structural efficiency of the house, is a measure of the contentment experienced by the residents, as a result of the housing. It is usually influenced by the numerous components in the system, and the background characteristics of the occupants (Jaafar et al., nd). These include social, behavioural, cultural, and other aspects of the socio-environmental system (Onibokun, 1974).

Housing satisfaction can be evaluated based on the following criteria, summarised from researches by Onibokun (1974) and Oladapo (2006):

1. Functional and physical adequacy of the building
Functional and physical adequacy imply that the housing must permit the performance of those functions which define the family lives of the residents, while also being structurally stable, and a shield from the natural elements.

2. Convenience for family living
Satisfactory housing should have characteristics which align with residents' needs. This is because when there is incongruence between residents' preferences; which is largely determined by family lifestyle, and their actual housing situations, the chances of dissatisfaction with their housing increase (Diaz-serrano, 2009).

3. Privacy
Privacy within the home can be defined in four dimensions namely protection from outside noise (sound), having enough room not encroached on by others (space), protection from unwanted sights (sight), and feeling safe at home from break-ins (security) (Mulholland Research and Consulting, 2003).

4. Quality and adequacy of social and neighbourhood facilities
Availability of communal spaces increases the likelihood of increased interaction among neighbours, and has implications bordering on security, social balance, environmental improvement, and economic well-being.

5. Territoriality and neighbourhood security
The safety and security of people within their homes are core issues in their housing satisfaction. These can be guaranteed to an extent, only if the neighbourhood is also protected from intrusions. Neighbourhood security goes beyond physical security barriers to include the design and maintenance quality of housing areas. Good neighbourhood design and effective maintenance can contribute to a sense of community which can also be a deterrent to certain forms of anti-social behaviours, while on the other hand helping build community networks that oversee the security of housing neighbourhoods.

SOCIO-ECONOMIC FACTORS IN HOUSING SATISFACTION

Studies have shown that policies towards providing affordable and qualitative housing in Nigeria have achieved minimal successes over the years, largely because the socio-economic and cultural attributes of the end users are ignored, along with their personal preferences (Awotona, 1987;

Ukoha and Beamish, 1996; Fatoye and Odusami, 2009; Ibem and Amole, 2010). According to Mohit and Al- KhanbashiRaja (2014), apart from the host of variables relating to housing and its environment which exert significant influences on housing satisfaction, other important factors such as the culture and values of a people also play major roles in their perceptions of housing satisfaction. This further reinforces the importance of case specific research, as a guide to public policies on housing.

Previous researchers have found linkages between housing satisfaction and factors like age (Varady and Preiser, 1998), family structure (Tan and Hamzah, 1979; Miller and Crader 1979 cited in Theodori, 2001), education, income, employment status, length of residency, and physical characteristics of the house (Yeh, 1972). Additionally, fulfilled housing preferences have also been shown to predict quality of life (O'Connell et al., 2006). This follows that notwithstanding the subjectivity of housing satisfaction, it is still a very important predictor of the overall quality of life of housing residents.

Socio-economic status (SES) and socio-economic class are terms used to stratify population according to the interplay of social and economic factors. It may also be defined as a measure of an individual's place within a social group based on various factors, including income and education (gse.berkely.edu). In absolute terms, the middle-income group as defined by the African Development Bank (AfDB, 2011) is a group of individuals or households with annual income exceeding $3,900 (₦627,900) in purchasing power parity. The middle class is also defined by the bank in relative terms, as individuals and households that fall between the 20th and 80th percentile of the consumption distribution

It is believed that the socio-economic status of a household plays a major role in the quality of their housing (Hwang et al, 1999). The socioeconomic factors that can affect the quality of housing formation are income, family size, family structure, education, nature of employment, and socialization habits. These are briefly described as follows:

Income - income determines to a large extent, the quality of housing a housing consumer can afford irrespective of what facilities he may be required to make his house a suitable home for his family. Limited income also translates to reduced expectations, such that housing satisfaction may be experienced at a lower scale of housing quality than for those with higher incomes.

Family size – family size is a major consideration in housing. Family size may be affected by the extended family system, and adequate space provisions should be available for family members to perform their chosen activities. Family activities include food preparation, dining, bathing, and entertaining, family recreation, sleeping, among others. Some of these activities require dedicated spaces, while some others may be performed in convenient locations within the house. It is expected that family size would affect perceptions of appropriateness of space provision, as posited by Jiboye

and Ogunshakin (2010), in asserting that for housing to be appropriate, it should have spatial relevance to its occupants' lifestyle.

Family structure – family structure may include nephews, nieces, cousins, grand-parents and others alike. Polygamy where it exists will pose its own challenges. Age and sex distribution are also important aspects of family structure that have implications for design.

Education – this includes level of educational attainment, whether primary, post-primary or tertiary. Educational background also determines a person's level of exposure and can affect his judgments and perceptions of things around him.

Nature of employment –Occupation and employment status may affect regularity of income, and may lead to operating income-yielding activities in the home which may include poultry business, small retail outlets, small-scale food processing, and vocational businesses like tailoring hairdressing etc. These may have implications for housing satisfaction.

Socialisation habits – the socialisation trends of housing consumers can affect their housing preferences. Where the residential environment is used for socialisation purposes, the housing consumers would want their housing to accommodate the nature and frequency of their social functions. Socialisation trends may extend beyond the housing unit to include the need for communal spaces for neighbourhood gatherings and activities. Additionally, adherence to traditional lifestyles, including demand for traditional dishes and their methods of preparation could affect kitchen layout. There may also be the need for outdoor relaxation spaces for family evening story-telling sessions where applicable.

The socio-economic factors here outlined, largely determine the lifestyles of housing consumers, and by extension, their preferences. Awotona et al (1994) opine that housing design that contradicts users' preferences and lifestyles would invariably lack originality and relevance. Jiboye and Ogunshakin (2010) believe that responsive housing should integrate housing designs with the physical, socio-economic and cultural peculiarities of a people. Diogu (2002) underscores the need for proper research on the lifestyle of housing consumers before designing a housing scheme for them, and states that housing programs seldom succeed, when data for the schemes are not based on strong preliminary research conducted on the target consumers.

RESEARCH METHODS

The study area Owerri, is the capital city of Imo state, situated in the south-eastern part of Nigeria. There are three local government areas that make up Owerri namely; Owerri municipal, Owerri North, and Owerri West. The total population for the three local government areas was 401,873 in 2006 (NPC, 2006). Owerri is home to a vibrant housing sector. There are different categories of public housing developments in Owerri.

- Firstly, there are estates which are wholly planned and built by the government, through contractors. These include Aladinma Housing estate and extension, federal Housing estate, Uratta, Imo housing Uratta, Egbeada Housing estate (1st phase).
- The second category of estates is planned by the government, and prototype designs made available to would-be developers. In these estates, properties are acquired by private persons, who are required to build according to government prepared designs.
- There is yet another type of estates, where the government makes land available to private developers, who plan and build the housing estates. The developers enter into a joint venture with the government for the sale and management of the estates. Area H Housing Estate New Owerri and Graceland housing estates fall within this category.

The common feature in all these estates is the existence of prototype building plans, which were designed without prior input of the housing residents.

Research strategy – quantitative research strategy was adopted for this study. The focus of the research was to find out if socio-economic factors have any effect on housing consumers' satisfaction with their housing, and to establish which of the socio-economic factors were more critical in achieving housing satisfaction. For this study, descriptive quantitative research method, specifically survey research using structured questionnaire, was employed to elicit information from housing consumers within the study area.

Table 1 – Estates and house distribution in Owerri as at April 2012 (Government Estates)

Estate	2 Br (D)	2 Br (SD)	3 Br (D)	3Br (SD)	4Br (D)	Total
Aladinma	93	203	114	-	5	415
Federal housing Uratta	14	-	116	-	14	144
Prefab	10	76	33	-	2	121
Trans-Egbu	63	16	82	-	15	176
Uratta Road	27	-	142	-	39	208
Prefab Ext I	18	-	31	-	22	71
Prefab Ext II	-	-	27	-	17	44
Aladinma Phase II	-	-	2	-	14	16
Umuguma Area 'S'	-	-	15	-	14	29
Umuguma Area 'X'	-	-	50	-	92	142
Umuguma Area 'XA'	14	24	16	-	109	163
Redemption	44	19	223	11	2	299
Avu/Oforola	4	-	20	-	28	52
Total	287	338	871	11	373	1,880

Source- Imo State Housing Corporation ISHC Owerri (2012)
Note: D – detached, SD – Semi-detached

Population of study - The research population included all residents of middle-income mass housing estates in Owerri capital territory. This did

not include middle income housing areas where individual property owners were wholly responsible for the design and construction of their houses, and were not required to build according to an approved prototype. Housing estates within Owerri are usually a combination of housing for different income groups. In such estates, middle-income sections were delineated for the survey. The types of houses that fall within the middle-income category include two-bedroom, three-bedroom, and four-bedroom detached or semi-detached bungalows and flats. Only these categories of houses were included in the survey.

Two other mass housing estates outside the coverage of Imo State Housing Corporation (ISHC) were included in the study, as they met the criteria for the sample population.

Table 2 Number of houses in Egbeada and Graceland Housing estates

Estate	No of units (3 & 4 Br detached)
Egbeada	136
Graceland	141
Total	277

Source - Physical Enumeration by Researcher (2012)

The total number of housing units that made up the sample population is 1880 + 277 = 2,157.

Sampling procedure - The sampling techniques adopted for the research were structured to ensure that the final sample size was truly representative of the population for purposes of determining parameters or characteristics of the whole population. Multi-stage sampling was used for the study. A combination of convenience sampling, simple random sampling, and systematic random sampling techniques were used at different stages of the sampling procedure. Non-probability convenience sampling was used to select the housing estates from which the sample population was drawn. These estates were chosen based on convenience and their accessibility to the researcher. Twelve (12) out of the fifteen (15) middle income housing estates identified in this research were chosen for the survey, based on convenience. The estates were grouped into eight distinct housing areas as shown in Table 3.

Table 3 - List of selected housing estates in Owerri.

S/n	Medium income housing	Total number of houses
1	Uratta Road Housing estate	208
2	Federal housing estate, Uratta road	144
3	Aladinma housing estate	415
4	Prefab, Prefab Ext I, Prefab Ext II	236
5	Umuguma housing estate 'X', 'XA', 'S'	334
6	Graceland estates Irete	141
7	Trans Egbu housing estate	176
8	Egbeada housing estate	136
TOTAL		1,790

Table 4 – List of housing estates where the survey was carried out

S/n	Medium income housing
1	Federal housing estate, Uratta road
2	Aladinma housing estate
3	Prefab, Prefab Ext I, Prefab Ext II
4	Graceland estates Irete
5	Egbeada housing estate

Simple random sampling without replacement was used to select five (5) housing estates out of the list of eight (8) chosen based on the researcher's convenience. The estates chosen by random sampling are shown in Table 4. Systematic random sampling was used to select the individual housing units, which made up the survey sample. In this sampling technique, one unit was initially selected on a random basis in each estate, while the other units were chosen at evenly spaced out intervals of two houses apart until the desired number of units was obtained.

Sample size – The sample size was calculated using the Watson (2001) formula as shown

$$n = \frac{\left\{\dfrac{P[1-P]}{\dfrac{A^2}{Z^2} + \dfrac{P[1-P]}{N}}\right\}}{R} \qquad \ldots. \qquad (1)$$

Where: n = sample size required

N = number of people in the population (number of households)

P = estimated variance in population, as a decimal (0.5 for 50-50, 0.3 for 70-30)

A = precision desired, expressed as a decimal (ie. 0.05 for 5%)

Z = based on confidence level: 1.96 for 95% confidence

R = estimated response rate as a decimal (0.8 for 80%)

In applying this equation, the considerations made included:

1. The degree of variability expected in the population was assumed to be in the ratio of 70:30. This is because the study population is made up typically of people in the middle-income category, ranging from the floating class to upper-middle class. According to Watson (2001) the higher the degree of variability expected in the target population, the larger the sample size must be to obtain the desired level of precision. As a result, this study did not require a very large sample size to achieve an accurate result, being a relatively homogeneous population.
2. The response rate was estimated at 80% because of the method adopted in the distribution of the questionnaire. The use of dedicated

research assistants who were also residents of the estates they surveyed led to the assumption of a high return rate of 80%.

3. A confidence level of 95% was assumed for the study. This level is standard for most social science researches (Watson, 2001).

$$n = \frac{\left\{\frac{0.3[1-0.3]}{\frac{0.05^2}{1.96^2} + \frac{0.3[1-0.3]}{2157}}\right\}}{0.8} \qquad n = \frac{280}{0.8} = 350$$

To determine the socio-economic factors that affect housing satisfaction among the middle-income group in Owerri, a total of 350 copies of structured questionnaire were administered with the help of dedicated research assistants over a period of four (4) weeks. The number of questionnaires returned was 344, making a response rate of 98%. The information elicited from the respondents included their socio-economic characteristics, the physical characteristics of their housing, and their satisfaction with their housing. In addition, physical appraisals of some selected prototypes were undertaken by the researcher, to validate the data from the research instrument.

FINDINGS AND DISCUSSION

The houses surveyed were 2-bedroom, 3-bedroom, 4-bedroom, and 5-bedroom house types. 12.8% of the houses were 2-bedroom house types, 51% were 3-bedroom, 26.6% were 4-bedroom, and 9.6% were 5-bedroom house types.

Summary of the socio-economic characteristics of surveyed households showed that majority of the households (63%) are headed by persons earning incomes ranging from N240,000 ($1,500) to N1,199,999 ($12,500) per annum. This translates to between N20,000 ($125) and N100,000 ($625) monthly. Only 16% of the population earn incomes of more than N2,400,000 (N200,000 or $1,350/month) per annum. These data show that majority of residents of middle income mass housing estates in Owerri fall within the lower-middle income category.

The results further showed that 96.7% of all respondents had a post-secondary education. 2.7% had maximum qualification of a secondary education, while respondents with only primary school education or no education accounted for only 0.6% of the population. Average middle-income household size is between 2 to 5 persons, with 56.1% of the population falling within this category. Household size is calculated as the total number of residents living together in one house, regardless of family relationship. Large households among this income group range from 6 to 9 persons, and were observed in 37.5% of the population. Households with 10 or more persons were clearly in the minority being only 6.4% of the population. It was also observed that household sizes were not made up entirely of nuclear

family members, but extended and non-family members also. 31.7% of the population live in exclusively nuclear family households. The remaining 68.3% are made up of a mix of extended family (40.3%) and non-family (28%) households.

Table 5- Summary of General information of respondents

General information		Frequency (no)	Total responses (no)	Percentage (%)
Gender	Male	202	344	58.7%
	Female	142		41.3%
Age	21-30 years	41		12.1%
	31-40 years	90		26.6%
	41-50 years	104	338	30.8%
	51-60 years	51		15.1%
	61 years and above	52		15.4%
Marital status	Married	281		83%
	Separated	0		0%
	Divorced	0	341	0%
	Widowed	21		6%
	Single	39		11%
Housing estate	Federal housing Uratta	75		22%
	Prefab	75		22%
	Graceland	44	344	12%
	Aladinma	75		22%
	Egbeada	75		22%
Status of residency	Rent paying tenant	113		32.8%
	Official residence	42	344	12.2%
	Home owner	189		55%
Time lived in the house	Less than one year	40		11.6%
	1 to 5yrs	96		27.9%
	Up to 10 years	79		23%
	Up to 20 years	47	344	13.7%
	More than 20 years	82		23.8%

Source Author's Fieldwork (2012)

The age distribution of middle-income housing residents showed the highest frequency among the 26 to 50yr age range. 81.8% of all the residents fall within this age range, which also accounts for the bulk of the socially, economically, and biologically active group of persons in any population. Children between the ages of 0-5 yrs were found in a little above a third (36.8%) of the households. Children 6-17 yrs were found in 54.8 % of all

households, accounting for more than half of the households surveyed. All age ranges were appropriately captured in significant proportions in most of the houses surveyed, meaning that housing formation in these estates must target needs that cut across all ages, from the very young to the old.

Table 6 – Facilities in the houses surveyed

Facility	Frequency (no)	Number of respondents	Percentage (%)
Living room			
One (1)	220		70.5%
Two (2)	92		29.5%
Dining room			
Available	260	312	83%
Not available	52		16%
Bedroom(s)			
Two	40		12.8%
Three	159		51%
Four	83		26.6%
five	30		9.6%
Library			
Available	13		4.2%
Not available	299		95.8%
Study			
Available	47		15%
Not available	265		85%
Kitchen			
Available	312	312	100%
Not available	0		0%
Store			
Available	246		78.8%
Not available	66		21.2%
Laundry/utility			
Available	56		17.9%
Not available	256		82.1%
Toilets			
One (1)	64		20.5%
Two (2)	127	312	40.7%
Three (3)	53		17%
Four (4)	68		21.8%
Bathroom			
One (1)	64		20.5%
Two (2)	146		46.8%
Three (3)	98		31.4%
Four (4)	4		1.3%
Garage/carport			
Available	147		47%
Not available	165		53%
Verandah/porch/sit-out			
Available	260		83.3%
Not available	52		16.7%
Parking space			
Available	263		84.3%
Not available	49		15.7%
Play area			
Available	194		62.2%
Not available	118		37.8%

Source Author's Fieldwork (June 2012)

Twenty two percent (22%) of all respondents were not in active employment; 5% of whom were unemployed, while 17% were retired. Of the remaining 78% engaged in active income yielding ventures, 33.5% were employed in the public service, 20.5% in the private sector, while 20% were self-employed. This statistic points to the fact that majority of middle income mass housing residents are persons outside government employ. This factor notwithstanding, prevalence of home-operated businesses was low at 31.1%, with 68.9% of respondents indicating that they did not operate any active businesses from their homes.

The regularity of social gatherings and socially related activities were also observed to be quite low in all categories identified in the research. Respondents who indicated hosting social gatherings in their houses either very often or often were 13.8%. On the other hand, 55.4% indicated that this occurred only sometimes. In the same vein, regular participation by families in outdoor activities, in the very often and often categories, was 14.8%, and entertainment of unannounced visitors overnight was 16.7%. These data show that these socialisation trends were not regular features of the lifestyles of the residents of the surveyed households.

Table 7 – How socio-economic characteristics of residents affect their decision to continue to live in present housing

Socio-economic considerations	Rating frequency				
	5	**4**	**3**	**2**	**1**
Affordable	121	88	84	25	26
Spacious for family size and structure	136	99	55	38	16
Suits nature of work	115	90	77	30	32
Suits level of education	130	98	62	26	28
Suits socialization habits	102	64	79	33	66

Source – Author's Fieldwork (2012)

Table 8 - Housing satisfaction rating of respondents based on willingness to continue living in house

Housing satisfaction indices	Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree
House is spacious enough to accommodate family	87	161	22	59	15
Facilities in the house complement residents' lifestyle	69	146	62	49	18
Housing gives satisfaction	96	89	36	16	7
Willingness to continue to maintain house	140	182	10	4	8
No need for unapproved amendments to the house	46	92	111	72	23
Would like to continue to live in house	65	128	96	39	16
Would like to continue to live in estate	85	176	42	29	12
Would move into another house like this	81	144	56	43	20
Would recommend present house to a friend	99	198	21	23	3

Source – Author's Fieldwork (2012)

Table 9 – Factors that will determine choice of future housing

Determining factors	Rating Frequency				
	5	4	3	2	1
Cost of the house	247	51	30	8	8
Adequacy of facilities in the house for family size	284	35	21	4	0
Efficiency of space design	356	59	29	0	0
Quality of finishing	248	72	29	0	0
Visual quality of house	253	57	30	4	0
Privacy from neighbours	235	57	30	4	0
Allowance in the design for possible expansion of house	190	116	18	11	9
Quality of the neighbourhood (visual quality, security, facilities)	286	48	7	0	3
Ease in accessing social services (public transportation, schools, shops)	253	54	29	8	0

Source – Author's Fieldwork (2012)

Table 10- Housing satisfaction among residents

Housing Satisfaction	Freq.	Percent	Cum.
Not Satisfied	178	51.74	51.74
Satisfied	166	48.26	100
Total	344	100	

The survey showed that 51.74% of the residents were not satisfied with their housing, while 48.26% expressed satisfaction with their housing. Applying the logit dichotomous model, three (3) out of the six (6) socio-economic factors analysed were found to significantly affect housing satisfaction among middle-income mass housing residents in Owerri. The socio-economic factors found to affect housing satisfaction in this study are income, employment status and socialisation habits. Level of education, family size and family structure were found not to be significant determinants of housing satisfaction among this income group. The regression table is shown in table 2 below.

Table 11 – Housing satisfaction and socio-economic characteristics of respondents

Logistic regression — Number of obs = 341
LR chi2(6) = 30.04
Prob > chi2 = 0.0000
Log likelihood = -221.22388 — Pseudo R2 = 0.0636

Y1	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
X1	0.470591	0.1783247	2.64	0.008	0.1210812	0.820101
X2	-0.16739	0.1935877	-0.86	0.387	-0.5468121	0.212038
X3	-0.28211	0.2286075	-1.23	0.217	-0.7301684	0.165957
X4	-0.02832	0.1378101	-0.21	0.837	-0.2984189	0.241787
X5	0.283569	0.079103	3.58	0.000	0.1285299	0.438608
X6	0.154261	0.051461	3	0.003	0.053399	0.255123
_cons	-2.68929	1.117151	-2.41	0.016	-4.878865	-0.49971

X1 = Income **X2** = Educational Qualification **X3** = Family Size **X4** = Family Structure **X5** = Employment Status**X6** = Socialization **X1** = Income **X2** = Educational Qualification **X3** = Family Size **X4** = Family Structure **X5** = Employment Status**X6** = Socialization Habits

From the table above, following the decision rule, given the column, P > |z|, null Hypotheses 1, 5 and 6 are rejected and the alternatives accepted. This means that *Income, Employment Status* and *Socialization Habits* contribute significantly to the Housing Satisfaction of middle income housing residents in Owerri. As seen from the analysis, the coefficients of X1, X5 and X6 are positive. This means that, these variables increase satisfaction when they are increased.

CONCLUSION

The socio-economic factors that significantly affect housing satisfaction among the middle-income group are *income*, *nature of employment*, and *socialization habits*. Other factors like family size, family structure and level of education were found not to be significant determinants of housing satisfaction among this group. Studies by Vera-Toscano and Ateca-Amestoy (2008) showed higher levels of satisfaction with higher educational attainment. This could not be established in this study, as the level of education among the survey population was relatively uniform, and could therefore not be isolated as a significant determinant of their housing satisfaction.

Findings of this research which show that income and nature of employment, rather than family size and structure have significant effects on housing satisfaction among the middle-income group affirm that middle-income housing residents in Owerri are satisfied with space and quality requirements of housing they can afford, effectively de-emphasizing large houses with expensive finishing for this group. The predominant house types in this study were the 3-bedroom and 4-bedroom units, while family size ranged from two (2) to nine (9) persons. It follows then that emphasis in housing design and development for this group would be to ensure effective and efficient management of resources to achieve functional cost-effective houses.

Premised on these findings, the research concludes that the quality of mass housing in Nigeria can be improved, through proper understanding of the intended category of residents. As established in this study, this group is highly educated, majority of whom are gainfully employed, and not engaged in any forms of money yielding activities in their homes. Accordingly, they see their homes principally as places for family expression and personal actualization. Expectedly, the design of their housing must meet these requirements, for them to experience any real satisfaction.

Results of this study will prove beneficial in developing policies for future mass housing schemes for the middle-income population in Nigeria. Housing development in this case would emphasise a sense of community, through provision of good and workable neighbourhood facilities that will address the issue of socialisation habits among this income group. In addition, individual housing units should range from two (2) to four (4) bedroom house types, with ancillary and supporting spaces provided to serve a varied range of functions. This effectively eliminates the need to

create dedicated rooms for certain household activities, as flexibility in space design would ensure that all household activities are accommodated in more compact floor plans. This addresses the critical aspect of affordability, which was found to be major factor in housing satisfaction for this group.

Finally, findings of this study should stir up further enquiries into more cost-effective ways of delivering adequate housing to the middle-income group in Nigeria.

REFERENCES

Adriaanse, C. C. M. (2007) "Measuring Residential Satisfaction: A Residential Environmental Satisfaction Scale (RESS). *Journal of Housing and the Built Environment* 22, pp 287-304.

African Development Bank (2011) *The Middle of the pyramid: Dynamics of the middle class in Africa.* Market Brief April 20, 2011. [online] http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications.pdf [23rd July 2012]

Agbola, T. and Olatura, C. O. (2003) "Private Sector driven Housing Delivery in Nigeria: Issues, Constraints, Challenges and Prospects", A lead paper presented at the 2nd Annual Workshop on private sector driven housing delivery in Nigeria, University of Lagos, 30th June – 3rd July.

Aigbavboa, C. And Thwala, W. (2013) "A Theoretical Framework of Users' Satisfaction/Dissatisfaction Theories and Models", 2nd International Conference on Arts, Behavioural sciences and Economics Issues (ICABSEI 2013), Dec17-18 Puttaya Thailand.

Aribigbola, A. (20000 "Conceptual issues in Housing Provision in Nigeria" in Akinbamijo, O. B., Fawehinmi, A. B., Ogunsemi, D. R., and Olotuah, A. O. (Eds.) *Effective Housing in the 21st Century.* The Environmental Forum FUTA pp 1-8.

Awotona, A. (1987) "Housing policy in Nigeria: Government Policies for Housing Nigeria's Urban Poor and the Working Class, Laudable great expectation, colossal failure". *Habitat International* 11(2) pp 89-103.

Awotona, A., Ogunshakin, L., and Mills-Tettey, R (1994) "Multi-Habitation and Cultural Structures: Experiences from Nigeria" *Proceedings of the conference on Ideal homes? Towards a sociology of domestic architecture and interior design*, University of Teesside, Middlesborough, United Kingdom, 6-8 September 1994.

Ayedun, C. A. and Oluwatobi, A. O. (2011) "Issues and Challenges Militating against the Sustainability of Affordable Housing Provision in Nigeria" *Business Management Dynamics* Vol 1 pp 1-8

Barnes, M., Butt, S., and Tomaszewski, W. (2008) The Dynamics of Bad Housing: The Impact of Bad Housing on the Living Standards of Children. National Centre for Social Research NatCen

Evans, G., Wells, N., and Moch, A. (2003) "Housing and Mental Health: A Review of the Evidence and a Methodological and Conceptual Critique" *Journal of Social Issues,* 59(3) 475-500

Diaz-Serrano, L. (2009) "Disentangling the Housing Satisfaction Puzzle: Does Home Ownership Really Matter?" *Journal of Economic Psychology* Vol 30 pp 745-795

Diogu J. O. (2002) "Housing the Poor in Nigeria: the Integrated Project Approach" *AARCHES Journal* No 2 Vol 1 pp 40-44

Djebarni, R. and Al-Abed, A. (2000) "Satisfaction Level with Neighbourhoods in Low-income Public Housing in Yemen", *Property Management,* 18 (4): 203 – 239

Fatoye, E. O. and Odusami, K. T. (2009) "Occupants' Satisfaction Approach to Housing Performance Evaluation: The case of Nigeria" Paper presented at the RICS COBRA Research conference held at the University of Cape Town 10-11 September 2009.

Galster, G. (1987) "Identifying the Correlates of Dwelling Satisfaction: An Empirical Critique" *Environment and Behaviour* 19(5), pp 539-568

Husna, S. and Nurizan, Y. (1987) "Housing satisfaction and low-income households in Kuala Lumpur" *Habitat International* 11(4) pp 27-38

Hwang, S.; Fuller-Thompson, E.; Hulchanski, J.D.; Bryant, T.; Habib, Y. and Regoeczi, W. (1999) *Housing and Population health: A review of the literature*. Centre for Applied Social Research, University of Toronto.

Ibem, E. O. and Amole, O. O. (2010) "Evaluation of Public Housing Programmes in Nigeria: A Theoretical and Conceptual Approach". *The Built Environment Review,* 3; 88-116.

Jaafar, M.; Hasan, N. L.; Mohamad, O.; Ramyah, T. (nd) "The Determinants of Housing Satisfaction Level: A Study on Residential Development Project by Penang Development Corporation (PDC)" [online] http://www.fppsm.utm.my/download/doc_view/73-the-determinants-of-housing-satisfaction-level-a-study-on-residential-development-project-by-penang.html [3rd July 2012]

Jiboye, A. D.; and Ogunshakin, L. (2010) "The Place of the Family House in Contemporary Oyo Town in Nigeria" *Journal of Sustainable Development* Vol 3 No 2 pp 117-128 [online] http://www.ccsenet.org/jsd [4th May 2012]

Kellekci, O. L., and Berkoz, L. (2006) "Mass housing: User Satisfaction in Housing and its Environment in Istanbul, Turkey" *European Journal of Housing Policy* 6(1): 77-99

McGray, J. W. and Day, S. S. (1997) "Housing Values, Aspirations and Satisfactions as Indicators of Housing Needs", *Home Economics*, 5 (4): 244 – 254

Mohit, M. A. and Al-KhanbashiRaja A. M. (2014) "Residential Satisfaction-Concept, Theories and Empirical Studies" Planning Malaysia: urban Planning and Local Governance III: 47-66.

MORI (2002) *Public attitudes towards Architecture and the Built Environment*, Research carried out by the MORI Social Research Institute for Commission for Architecture and the Built Environment CABE.

Mulholland Research and Consulting (2003) *Perceptions of privacy and density in housing,* Report on Research findings prepared for the popular house group. August 2003 [online] http://www.cabe.org/files/perceptions-of-privacy-and-density-in-housing.pdf [6th September 2012]

Njoku, J. (2014) "Why Festac, Shagari Schemes Failed – Expert" Vanguard 29th April 2014 [online] www.vanguardngr.com/2014/04/festac-shagari-housing-schemes-failed-expert/

NPC (2006) *National Population Census of Nigeria,* Federal Republic of Nigeria.

O'Connell, M., Rosenheck, R., Kasprow, W., and Frisman, L. (2006) "An Examination of Fulfilled Housing Preferences and Quality of Life among Homeless Persons with Mental Illness and/or Substance use Disorders" *The Journal of Behavioural Health Services & Research*, 33: 354-365

Oladapo, A. A. (2006) "A Study of Tenant Maintenance Awareness, Responsibility and Satisfaction in Institutional Housing in Nigeria" *International Journal of Strategic Property Management* 10 pp 217-231

Olotuah, A. O. and Taiwo A. A (2015) "Housing Strategies and Quality of Housing in Nigeria: What Lessons from Wales?" Developing Country Studies 5(16)

Olotuah, A. O. (1997) "The House: Accessibility and Development – A critical Evaluation of the Nigerian Situation". Proceedings of National Symposia on Housing in Nigeria, Obafemi Awolowo University Ile-Ife pp 312 – 317.

Onibokun, A. G. (1975) "A Critical Review of the Nigerian Government Housing Policy and Programmes" Ibadan: Second International Housing Conference Proceedings pp4.

Onibokun, A. G. (1974) "Evaluating Consumers' Satisfaction with Housing: An Application of a System Approach", *Journal of American Institute of Planners*, 40 (3): 189 – 200

Preiser, W. F. E. (1989) "Towards a Performance-based Conceptual Framework of Systematic POES" in Preiser, W. F. E. [ed] *Building Evaluation.* New York: Plenum Press

Scottish Government (2010) A Select Review of Literature on the Relationship between Housing and Health, http://www.gov.scot

Spiker, P. (2011) "Housing and urban policy" [online] http://www2.rgu.ac.uk/publicpolicy/introduction/housing.htm [13th September 2011]

Tan S. H. and Hamzah, S. [ed.] (1979) *Public and Private Housing in Malaysia.* Selangor: Heinemann Educational Books (Asia) Ltd.

Teck-Hong, T. (2012) "Housing Satisfaction in Medium and High Cost Housing": The case of Greater Kuala Lumpur, Malaysia" *Habitat International* vol 36 (1) pp108-116

Theodori, G. L. (2001) "Examining the Effects of Community Satisfaction and Attachment on Individual Well-being", *Rural Sociology*, 4 (66): 618 -628.

Ukoha, O. M. and Beamish, J. O. (1996) "Predictors of Housing Satisfaction in Abuja, Nigeria". *Housing and Society* Vol 23 No 3 pp 26-46.

UN-HABITAT (1993) National Trends in Housing Provision-Production Practices vol 4: Nigeria

United Nations General Assembly (1966) International Covenant on Economic, Social and Cultural Rights. United Nations Treaty Series, vol 993, 16th December 1966. [online] http://www.refworld.org/docid/3ae6b36c0.html

United Nations General Assembly (1988) Global Strategy for Shelter to the year 2000. 83rd Plenary Meeting, 20th December 1988 [online] www.un.org/documents/ga/res/43/a43r181.htm

Vandivere, S., Hair, E., Theokas, C., Cleveland, K., McNamara, M., and Atienza, A. (2006) How Housing affects Child Well-Being, Funders Network [online] http://www.fundersnetwork.org/files/learn/Housing_and_child_well_being.pdf

Varady, D. P. and Preiser, W. F. E. (1998) "Scattered-site Public Housing and Housing Satisfaction: Implications for the New Public Housing Program", *Journal of American Planning Association 6* (2): 189 – 207

Vera-Toscano, E. and Ateca-Amestoy, V. (2007) "The Relevance of Social Interactions on Housing Satisfaction" [online] http://www.ehu.es/vickysteca/Housing_satisfaction_SIR.pdf [16th June 2011]

Watson, J. (2001) *How to determine sample size: Tipsheet #60*, University Park, PA: Penn State Cooperative Extension. [online] http://www.extension.psu.edu/evaluation/pdf/TS60.pdf retrieved 7th July 2012.

Yeh, S. H. K. (1972) *Homes for the People: A study of Tenants' Views on Public Housing in Singapore*. In collaboration with Statistics and Research Department Housing and Development Board, University of Singapore: Economic Research Centre.

STUDY OF WOOD AS A SUSTAINABLE MATERIAL FOR CLIMATE CHANGE MITIGATION USING ATHENA ECOCALCULATOR AND SYSTEM DYNAMIC MODEL

Bernard Effah[1], Jack Nti Asamoah[2] and Kwaku Antwi[3]

[1]*Department of Interior Design & Material Technology, Kumasi Technical University, Kumasi, Ghana*

[2]*Department of Civil Engineering, Kumasi Technical University, Kumasi, Ghana*

[3]*Department of Wood Construction Technology, Tamale Technical University, Tamale, Ghana*

In this study, the environmental effects of wood, steel and concrete as sustainable building materials were investigated quantitatively using Athena EcoCalculator model for Commercial and Residential Assemblies. A desk study methodology was adopted whiles a second model, System Dynamic Model (SDM) was used to further model the dynamics of the impact categories of wood, steel and concrete for a 60 m^2 two-bedroom residential building for 60 years life of the building. The results showed that wood materials require much lower process energy and result in lower (35% and 38%) carbon emissions than concrete and steel. The SDM also showed that wood has lower environmental impact of a building when compared to concrete and steel. The behaviour of each material indicated varied trend of increasing behaviour over the 60-year period.

Keywords: climate change, life cycle assessment, sustainable material, system dynamic model, wood

INTRODUCTION

Climate change has been of great worldwide concern since the 1970s especially due to its adverse effect on livelihood and sustainability. Currently, the thirteenth Sustainable Development Goal (SDG) admonishes all state and non-state actors to embark on actions to reduce adverse effect of global climate change through appropriate adaptation practices. It is now clear and very compelling that the climate of the earth is changing and that the earth is becoming warmer (IPCC, 2007; Kankam-Yeboah *et al.*, 2010).

[1] bernardeffah@gmail.com

[2] jaccephas@gmail.com

[3] antwikwaku10@gmail.com

Effah, B., Nti Asamoah, J. and Antwi, K. (2017) Study of wood as a sustainable material for climate change mitigation using Athena EcoCalculator and System Dynamic Model *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1274-1280

Among some of the main environmental concerns of our times are the environmental burdens of the various industries of which the construction industry is not exception for the emissions in the use of buildings. Similarly, the national housing policy also makes it clear that all new housing must utilise durable materials in their construction without jeopardising the environment (Government of Ghana, 2015).

For some time now, the idea of green building has become very familiar to the masses and the public has become increasingly aware of the potential environmental benefits of this alternative to conventional construction. A trend towards environmentally and climate-friendly building is becoming apparent in the construction industry throughout the world and will continue to grow in the future in the wake of sustainability (HLPA**,** 2017). Sustainable construction is the creation and responsible maintenance of a healthy built environment, based on ecological principles and the efficient use of resources (Huovila, 2010).

Currently, in Ghana, government and religious organizations appear to make a sharp switch from the use of wood to aluminium, plastics, steel and glass in their building projects especially in the post-2000 era. From building practices, especially with the selection of building materials in Ghana presently, it seems to suggest a lack of awareness and understanding of the social and environmental consequences of individual actions notwithstanding the fact that the choice of material dictates the design process of a building while the right choice of materials influences all aspects of the building project as a whole.

Since the construction sector holds a significant potential for lowering greenhouse gas emissions, the selection and choice of building materials and components thus become a major factor that has potential environmental consequences on climate change. Therefore, the design of buildings must be directed towards the maximization and sustainability of each material regarding their extraction, processing and utilization.

In this study, the environmental effects and dynamic behaviour of wood, steel and concrete as building materials were investigated quantitatively using Athena EcoCalculator model for commercial and residential assemblies and system dynamic model.

LITERATURE REVIEW

Timber has remained a primary construction material for thousands of years and the simple reason for this is that no other competitive material is as versatile or possesses all the advantages to be found in timber (Rowell, 2012). Similarly, the sustainable qualities of wood from production through construction, has made it undoubtedly the leading choice in the green trend (Börjesson and Gustavsson, 2000; Boyd *et al.* 2007).

From the social and environmental point of view, wood products have a positive effect on the climate and their importance is increasing steadily and much appreciated by citizens. There is a direct physical relationship

between the quantity of raw materials used in industrial processes, the energy required and GHG emissions (Behrens, 2016). Timber and wood-based products are not only the first choice for the construction of new buildings as these new structures are becoming more energy efficient, the energy demand and carbon footprint of construction materials seem to become increasingly important (CEI-Bois, 2011). Timber offers great potential for changing and modernizing the construction industry. By nature, dry wood is roughly half carbon by weight and each cubic foot of wood contains between 11 - 20 pounds of carbon (Rowell, 2012). This makes wood-based building materials have several direct and indirect climate related advantages (CEI-Bois, 2011).

There has been some studies proving wood as the most 'democratic material' towards climate change (Gustavsson *et al.*, 2006a; Gustavsson *et al.*, 2006b; Suter *et al.*, 2016). Gustavsson *et al.* (2006a) assessed the role of wood as a carbon sink, as a multi-purpose material, and as a renewable energy source for the net reduction of greenhouse gases. They concluded on the threefold role of wood as a carbon sink, as a versatile material, and as an energy source that helps to reduce net GHG emission. Suter *et al.* (2016) analyzed the complete value chain of all wooden goods produced and consumed in Switzerland in order to increase knowledge of the environmental effects of wood use. Gustavsson *et al.* (2006b) investigated the primary energy use and net CO_2 emission for two buildings in Sweden and Finland made with wood frames compared with functionally equivalent buildings made with concrete frames. The authors observed that the production of materials for wood-framed construction requires less energy, and emits less CO_2 to the atmosphere, than the production of materials for concrete construction.

RESEARCH DESIGN AND METHODS

A desk study methodology was employed for this paper to mainly review relevant literature, document and to reanalyse secondary data from various sources. ATHENA® EcoCalculator for both Commercial and Residential Assemblies (1.21) and Vinsim PLEVensim software were used for modelling the environmental effects and their dynamics.

The EcoCalculator is a Life Cycle Assessment accounting for the impacts of a product, material, or process based on the effects of obtaining the raw materials from which it is made, the processes through which those raw materials go to become usable products, the assembly of those products into a structure, the maintenance and operations required to maintain those products, the effects of disposing the product after its useable life, and the transportation impacts that arise between each of those phases (ATHENA, 2012).

The analysis was based on seven impact categories of Fossil Fuel Consumption (in megajoules), Global Warming Potential (in mass units of carbon dioxide equivalents), Acidification Potential (in moles of hydron (H+) equivalents), Human Health Criteria (in mass units of 10 micron particulate matter), Aquatic Eutrophication Potential (in mass units of Nitrogen

equivalents), Ozone Depletion Potential (in mass units of CFC-11 equivalents) and Smog Potential (in mass units of ozone equivalents) of an assumed two-bedroom residential building in Ghana. There are seven types of building assemblies included in the EcoCalculator: Foundations and footings, Columns and beams, Intermediate floors, Exterior walls, Windows, Interior walls and Roofs. Three material scenarios of wood (1), concrete (2) and steel (3) were modelled. The building in this study was assumed to be a two bedroom, no garage building of 60 m^2 in size.

Qualitative system dynamics models with stock and flow causal-loop diagrams were modelled for the three construction materials. The result was interpreted in qualitative sense and discussed using qualitative system dynamics. Three sub-models based on the three materials were modelled.

RESULTS AND DISCUSSION

Table 1 depicts results of the environmental impact assessment based on the seven thematic areas from the Athena EcoCalculator.

Table 1: Environmental Impact Summary of wood, concrete and steel

Assembly	Total area	FFC (MJ)	GWP (tonnes CO_2eq)	AP (moles o H+ eq)	HHC (kg PM10 eq)	EP (g N eq)	ODP (mg CFC-11 eq)	SP (kg O_3eq)
Wood	60 m^2	6 402	1	227	5	180	2	32
Concrete	60 m^2	9 888	1	315	6	227	4	52
Steel	60 m^2	10 435	1	462	7	254	4	45

FFC (Fossil Fuel Consumption), GWP (Global Warming Potential), AP (Acidification Potential), HHC (Human Health Criteria), EP (Eutrophication Potential), ODP (Ozone Depletion Potential), SP (Smog Potential).

The complete environmental impact profile of three building materials in Ghana in the form of wood, concrete and steel were assessed based on the seven impact factors of the ATHENA EcoCalculator and the results shown in table 1. From table 1, estimated amount of fossil fuel energy used in the extraction, processing, transportation, construction, and disposal of each material shows that wood (timber) results in low fossil fuel consumption (6,402 MJ). In comparison, concrete used 35% more of fossil fuel than wood. Similarly, steel also used 38% more of energy than wood. For global warming potential, all the three materials contributed not more than 1 ton of carbon dioxide equivalents. The equal amount of global warming potential for all the materials was due to the fact that the estimated amount of greenhouse gases generated by each of the materials (wood, concrete and steel) was in small quantities so did not produce carbon dioxide quantities. Regarding the estimated amount of acid-forming chemicals produced by the three construction materials, wood produced the least moles of hydron (H+). Compared to wood, both concrete and steel generated 27% and 51% moles of hydron more than wood respectively.

The amount of airborne particles that affects human health like bronchitis, asthma and acute pulmonary disease when using building materials was estimated. Wood generated the least airborne particles (5 kg / PM 10 eq). Concrete created (6 kg / PM 10 eq) 5.6% more than wood whiles steel also produced (7 kg / PM 10 eq) 28.6% more than wood. Since the EcoCalculator helps to determine the extended environmental effects of the materials used in a building, the aquatic eutrophication potential of the materials was estimated. The water nitrifying substances generated by wood was lower (180 g / N eq) than the other two materials. Concrete produced (227 g / N eq) 7.1% more water nitrifying substances than wood. Steel also generated (254 g / N eq) 11.2% more water nitrifying substances than wood. Ozone depleting substances of the three materials when used for building construction was also accounted for. Both concrete and steel created twice more ozone depleting substances than wood. Finally, the amount of chemicals that could produce photochemical smog was estimated. Wood generated the least smog potential. Concrete generated 38.5% more than wood. The same situation happened for steel, where the smog potential was 28.9% more than wood.

Result from the system dynamics model is illustrated in Figure 1. Three scenarios of wood, concrete and steel were developed for the purposes of this study in order to assess the dynamics behaviour of the system and the reaction of the system over the 60-year simulation period. The wood scenario was the basis and represents the 'business as usual' scenario where wood was chosen as the basic material to consider for construction. Scenarios 2 and 3 are situations for substituting wood with concrete and steel respectively. From figure 1, climate change was the stock where the three building materials flowed. Figure 1 shows the environmental impact dynamics of wood, concrete and steel based on seven environmental assessments.

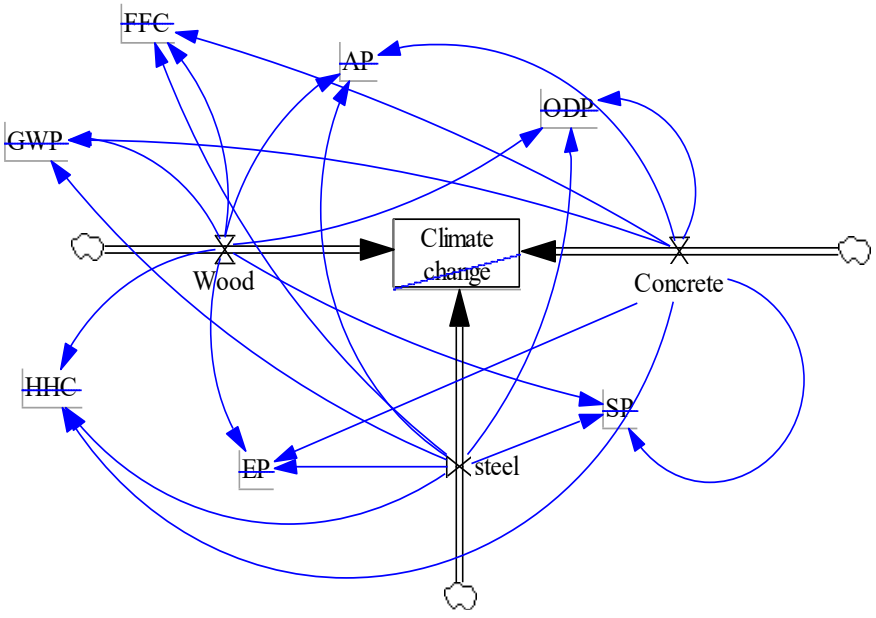


Figure 1: The environmental impact dynamics of wood, concrete and steel

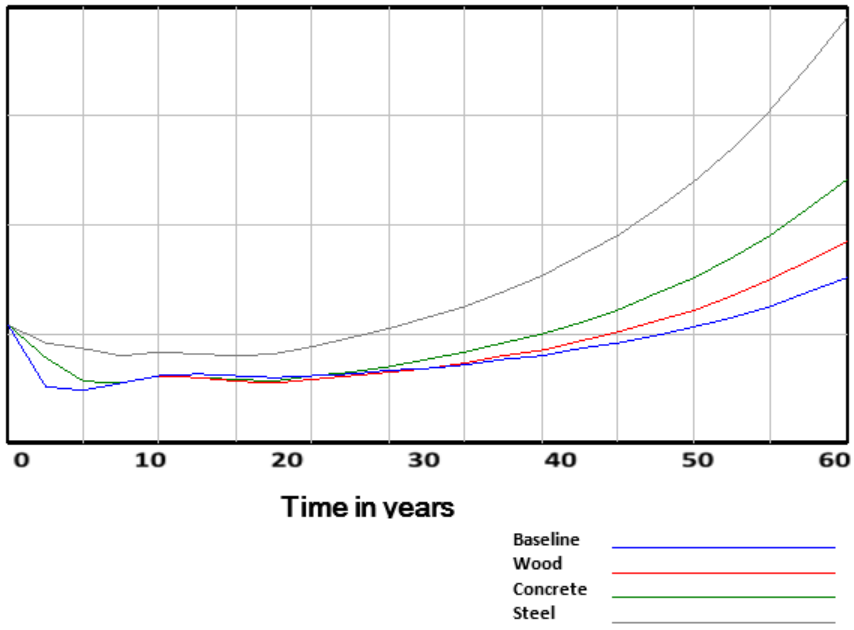


Figure 2: The dynamic behaviour of wood, concrete and steel

Result of the dynamic behaviour of wood, concrete and steel is shown in figure 2. The wood, concrete and steel model results showed that using the model results from the EcoCalculator for all the seven environmental impact assessed, wood produced the least impact when compared with concrete and steel, climate change is thus going to increase if more concrete and steel are used to substitute wood. The behaviour of each material indicated varied trend of increasing behaviour over the 60-year period.

CONCLUSIONS

Using life cycle assessment tools, the study investigated the environmental effects of building materials by comparing wood, concrete and steel to assess how each of these contributes to climate change. The results show that by substituting wood materials in place of concrete and steel, fossil fuel consumption will be reduced by 35 % and 38 % (MJ) respectively. Similarly, acidification potential of the materials will also be reduced by 27 % and 57 % (moles of H+ eq) respectively. When concrete and steel are used for construction, smog potential will increase by 38 % and 28 % (kg O_3eq) when compared to wood. On a whole, the model showed that wood has comparatively lower environmental impact of a building when compared to concrete and steel. Similarly, the dynamic behaviour assessment of the three materials also indicated least behaviour for wood.

REFERENCES

Athena Sustainable Materials Institute, 2012. Athena EcoCalculator for Commercial and Residential Assemblies: Inner Workings Synopsis.www.athenasmi.org.

Behrens, A., 2016. The Climate Change Impact of Material Use. *Intereconomics*, 51(4), .209-212.

Börjesson, P. and Gustavsson, L., 2000. Greenhouse gas balances in building construction: wood versus concrete from life-cycle and forest land-use perspectives. *Energy Policy* 28(9), 575-588.

Boyd, C. W., Koch, P., McKean, H. B., Morschauser, C. R., Preston, S. B., and Wangaard, F. F., 2007. Wood for structural and architectural purposes. *Wood and Fiber Science*, *8*(1), 3-72.

CEI-Bois, 2011. *Tackle climate change, use wood.* 2nd edition, CEI-Bois (Ed.), Brussels.

Government of Ghana, 2015. National Housing Policy. Ministry of Water Resources, Works and Housing, Accra-Ghana.

Gustavsson, L., Madlener, R., Hoen, H. F., Jungmeier, G., Karjalainen, T., Klöhn, S. and Spelter, H., 2006a. The role of wood material for greenhouse gas mitigation. *Mitigation and adaptation strategies for global change*, *11*(5), 1097-1127.

Gustavsson, L., Pingoud, K. and Sathre, R., 2006b. Carbon dioxide balance of wood substitution: comparing concrete-and wood-framed buildings. *Mitigation and adaptation strategies for global change*, 11(3), pp.667-691.

HLPA, 2017. Environmental Benefits. Retrieved from http://hawaiilumber.com/benifits.php

Huovila, P., 2010. Sustainable Construction in Finland in 2010 - Report 2. VTT Building Technology, Finland.

IPCC, 2007: Impacts, Adaptation and Vulnerability Contribution of Working Group II to the Fourth Assessment Report.

Kankam-Yeboah, K., Amisigo, B. and Obuobi, E., 2010. Climate Change Impacts on Water Resources in Ghana. Ghana National Commission for UNESCO. The Pan-African Workshop on "Decision-Making Support for Coastal Zone Management, Water Resources and Climate Change in Africa" Cotonou, Benin, 15-17 February 2010.

Rowell, R.M., 2012. *Handbook of wood chemistry and wood composites*. CRC press.

Suter, F., Steubing, B. and Hellweg, S., 2016. Life Cycle Impacts and Benefits of Wood along the Value Chain: The Case of Switzerland. *Journal of Industrial Ecology*.

SUCCESSION PLANNING AND CONTINUITY OF FAMILY-OWNED BUSINESS: "PERCEPTION OF OWNERS IN THE WA MUNICIPALITY, GHANA

Rhoda Saan[1] , Francis Enu-Kwesi[2]and Remy Faadiwie Nyewie[3]
[1]*Department of Building Technology and Estate Management, Wa Polytechnic, Ghana*
[2]*Institute for Development Studies, University of Cape Coast, Ghana*
[3]*West Gonja Hospital, Damongo, Ghana*

The focus of this paper was to determine the perceptions of succession planning by owners/founders of family businesses and its importance in ensuring the continuity and prosperity of businesses in the Wa Municipality,Ghana. The literature generally indicates that succession in family businesses takes the form of transfer from one generation to another but succession planning appears to be left to chance by many firms. This neglect of succession planning and the emotions generated by the process makes owners ill-prepared for succession. The main question explored in the current study was: To what extent do Owners/Managers of family-owned businesses (FOBs) perceive succession planning as an important aspect of business continuity? A sample of 205 small firms was drawn randomly from a population of 440 family businesses in the Wa Municipality in Ghana. A structured questionnaire schedule was used to collect data which was analysed using descriptive and inferential statistics. The findings indicate that majority (94.1%) of FOBs perceive business planning as an important skill for owners or founder while the ability to develop a business strategy has a positive impact on succession and leads to continuity of FOB. People with high level of formal education tend to have positive perception on the importance of succession planning and business continuity as compared with those with lower levels of formal education. Majority of FOB owners or founders perceive that business continuity benefits the founder, the successor, the family and other stakeholders. It is therefore recommended that founders or owners of FOBs should make provision for the education and training of potential successors to facilitate succession for continuity.

Keywords: continuity, family-owned business, perception, planning and succession.

[1] rhodasaan@gmail.com
[2] fenu-kwesi@ucc.edu.gh; enukwesi@yahoo.com
[3] rnyewie@yahoo.co.uk

Saan, R., Enu-Kwesi, F. and Nyewie, R. F. (2017) Succession planning and continuity of family-owned business: "perception of owners in the Wa Municipality, Ghana *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1281-1299

INTRODUCTION

Succession is an event that confronts virtually all viable organisations. In cases where the incumbent dies, retires or resigns, succession is forced upon the organisation. In instances like firing or internal relocation of the incumbent, such as transfer, promotion or demotion, succession is a decision over which an organisation's decision-makers do have some control (Gephart, 1978). According to Gephart, succession is inevitable and for this reason, should be both anticipated and managed for the continuity of business organisations. In this context, succession should be planned ahead to avoid the circumstance of a void in the management of family-owned businesses.

Like a well-run relay race, to be successful, the handing over of a company should be graceful, carefully strategized and well executed. A well-thought out succession plan is essential for the continuation of a business, regardless of its size and structure. The relay race theory gives an increased understanding to executive succession. Considering the analogy, the theory often uses the metaphor "passing the baton" in a 4×100 relay race (Vancil, 1987). The practical importance of baton passing is so obvious that even casual observers of business firms and of relay races understand how difficult it can be to pass the baton successfully. Great caution should be exercised because dropping the baton leads to performance decrements or to complete performance failure and spells doom for the family and business stakeholders.

Researchers and consultants have long stressed the importance of succession planning in ensuring the continuity and prosperity of a business (Christensen, 1953; Ward, 1987). Some have even gone to the extent of stating that dealing effectively with the issue of succession planning is the single most lasting gift that one generation can bestow upon the next (Ayres, 1990). Succession can represent a strategic opportunity for an organisation, particularly for those firms in growing and dynamic markets, not to mention rapidly growing firms whose managerial needs are changing (Churchill & Lewis, 1983). The neglect of both the processual and the strategic aspects of succession are informed by intentions, attitudes and behaviour as theory of planned behaviour suggests. This challenges the firm's future when delays assume a prolonged pattern to hand over or assume responsibility.

Scholars of family business argue that succession can lead to an important infusion of entrepreneurial energy based on the potential of new owners and managers to rejuvenate their firms (Habbershon & Pistrui, 2002; Nordqvist & Melin, 2009). Scholars of entrepreneurship argue that the entrepreneurial process does not end with the creation of a new venture but that firm succession is a vital part of the entrepreneurship process (DeTienne, 2010).

Family owned businesses have been grappling with many challenges, including their ability to survive for a long period of time and achieve their set objectives (Hamilton, 2003). The challenges of FOBs include, but are not

limited to planning, satisfying customers' expectations, competing effectively, and gaining wealth for survival. Aside these, FOBs face some internal issues such as inability or desirability of founders to determine succession, fewer available resources to devote to succession planning, less in-house staff with the expertise to develop and manage an integrated succession planning initiative, and resistance of family owners to open succession lines to non-family members (Hamilton, 2003).

According to Rue and Ibrahim (1996), succession planning appears to be left to chance by many firms. This neglect of succession planning and the emotions generated by the process makes owners ill-prepared for succession, forces incumbents to face their mortality and makes other family members confront the need for change with difficulty (Beckhard & Dyer, 1983; Dyer, 1986; Lansberg, 1988).

Consequently, prevailing state of business operations can result in diminished growth arising from hindrances in incorporating new thinking processes, innovativeness, decision-making, and total commitment from interested members, which ultimately could thwart success. Conceptually, Lansberg (1988), as cited in Leach and Bogod (1999), identified a whole range of obstacles to succession planning, categorising them into those connected with the founder, the family, the employees and the general environment in which the firm operates. Notwithstanding its importance, succession planning is a major problem within small, micro and medium enterprises. Garg and Weele (2012), for instance, concluded that most of these entities are run by their founders or by a small management team and very few such operators have in place proper succession planning. They continued that the absence of proper succession planning can have the direct effect of causing the collapse of these businesses especially when key players leave the business upon retirement or in pursuit of other options. The exit or exodus of key stakeholders can make a business vulnerable and diminish its worth as investors will not invest in a business that is not sustainable. This can be particularly troublesome in countries, including Ghana where micro and small enterprises, mostly family-owned, dominate the economy.

According to Basu, Blavy and Yulek (2004), Ghana's economy is largely characterised by micro and small scale enterprises (MSEs) who fulfil important roles through job creation, especially female employment, contribution to tax revenues, export and import revenues, facilitate the distribution of goods, contribute to human resource development and are the cradle of innovations and entrepreneurship (Agyapong, 2010). Such characterizations apply to many businesses in the Wa Municipality of the Upper West Region which, like many micro and small enterprises, are family-owned. As such, they are susceptible to experiencing the challenges of succession that others face elsewhere, a challenge that has implications for business continuity, job creation for a large number of unemployed youth, tax contribution to the economy, and a source of living for families of owners in both short and long terms as suggested by Agyapong, (2010).

According to Ramona, Hoy, Poutziouris and Steier (2008), researches on family business are very slow or are being neglected by researchers in the field of entrepreneurship and business, and called for more studies to increase and advance understanding of family business. We therefore argue that the neglect of succession planning and the emotions generated by the process make owners ill-prepared for succession. Consequently, the challenge of succession planning by family-owned businesses in the Wa municipality, raises several issues and as a contribution, this paper sought to determine owners perceptions of succession planning in family-owned businesses and their importance in ensuring the continuity and prosperity of businesses in the Wa Municipality. The rest of the paper discusses the theoretical and conceptual issues, followed by the methodology. The latter parts of the paper contain the results and discussion, conclusions and policy implications.

LITERATURE REVIEW

Theoretical and conceptual discussions

Succession planning is built on a number of theories in the literature. The theories discussed include agency cost, relay race, planned behaviour and stakeholder, followed by concepts such as succession planning practices and Family-owned business and economic development.

Agency cost theory

Agency cost theory is a dominant theoretical framework for explaining and understanding the relationship between owners and managers among mainstream management researchers (Bocatto, Gispert & Rialp, 2010). Pollak (1985) argues for entrenchment in family firms when he observes that family firms have advantages in incentives and monitoring compared to non-family firms. Shleifer and Vishny (1997) suggest that there is value in family ownership and management when the political and legal systems of a country do not provide sufficient protection against the expropriation of minority shareholders' value by the majority shareholder.

Relay race theory

Dyck, Mauws, Starke & Mischke (2002) emphasised that the concept of succession could better be understood if the analogy of relay racing is considered, with attention on success factors such as sequence, timing, baton-passing technique and communication. To ensure that firms continue to exist and be of utmost benefit to stakeholders, succession planning is critical. In fostering this, the four key factors in running a successful relay race - sequence, timing, baton-passing technique, and communication (Steben & Bell, 1978) - are examined to create a picturesque view and develop insights on how relay racing and succession relate. Absolute caution is the hallmark of successful baton-passing otherwise the move can plunge the firm into reduced performance or complete failure (Dyck, Mauws, Starke & Mischke, 2002).

Theory of planned behaviour

The theory of planned behaviour (Ajzen & Fishbein, 1980; Ajzen, 1987, 1991) was adopted by Stavrou (1999) to explain successors' intentions to take over a business. The theory postulates that the chance that behaviour will occur is dependent on the intention of an individual to engage in that behaviour. Intention in turn, is shaped by the individual's attitudes. The attitudes include the perceived desirability of the outcomes to the initiator, the acceptability of the outcomes according to the social norms of a reference group, and the perception that the behaviour will feasibly lead to the desired outcomes. Thus, attitudes develop intention and the latter leads to behaviour (Ajzen & Fishbein, 1980; Ajzen, 1987). Generally, research (Ajzen, 1991; Chrisman, 1999; Krueger, 1993; Sheppard, Hartwick, & Warshaw, 1988) supports the theoretical relationships proposed between attitudes, intentions and behaviour. There is always a motivation for the behaviour of an individual. According to Arnold, Robertson and Cooper (1991) as cited in Armstrong (2003), motivation is influenced by three factors – the direction, effort, and persistence. Motivation is therefore a goal-directed behaviour. The actions of the founder, family and successor are all attributable to their motivation, since people are motivated when they anticipate that a course of action could lead to the achievement of a goal or a valued reward which satisfies their needs.

In the foregoing, the theory of planned behaviour stipulates three things that affect intention and behaviour. These are desirability of the anticipated outcomes to the initiator, acceptability of the outcomes by a reference group, and the initiator's perception that the behaviour will lead to the desired outcomes. It stems from this then, that a succession that is a planned behaviour must have an initiator who possesses these three attitudes about succession. There is a belief that succession is largely influenced by the incumbent leader of the family firm (Lansberg, 1988; Malone, 1989; Rubenson & Gupta, 1996).

Sharma, Chrisman and Chua's (2003) study on succession planning as planned behaviour used the theory of planned behaviour to hypothesise the influence of the incumbent's desire to keep the business in the family, the family's commitment to the business, and the propensity of a trusted successor to take over on the extent to which family firms engage in succession planning activities. Findings of various researchers (Ajzen, 1991; Chrisman, 1999; Krueger, 1993; Sheppard, Hartwick & Warshaw 1988) back the theoretical ties of attitudes, intentions and behaviour. Other literature (Ajzen, 1987; Krueger & Carsrud, 1993) highlights the value of feasibility and self-efficacy in planned behaviour. It is argued that only few individuals deliberately indulge in actions believed not to lead to a desired conclusion. Since the feasibility of the succession dilemma depends on the availability of a suitable successor to take over the business, the incumbent's desire to pursue succession depends on the willingness of a trusted family member to be the new manager. In this context, succession cannot be realised when no one is willing to become the new leader of the firm. Succession is thus far from thought if the candidate is unsuitable following perceived untrustworthiness or incompetence to assure the

feasibility and the occurrence of the planned behaviour. For the sake of necessity, the components of succession planning should include selecting and training the successor, developing a post-succession business strategy, defining the post-succession role for the outgoing incumbent, and communicating the succession decision to key stakeholders. Family firm succession planning activities will nonetheless, differ according to the firm's characteristics influencing such succession (Sharma, et al, 2003). Training of the successor is a step that can unleash the potential of an inexperienced individual. All such investment to imbue experience grinds to naught if successor's authority and responsibility are not fully handed to him and all stakeholders regard the new occupant of the position as required.

Stakeholder theory

Mahoney (2005) broadly defines stakeholders as individuals and groups who contribute to the wealth-creating potential of the firm and are its potential beneficiaries and/or those who voluntarily or involuntarily become exposed to risk from the activities of a firm (Post, Preston & Sachs, 2002). In this view, stakeholders embody shareholders, holders of options issued by the firm and debt holders. According to Branco and Rodrigues, (2007), employees' local communities as well as the environment is all part of the stakeholders. Also, Post, Preston and Sachs (2002) added regulatory authorities, the government, inter-organisational alliance partners, customers and suppliers. The impacts of the various stakeholders are not equal as they do not carry the same weight and stakes and as risks may vary in significant proportions (Branco & Rodrigues, 2007). On succession matters in family firms therefore, the various stakeholders might exert thrust in the decision process according to their relative interest, stake and contribution to the firm.

Phillips (2003) reported that it is inappropriate to interpret stakeholder theory as arguing for treating all stakeholders equally in disregard for differentials in contribution to the organisation. Conversely, stakeholders, irrespective of their levels of contribution or stake in the firm, must be given attention but the succession route must be charted as policy or appropriateness dictates.

Succession planning and practices

Succession is interpreted as the explicit process by which a family business will be passed on to the family's next generation to manage and control (Motwani & Schwarz, 2002). This suggests that succession planning is a pre-meditated process that spans a period of time and not an adhoc, one-time activity. When it is pre-planned and carefully implemented, taking into account, the dynamics of both family and business, there is the likelihood that the succession process will be successful and effective. Conversely, an unplanned succession could lead to dissatisfaction with the succession process and could occasion prolonged conflicts and make the succession ineffective.

Scholars and consultants alike stress the importance of such a process to ensure continuity and prosperity of family businesses but remark that it is

left to chance by many family firms (e.g., Sharma, Chua & Chrisman, 2000). It can be contended that succession is to protect the future of a firm and depends largely on the founder to ensure its success. According to Handler (1994), succession is the transfer of leadership and ownership to the next family generation. This definition suggest that transfer is to family members. This is a practice in the USA where over 90 percent of family firm leaders wish to have their businesses controlled by their family members in the future (O'Connell, Raymond &Raymond Jr., 1997; 1993).

Christensen (1953) suggests that succession planning as a process should include identifying the pool of potential successors, designating the successor, and notifying the successor designate and other management leaders of the decision made. To this set of activities, Ward (1987) and Lansberg (1988) added the need to train the successors and to formulate a vision of the company after succession, whereas Sharma, Chua, and Chrisman (2003) added defining a role for the retiring CEO. The authors suggest that succession planning process consists of discrete components which include selecting and training a successor, developing a vision or strategic plan for the company after succession, defining the role of the departing incumbent, and communicating the decision to key stakeholders.

A report by the Families Business Review **(**2002) reveal that less than one in three family businesses live into the second and about one in 10 make it to the third generation, with an average firm age of 24 years. Lam (2009) cautioned on the dangerous and devastating effect of family business discontinuation which results in the loss of jobs, family assets and family relationships. Despite the importance of succession to the continuity of family business, studies on succession and its impact on continuity of family business is in dearth. However, the works of Ramona, Hoy, Poutziouris and Steier (2008), and Lam (2009), are commendable pioneering works for theoretical development.

The European Commission estimates that there are around 1.5 million small businesses in Europe that have a high risk of failure as a result of succession problems (Esuh, Mohd & Adebayo, 2011). A review and tracking the failure rate of firms shows that a high number of first generation firms and a large number of third generation firms file for bankruptcy. While reasons for their collapse vary, those for unfulfilled succession attracted many studies and yet firms like the Pritzker (U.S.) and the Bacardi's (Puerto Rico) encountered protracted succession problems (Esuh, Mohd & Adebayo, 2011). One may wonder how it happens that imminent failure is not avoided in firms despite the findings on how others folded up. Succession decisions are often influenced by the needs of the family rather than on business requirements and these are a recipe for serious problems when the two are incompatible (Goldberg & Woodridge, 1993).

Family-owned business and economic development

According to Litz (1997), a family firm is a business in which ownership and management are concentrated in a family unit and in which individuals within the firm seek to perpetuate or increase the degree of family

involvement. Abouzaid (2008) defined family business as "a company where the voting majority is in the hands of the controlling family, including the founder(s) who intend to pass the business on to their descendants" (p. 12). It can be deduced from the foregoing definitions that family businesses therefore are businesses that are owned and run by a family. The manager may be the founder, a family member, or a hired individual. It is asserted for instance, that about 92 percent of the businesses in the United States are all in the control of one family or the other (Kuratko & Hodgetts, 2004; Lam, 2009).

Many family businesses are MSMEs or SMEs and are indispensable sources of employment for both family and non-family members, economic growth and development in the locality of the business, and increased Gross Domestic Product (GDP) through business taxes. In the United States., family businesses contribute about 59 percent of jobs and 78 percent of all new employment (Kuratko & Hodgetts, 2004). Kuratko and Hodgetts (2004) further reported that family businesses produce about 50 percent of gross domestic product in the United States. Thus, the economic potential of FOBs calls for efforts to ensure their survival and continuity. The support may vary from policy to support family businesses to develop and implement succession plans for business survival and continuity, provision of micro-finance for business expansion and growth, and provision of other business development services.

Family business existence can be traced to pre-historic era and has been known to water economies, most especially during the dry days. Winter, Fitzgerald, Heck, Haynes and Danes (1998) claimed that family business is very essential in the economy and social unit building in the modern era. Klein (2000) reported that family businesses are very much relevant to the German economy and contribute to the economic growth of any nation. According to Beck, Demirguc-Kunt and Levine (2003), the World Bank supports MMSEs development programmes. And suggest that MSMEs make special contributions to developing economies by generating the needed income for alleviating poverty.

RESEARCH DESIGN AND METHODS

The Wa Municipality is predominantly populated by small and medium-sized enterprises, which are mostly owned and or managed by family members. Using an exploratory design, upon the assumption that not much has been done in the municipality with respect to studies on business succession planning, we set out to explore owners' perception of succession planning. Based on the conventional confidence level of 95 percent, with a margin of error of five percent (Babbie, 2007; Saunders, Lewis & Thornhill, 2009) and a targeted population of 440 (N=440) supplied by the National Board for Small Scale Industries, the sample size was computed as two hundred and five (S=205). The owner-managers or managers of these family-owned businesses were selected using the systematic random sampling technique. The sample fraction was determined by N/S = 440/205

= 2.15 which was rounded up to 3. The first sample unit was then randomly selected between 1 and 3 and from there, every 3rd unit in the frame was selected to obtain the desired sample, taking 2 as the first sample unit, the others were 5, 8, 11, 14, et cetera

A structured questionnaire items measuring the perceptions of owners and/or managers on the importance of succession planning was used to collect the primary data from two hundred and five (205) respondents. Items were of both open- and close-ended forms. The close-ended items were dichotomous response, ranking and multiple choice types. Ranking items were of a 5-point Likert scale to deal with items that have ordered responses. The responses were numbered 1 to 5, where 1 shows weak agreement and 5 shows strong agreement. The subjective/open-ended types were used for amassing divergent views on the topic. The fieldwork was carried out by the researchers with the support of five research assistants selected and trained to spend five days during which each made contacts with about 40 respondents for the data while the researchers administered the pilot survey and remaining five to make up the sample size of 205. Each research assistant administered an average of eight questionnaire daily from the 6th to the 10th of February 2012, to complete the data collection process. To ensure the statistical validity and reliability of the constructs, 25 questionnaire were pre-tested and analysed using Cronbach's alpha reliability test which yielded a consistency co-efficient of 0.846. Data were coded and a data file created in the Statistical Product and Service Solutions (SPSS, version. 17.0) for data entry, editing, cleaning, analyses and presentation. The data were analysed using descriptive and inferential statistics including frequencies, percentages, chi-square and correlation analysis.

RESULTS

Demographic characteristics

The various variables included: gender, age, level of education, type of business and number of employees. In all, there were 67.8 percent males and 32.2 percent females. From the results, it can be deduced that there is a male dominance in the business. This implies that fewer women own and run family businesses. This might arise from the patrilineal system of inheritance where women do not become family heads and probably are less entrepreneurial (Dyer Jr., 1986). Majority (99%) of the current owners of FOBs in the study area have had some level of formal education. About 28 percent of the total respondents have college education, 27.7 percent had SHS or Technical school education while one percent had no formal education. On the type of businesses, 57 percent of the respondents were artisans, 42 percent were engaged in trade, and only one percent owned private schools. The type of businesses was further examined with regard to sex of the respondents. The results revealed that the type of business activity engaged in by the respondent is significantly influenced by the gender of the founder or owner ($N = 205$, $\chi 2=52.800$, $df = 8$, $p = 0.000$). For businesses such as building and construction, education and mechanic

shops, the results revealed a 100 percent male dominance, while 85.7 percent of the female respondents were tailors and seamstresses. Majority of the FOBs (74.6%) in the Municipality were established and managed by their current owners and therefore have not had any succession experience.

Table 1 depicts the relationship that managers of FOBs have with the business. The result in Table 1 reveals that around 76 percent of the respondents said that they were owners/founders of their businesses, while about six percent of the respondents were hired managers. Thus, majority of the businesses were owned and managed by the founders. This is consistent with agency cost theorists who encourage family successions and argue in support of family ownership in view of it being efficient to minimise agency problems. In such situations, shares are in the hands of agents whose special relations with other decision agents allow agency problems to be controlled without separation of the management and control decisions (Fama & Jensen, 1983).

Table 1: Relationship with the business

Relationship	Frequency	Percent
Owner or founder	155	75.6
Hired manager	13	6.3
Spouse of founder/owner	13	6.3
Son/daughter of owner/founder	11	5.5
Other family relation	13	6.3
Total	205	100.0

Source: Field work (2012.)

The issues examined on owners' perception on the importance of succession planning were: availability of succession plans, reasons for not planning, the development of the plan, planning for succession being tedious, planning being a lasting gift, skill of founder in business planning, strategy, the need for human resource development and the benefits of succession planning. The issues were captured in the form of statements with "yes" or "no" and ranking responses. The items were then analysed using cross tabulations and correlation analysis in SPSS.

On the issue of whether FOBs in the municipality had succession plans for their businesses, it was observed in Figure 1 that 43 percent, indicated that their businesses have written succession plans; 33 percent have unwritten succession plans for their businesses; while 24 percent of FOB owners/managers have neither a written nor unwritten succession plan for their businesses. From the figure below, it is observed that 117 respondents out of the 205 had not made plans for the transfer of their businesses, the 33 percent who indicated unwritten succession plans only gave it a thought but had not actually planned for succession. The result is similar to the Government of Alberta's (2007) report that majority of business owners were not sufficiently prepared for the future of their businesses, with only

10 percent having a written plan, 38 percent an unwritten plan, while 52 percent had no plan at all.

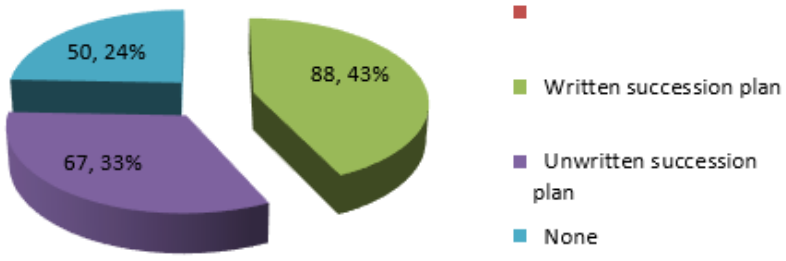


Figure 1: Succession Planning in FOBs

On the issue of development of the succession plan, 77.3 percent of the 88 respondents with written succession plans, developed the plans themselves. Another 10.2 percent also indicated that their succession plans were developed by a family member and another 10.2 percent indicated that the plans were developed by consultants. This implies that majority of the succession plans among the FOBs in the study area were not developed by professionals in the field.

Table 2: reasons for the lack of succession planning in FOBs

Reasons	Frequency	Percent
Lack of skill	18	15.4
Lack of time	17	14.5
No need for succession plan	38	32.5
No potential family successor	4	3.4
Fear of losing power	3	2.6
Not yet given a thought	37	31.4
Total	117	100.0

Source: Field work (2012)

For those who did not have written succession plans for their businesses, several reasons were provided, the result showed that 32.5 percent of respondents, out of 117 did not see the need for any formal planning as far as succession is concerned, 31.6 percent had not yet given it a thought, 15.4 lack of skills to devote to the development of a succession plan while 2.3 percent indicated that the fear of losing control was the reason why they did not have succession plans in their businesses (Table 2). This confirms the comment by scholars that succession planning in some FOBs is left to chance (e.g., Sharma et al., 2000).

The results of the perception that succession planning is tedious suggest a very strong agreement (88.8%) that planning for succession is a tedious work among FOBs within the sampled population. In order to verify if this perception is relative to level of education and or gender of FOB owners or founders, a cross tabulation was carried out and the results indicated that

there is no significant relationship between gender and the perception that planning for succession is a tedious work for FOBs (χ^2=0.539, df =1, p = 0.467). From Table 3, it can be observed that the level of agreement with this perception does not differ with respect to gender as more females and males indicated a strong agreement to the claim. The results also revealed that there is no significant difference between the percentages within gender (92.8% and 95.5%) for the male and female respectively and within planning for succession as tedious work for FOBs. Therefore, there were no is differences between both males and females so far as the difficulty in planning for succession was concerned.

However, there was a significant association between the level of education and planning for succession being a tedious work for FOBs (χ^2=42.076, df =20 and p = 0.003). The results revealed that there were differences in opinion with regard to level of education and planning for succession being a tedious work. As to whether succession planning is a gift to future generations or not, the analysis reveals that many of the respondents (96.1%) agreed that dealing effectively with succession planning is a lasting gift one generation can bestow upon another in business while a few (3.9%) of respondents disagreed. Thus, majority of FOB owners or founders perceive that the lasting gift from one generation to the other in business is an effective succession planning.

Table 3: Gender and Planning for succession

			Planning for succession is a tedious work for FOBs.		
			Yes	No	Total
Gender	Male	Count	129	10	139
		% within Gender	92.8%	7.2%	100.0%
		% within Planning for succession is a tedious work for FOBs.	67.2%	76.9%	67.8%
		% of Total	62.9%	4.9%	67.8%
	Female	Count	63	3	66
		% within Gender	95.5%	4.5%	100.0%
		% within Planning for succession is a tedious work for FOBs.	32.8%	23.1%	32.2%
		% of Total	30.7%	1.5%	32.2%
Total		Count	192	13	205
		% within Gender	93.7%	6.3%	100.0%
		% within Planning for succession is a tedious work for FOBs.	100.0%	100.0%	100.0%
		% of Total	93.7%	6.3%	100.0%

χ2=0.539, df =1 and p = 0.467

Source: Field work (2012)

Similarly, on the importance of skills in business planning for founders or owners of family businesses, 94.1 percent perceived that business planning

is an important skill for owners or founders while 5.9 percent of the respondents said there was no need for business planning skills for founder or owners of family businesses. Also, with regard to the ability to develop a business strategy and its impact on succession, 98.5 percent agreed that the ability to develop a business strategy has a positive impact on succession whereas 1.5 percent disagreed. Furthermore, 98.5 percent of the respondents think that human resource development is key to performance after succession and 1.5 percent of the respondents did not agree.

The relationship among these four variables was explored using Spearman's rank order bivariate correlation. The results show that correlation is significant at a 0.01 alpha level (2-tailed) among all four variables (see Table 4). Thus, there is a positively significant relationship among the variables. This implies that, for a succession to be successful and serve as a lasting gift from one generation to another, there must be an effective planning process leading to a plan, and the development of human resource and a business strategy. This finding is consistent with the opinion of Christensen (1953): Ward (1987): Lansberg (1988) and Sharma, Chua, and Chrisman (2003) who suggested that succession planning as a process should include identifying the pool of potential successors, designating the successor, and notifying the successor designate and other management leaders of the decision made, the need to train the successors and to formulate a vision of the company after succession, as well as defining a role for the retiring CEO. The authors suggest that succession planning process consists of discrete components which include selecting and training a successor, developing a vision or strategic plan for the company after succession, defining the role of the departing incumbent, and communicating the decision to key stakeholders

Table 4: Correlation coefficients of explanatory variables

		Succession planning	Business Planning	Business strategy	Human Resource
succession planning	Correlation Coefficient	1.000	0.540**	0.546*	0.469**
	Sig. (2-tailed)		0.000	-0.042	0.000
Business planning	Correlation Coefficient	0.540**	1.000	0.667*	0.607**
	Sig. (2-tailed)	0.000		-0.030	0.000
business strategy	Correlation Coefficient	0.546*	0.667*	1.000	0.533*
	Sig. (2-tailed)	-0.042	-0.030		-0.044
Human resource	Correlation Coefficient	0.469**	0.607**	0.533*	1.000
	Sig.(2tailed)	0.000	0.000	-0.044	.

Correlation is significant at the 0.01 level (2-tailed)
Source: Field work (2012)

The issues were further examined to determine whether these perceptions were influenced by the educational background of owners or founders. The chi square test showed that there is a positively significant relationship between the level of education and perceptions of owners or founders on the proposition that dealing effectively with succession planning is a lasting gift that one generation can bestow upon another (χ^2=36.209, df = 20 and p = 0.028). Many of the respondents who agreed with the statement were those with at least Senior High or Technical School Education. On the other hand, those who disagreed were those that had no education or schooled only up to the junior high school level. This implies that people with high level of formal education tend to have positive perception on the importance of succession planning as compared with those with lower levels of formal education. The other three issues: business planning is an important skill for founders and successors, the ability to develop a business strategy had a positive impact on succession, and human resource development is a key to performance after succession were cross-tabulated with level of education. There was also evidence that perceptions on the importance of succession planning and business continuity are significantly related to the level of education; and the higher the educational achievement among founders, the more positive perceptions they have about succession and the need to plan for it.

As to how respondents perceive the benefits of succession planning and business continuity to the founder, the successor, the family and other stakeholders, the results reveal 92.7 percent of the respondents agreed that business continuity benefits the founder while 7.3 percent of the respondents disagreed. Similarly, 90.7 percent noted that it benefits the successor and 9.3 percent of the respondents thought otherwise. On benefits to family, 95.4 percent of the respondents indicated their agreement while 4 percent of the respondents indicated that succession planning and business continuity cannot benefit the family. Also, 59.5 percent thought that it benefits other stakeholders.

Using cross tabulation, the relationship between gender and the benefits of FOBs continuity was further explored, and the result is presented in Table 5. The finding showed no significant relationship (χ^2=0.3329, df = 1, p = 0.565) between gender and benefits to the founder. The percentages, 89.9% for male and 92.4 for female, further suggest that there were no differences. There was also no difference in opinion between males and females on the perception that business continuity benefits the successor (χ^2=0.443, df = 1, p = 0.668). The cross tabulation for business continuity and benefits to the family and other stakeholders indicated no significant relationships (χ2=0.3329, df = 1, p = 0.565) and (χ^2=1.850, df = 1, p = 0.177), respectively (Table 5).

This implies that both male and female owners and founders strongly agreed that continuity of FOBs benefits the founder, successor, family and other stakeholders. This finding is consistent with that of Mahoney (2005),

who broadly defines stakeholders as individuals and groups who contribute to the wealth-creating potential of the firm and are its potential beneficiaries and or those who voluntarily or involuntarily become exposed to risk from the activities of a firm.

Table 5: Gender and Benefits of Business continuity to the founder

			Business continuity benefits th founder.		
			Yes	No	Total
Gender	Male	Count	125	14	139
		Expected Count	126.1	12.9	139.0
		% within Gender	89.9%	10.1%	100.0%
		% within benefits to founder.	67.2%	73.7%	67.8%
		% of Total	61.0%	6.8%	67.8%
	Female	Count	61	5	66
		Expected Count	59.9	6.1	66.0
		% within Gender	92.4%	7.6%	100.0%
		% within benefits to founder.	32.8%	26.3%	32.2%
		% of Total	29.8%	2.4%	32.2%
Total		Count	186	19	205
		Expected Count	186.0	19.0	205.0
		% within Gender	90.7%	9.3%	100.0%
		% within benefits to founder.	100.0%	100.0%	100.0%
		% of Total	90.7%	9.3%	100.0%

χ^2=0.3329, df = 1 and p = .565
Source: Field work (2012)

SUMMARY OF KEY FINDINGS

Majority of Owners of FOBs perceived that business planning, though tedious is an important skill and has a positive impact on succession planning which leads to FOB continuity.

People with high level of formal education tend to have positive perception on the importance and need for succession planning and business continuity as compared with those with lower levels of formal education.

That succession planning being a tedious work has no significant differences between gender of Owners, both male and female agreed to that perception ($\chi 2=0.539$, df =1, p = 0.467).

Majority (96.1%) of FOB owners or founders perceive that business continuity benefits the founder, the successor, the family and other stakeholders.

That succession planning in relation to business continuity should emphasise human resource development as key to performance after succession.

CONCLUSION AND RECOMMENDATIONS

The perception of many founders or owners on the importance of succession planning in relation to business continuity is that people with high level of formal education tend to have positive perception on the importance and need for succession planning and business continuity as compared with those with lower levels of formal education. Business planning, though tedious, is an important skill for owners or founders. Also, human resource development had a positive impact on succession and is key to performance after succession. It is recommended that founders or owners should upgrade themselves an through the non-formal education system, workshops, seminars, and ensure that potential successors go through formal education to acquire the necessary knowledge and competencies required for effective performance.

REFERENCES

Abouzaid, S. (2008). IFC family business governance handbook. Washington: International Finance Corporation.

Agyapong, D. (2010). Micro, small and medium enterprises' activities: Income level and poverty reduction in Ghana – A synthesis of related literature. *International Journal of Business and Management*, *5* (12), 196-205.

Ajzen, I. (1987). Attitudes, traits and actions: Dispositional prediction of behaviour in social psychology. *Advances in Experimental Psychology*, *20*:1-63.

Ajzen, I. (1991). The theory of planned behaviour. *Organisational Behaviour and Human Decision Processes*, *50*, 179-211.

Ajzen, I. & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour.* Eaglewood Cliffs, NJ: Prentice-Hall

Armstrong, M. (2003). *A handbook of human resource management in practice* (9th Ed), Kogan Page, London and Sterling, VA.

Ayres, G R. (1990). Rough family justice: Equity in family business succession Planning. *Family Business Review*, *3* (1), 3-22.

Basu, A., Blavy, R. & Yulek, M (2004) Microfinance in Africa: Experience and Lessons from IMF International Monetary Fund.

Beckhard, R. & Dyer, W. G. Jr. (1983). Managing continuity in the family owned business. *Organizational Dynamics,* 5-12.

Beck, T., Demirguc-Kunt A. & Maksimovic, V. (2004). SMEs, Growth, and poverty – Do pro-SME policies work? *World Bank Policy Research Working Paper No. 268*.

Bocatto, E., Gispert, C. & Rialp, J. (2010). Family-owned business succession: The influence of pre-performance in the nomination of family and nonfamily members: Evidence from Spanish Firms. *Journal of Small Business Management*, *48* (4), 497–523.

Branco, M.C. & Rodrigues, L.L. (2007). Positioning stakeholder theory within the debate on corporate social responsibility. *Electronic Journal of Business Ethics and Organisation Studies, 12*, (1), 5-15. Retrieved from http://ejbo.jyu.fi/pdf/ejbo_vol12_no1.

Chrisman, J. J. (1999). The influence of outsider generated knowledge resources on venture creation. *Journal of Small Business Management*, *37* (4), 42-58.

Churchill, N. C. & Lewis, V. L., (1983). The five stages of small business growth. *Harvard Business Review, 61* (3), 30–50.

Christensen, C. (1953). *Management succession in small and growing enterprises*. Boston: Harvard Business School.

Detienne, D. (2010). Entrepreneurial exit as a critical component of the entrepreneurial process: *Theoretical development. Journal of Business Venturing, 25(2): 203-215.*

Dyck, B., Mauws, M., Starke, F. A. & Mischke, G. A. (2002). Passing the baton: The importance of sequence, timing, technique and communication in executive succession. *Journal of Business Venturing, 17*, 143-162.

Dyer, Jr. W. G. (1986). Cultural change in family firms: Anticipating and managing business and family transitions. San Francisco: Jossey Bass.

Esuh, O. L., Mohd S. M., and Adebayo, O. I. (2011). A Conceptual framework of family business succession: Bane of family business continuity. *Internal Journal of Business and Social Science*, 2, 18.

Fama, E. & Jensen, M. (1983). Separation of ownership and control. *Journal of Law and Economics*, *26,* 301-325.

Family Business Magazine (2002). The world's largest family companies. Retrieved from www/family business magazine.com /topglobal.html

Gephart, R. P. (1978). Status degradation and organizational succession: an ethnomethodological approach. *Administrative Science Quarterly*, 23, 553–581.

Goldberg, S. D. & Woodridge, B. (1993). Self-confidence and managerial autonomy: Successor characteristics critical to succession in family firms. *Family Business Review, 6* (1), 55-73.

Handler, W.C. (1994). Succession in family business: a review of the research. *Family Business Review*, *7*, 133–174.

Habbershon, T. G. & Pistrui, J. (2002). Enterprising families' domain: Family-influenced ownership groups in Pursuit of Transgenerational wealth. *Family Business Review, 15*, 223-237.

Hamilton, L. (2003). *SMES succession planning: Its pros and cons, a survival process.* In International Council for Small Business, 48th World Conference, Belfast, UK.

Klein, S. (2000). Family businesses in Germany: Significance and structure. *Family Business Review. 13*, 157-181.

Krueger, N. F. Jr. (1993). The impact of prior entrepreneurial exposure on perceptions of new venture feasibility and desirability. *Entrepreneurship Theory and Practice*, *18* (1), 5-21.

Krueger, N. F. Jr. & Carsrud, A. L. (1993). Entrepreneurial intentions: Applying the theory of planned behaviour. *Entrepreneurship and Regional Development, 5*, 315-330.

Kuratko, D. K. & Hodgetts, R. M. (2004*). Entrepreneurship: Theory,*

process and practice (6th Ed). United. States of American: Thomson South-Western.

Lam, J. (2009). Succession process in a large Canadian family business: A longitudinal case study of the Molson Family Business: 1786-2007. *Family Business Review*, *1* (2), 119-143.

Lansberg, I. (1988). *The succession conspiracy*. A Ph. D Thesis Report. Concordia University of Montreal, Quebec, Canada.

Leach, P. & Bogod, T. (1999). *A guide to the family business* (3rd Ed), London: Kogan Page.

Litz, R. A. (1997). The family firm's exclusion from business school research: Explaining the void; addressing the opportunity. *Entrepreneurship Theory and Practice*, *21*, 55-72.

Mahoney, J.T. (2005). *Economic foundations of strategy*. Sage Publications: Thousand Oaks, CA.

Malone, S. C. (1989). Selected correlates of business continuity planning in the family business. *Family Business Review*, *2* (4), 341-353.

Motwani, J. & Schwarz, T. V. (2002*). Succession planning practices of West Michigan family-owned businesses: An empirical analysis*. Retrieved from www.sbaer.uca.edu/research/sbida/2002/Papers/24.pdf

Nordqvist, M. & Melin, L. (2009). Entrepreneurial families and family firms. *Entrepreneurship and Regional Development* (accepted and forthcoming).

O'Connell, P., Sedigdeilami, F., Pepler, D., Craig, W., Connolly, J., Atlas, R., Smith, C. & Charach, A. (1997). Prevalence of bullying and victimization among Canadian elementary and middle school children. Poster session presented at the meeting of the Society for Research in Child Development, Washington, D.C.

Phillips, R. (2003). *Stakeholder theory and organisational ethics.* San Francisco, CA: Berrett-Koehler.

Pollak, R. A. (1985). A transaction cost approach to families & households. *Journal of Economic Literature*, *23:*581-608.

Post, J. E., Preston E. L. & Sachs, S. (2002). *Redefining the corporation: Stakeholder management and organizational wealth*. Stanford, CA: Stanford University Press.

Ramona, K. Z., Hoy, F., Poutziouris, P. Z. & Steier, L. P. (2008). Emerging paths of family entrepreneurship research. *Journal of Small Business Management*, *46* (3), 317-330

Rubenson, G. C. & Gupta, A. K. (1996). The initial succession: A contingency model of founder tenure. *Entrepreneurship Theory and Practice*, *21* (2), 21-35.

Rue, L. W. & Ibrahim, N. A. (1996). The status of planning in smaller family-owned business. *Family Business Review*, *9* (1), 29-43.

Sharma, P. (1997). Determinants of the satisfaction of the primary stakeholders with the succession process in family firms. Doctoral dissertation, University of Calgary.

Sharma, P., Chua, J. H. & Chrisman, J. J. (2000). Perceptions about the extent of succession planning in Canadian family firms. *Canadian Journal of Administrative Sciences*, *17*, 233-244.

Sharma, P., Chrisman, J. J. & Chua, J. H. (2003). Succession planning as planned behavior: Some empirical results. *Family Business Review, 16* (1), 1–15.

Sheppard, B., Hartwick, J. & Warshaw, P. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations and future research. *Journal of Consumer Research*, *15*, 325-344.

Shleifer, A. & Vishny, R. (1997). A survey of corporate governance. *Journal of Finance*, *52*, 737-783.

Small Business Administration (2001). Major management challenges and program risks (GAO-01-260).

Stavrou, E. T. (1999). Succession in family businesses: Exploring the effects of demographic factors on offspring intentions to join and take over the business. *Journal of Small Business Management*, *37* (3), 43-61.

Steben, R. E. & Bell, S. (1978). Track and field: An Administrative Approach to the Science of Coaching. New York: Wiley.

Vancil, R. F. (1987). *Passing the baton: Managing the process of CEO succession.* Boston, MA: Harvard Business School Press.

Ward, J. L. (1987). Keeping the family business healthy: How to plan for continuing growth, profitability, and family leadership. San Francisco: Jossey-Bass.

Winter, M., Fitzgerald, M., Heck, R., Haynes, G. & Danes, S. (1998). Revisiting the study of family businesses: Methodological challenges, dilemmas, and alternative approaches. *Family Business Review, 11*:239-252.

THE IMPACT OF THE VAN STADENS WIND FARM ON THE SURROUNDING COMMUNITY – A CASE STUDY

Nicole O'Connor[1] and Christopher Allen[2]
[1]*Mott MacDonald, London, UK*
[2]*Department of Construction Management, School of the Built Environment, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa*

In March 2013, an urgent application was brought forward by residents of Blue Horizon Bay, South Africa, in which they were seeking an interdict to restrain the continued construction of a Wind Farm granted special consent by the Nelson Mandela Bay Municipality. Residents had objected to the process followed when approving the development of this major new project and how the existing legislation was applied. The aim was thus to determine the nature of the impact the Metro Wind Van Stadens wind farm had on the surrounding environment including the health and wellbeing of residents as well as on the value of properties, thereby better informing future wind farm / project public participation processes. A quantitative research method has been employed, using a Stratified sampling technique, to collect data from thirty-five permanent residents in Blue Horizon Bay residing within a two-kilometre radius of the wind turbines as well as from a random selection of seven property experts operating in Nelson Mandela Bay was also collected. The results of the study show that residents have opposing perceptions towards the wind farm with visual pollution on the horizon in the nature conservancy negatively impacting the majority of residents, whilst a minority of residents have reported adverse health effects linked to infrasound. The property experts had similar perceptions although they did agree that wind turbines can cause the value of residential properties to drop when placed within a certain proximity to residential dwellings, with the distance and the topography having an impact thereon. The results of the study provide insight into the importance of an open and transparent public participation process that effectively addresses the impact wind turbines can have on people and the environment as well as the implications for property prices, as this process generated the most concern. In addition, the findings have relevance to the engagement processes of government entities with communities on projects of any scale particularly the communications process employed.

Keywords: Blue Horizon Bay, health, Van Stadens wind farm, wind turbine

[1] Nicole.O'Connor@mottmac.com
[2] Chris.Allen@nmmu.ac.za

O'Connor, N. and Allen, C. (2017) The impact of the Van Stadens wind farm on the surrounding community – a case study *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1300-1313

INTRODUCTION

In March 2013, an urgent application was brought forward by residents of Blue Horizon Bay (BHB), a coastal suburb on the western outskirts of Nelson Mandela Bay (NMB), in which they were seeking an interdict to restrain the continued construction of a wind farm on agricultural land situated inland of their suburb. The interdict sought to pend for finalisation appeals lodged by the applicants, in terms of section 44 of the Land Use Planning Ordinance of the National Environmental Management Act, against a decision taken by the second respondent, the city, to grant special consent for the use of the property upon which the wind farm was developed. (Vermaak vs The Minister of Water and Environmental Affairs, 2013).

This was the culmination of a process that had commenced on the 28th March 2011, when the Department of Environmental Affairs approved an environmental authorisation for the construction and operation of a wind farm of ten industrial wind turbines with a generating capacity of twenty megawatts in the Van Stadens region of the Eastern Cape. An amended authorisation was approved on the 13th October 2011 permitting the erection of nine turbines with a generating capacity of twenty-seven megawatts. In December 2011, the objecting parties lodged notices of appeal against the environmental authorisation, being adamant that the process followed by the developers was unethical and insufficient, particularly the public consultation process carried out.

This case raised a number of pertinent concerns regarding the current legislation and its application when approval for a major new project with the potential to negatively affect communities in its immediate vicinity occurs. Eltham *et al.* (2008) noted that "the physical infrastructure of a wind farm is often prevented by objections that are based on social and institutional factors". It also raised the issue of whether the respondents were in a position to challenge the development on the basis of perceived impact on resident's health (Pierpoint, 2009; Yano *et. al*, 2013) or were they simply resisting an agreeable change to their existing neighbourhood as a result of the NIMBY (Not In My Back Yard) effect? The research therefore aimed to determine the nature of the impact the Metro Wind Van Stadens wind farm has had on the environment and in particular the residents in BHB as well as on property values in the area. The objective was to establish whether residents' concerns were valid with respect to:

- Noise and vibration from infrasound really affecting human health and well-being;
- Residents experiencing health symptoms found in previous international studies; and
- The presence of industrial wind turbines causing the value of homes and properties to diminish and/or become impossible to sell.

WIND ENERGY: PARIAH OR GODSEND

All over the world, public attitudes are showing moderate to strong support for the implementation of renewable energy. According to Molnarova *et al.* (2012), there is a global desire for wind energy because of the low emissions generated in the production of power. Onshore wind farms generate clean, green energy, delivering real and tangible reductions in greenhouse gas emissions; provide security of energy supply and socio-economic benefits to the local and national economy. (Community Benefits Report, 2013).

The Constitution of the Republic of South Africa (1996) states that everyone has the right to an environment that is not harmful to their health or well-being and have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures. It was created with the stated aim of fostering co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for co-ordinating environmental functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and matters connected therewith. Sustainable development requires the integration of social, economic and environmental factors in the planning, implementation and evaluation of decisions to ensure that development serves present and future generations (South African Government, 1998).

Developers and companies should thus be focused on establishing strong relationships with stakeholders, landowners, the government and local communities. Breukers and Wolsink (2007) suggest engagement with the public early in the planning stages and inviting key stakeholders to contribute local understanding during the preparation of a project as this will enhance the design quality of the scheme and reduce the perceived threat posed to a community, increasing the anticipation of benefit from the wind farm. Siting of the physical infrastructure of a wind farm is often prevented by objections, such as not trusting the planning system or being skeptical of what the proposed developer's intentions are (Eltham *et al.*, 2008). It has been demonstrated that involving communities before a site had been established for the development has much greater advantages than including them once this has been identified (Wolsink, 2007a). Metrowind Van Stadens Wind Farm developer Donald McGillivray said, "the company had always had a good relationship with the residents and there were only a handful who had been opposed to it". The application to the Port Elizabeth High Court was brought by 'The Wind Farm Concerned Group' representing 352 residents from Blue Horizon Bay who were quoted in an article in the Herald newspaper (Butler, 2013) as identifying the real issue being "*no proper public participation by either the developers or the municipality before the go-ahead was given for the development of this so-called 'wind farm' on the doorstep of Blue Horizon Bay. The concomitant result is that the residents did not have an opportunity to make representations about factors such as noise, visual impact, the effect on flora*

and fauna, and health effects." This would therefore suggest that strong relationships with the community had not been fostered prior to the submission of the planning application.

Parks and Theobald (2013) confirm that trust is built between developers and the public when involvement is sought, which prevents misconceptions, whilst having an expert in the field of renewable energy and wind generation, was reassuring, as such a person was objective and considered the project as a whole without having any interest to promote. Effective public participation in the planning process is regarded by many as the best possible way of alleviating a few of the current problems related to wind farm developments (Berry et al., 2011). Berry and Higgs (2012) have since identified five aspects of good practice, including: The scope of participation; the timing of the participation; the representativeness of the groups involved; the convenience of the forms of participation for the public, and, the likely impact of the participation on the final decision-making process.

Although public acceptance is high in general for wind energy, a variety of local concerns exist that can impact the length and outcome of the siting and permitting process of a wind farm. It should be noted that "Public attitudes towards wind power are fundamentally different from attitudes towards wind farms." (Wolsink, 2007b). Problems with the siting of industrial wind turbines during the decision-making process are usually referred to as 'communication problems'. Appropriate placement of wind projects is crucial, not only for minimizing project impacts on a community, but also for maximizing a community's economic and renewable energy development potential. Identifying specific wind project areas is important as wind development may not be a viable option in all areas because of natural topography and wind patterns. (Stone, 2012). According to Community Benefits Report (2013) there are three main approaches to zoning areas suited for wind energy developments:

i. allowing wind projects only in particular base land use classifications
ii. creating an overlay district, or
iii. allowing wind projects anywhere, but only upon approval of a conditional use permit.

In addition, some countries combine these approaches.

The Sustainable Development Commission (2009) suggest landscapes and visual impacts are by far the most common grounds given for refusal of planning permission in the United Kingdom. Permission is granted in areas only where the environmental, social and economic benefits outweigh any significant adverse effects and where the objectives of the designation will not be compromised. Stone (2012) also states that when selecting development areas, local governments should consider how wind projects can impact floodplains, wetlands, historical and cultural areas, view sheds, environmentally sensitive areas, and residential areas as well as the wind project's proximity to the power grid. Stakeholders commonly put forth the concern that property values will be adversely affected by wind energy

facilities. According to Hoen *et al.* (2009), concerns about the impact of wind facilities on residential property values can be categorized into three potential perceptions: Scenic Vista Stigma – devaluation due to potential impact of the view of a wind energy facility on an otherwise scenic vista; Area Stigma - the area surrounding a wind energy facility will appear more developed, adversely affecting home values regardless of any home having a view of a turbine; Nuisance Stigma - factors that may occur in close proximity to wind turbines, such as sound and shadow flicker, have an adverse influence on home values. Although these concerns are not unreasonable given property value impacts that have been found near high voltage transmission lines and other electric generation facilities "there is no conclusive evidence that wind farms consistently, measurably or significantly affect house prices." (RenewableUK & Cebr Study, 2014).

Surveys of local communities considering wind facilities have frequently found that adverse impacts on aesthetics and property values are in the top tier of concerns (Firestone & Kempton, 2006). One specific concern is the effect on interrupted views and how this might impact the values of homes negatively, or extend the period of re-sale processes. However, Sims *et al.*, (2008) and Hoen *et al.'s* 2013 research explain that even though some indication of the different visual aspects enjoyed by houses in a location with wind turbines visible might influence transaction prices, neither the view of the facilities nor the distance of the home to them was found to have any consistent, measurable effect on home sales prices. Sims & Dent (2007) highlight that a planning application for a wind farm can affect local house prices, but this impact begins to recover approximately two years after the wind farm has been up and running. According to Wolsink (2007b), misunderstandings about public support for wind turbines relate to the visual evaluation of the impact of wind turbines on landscape values, which is by far the dominant factor why people oppose wind farms. Feelings about equity and fairness also appear to be the determinants of the NIMBY motives. Furze (2002) and Chazan (2010) have noted that industrial wind turbines are often objected to on the grounds of NIMBY-ism. An additional concern is the proximity of industrial wind turbines to homes and how this might directly impact the general health and well-being of residents and thereby indirectly decrease the values of homes and the surrounding area. Moller & Pederson (2011) refer to research by Professor Steve Gibbons, Director of London School of Economics Spatial Economics Research Centre, who reviewed more than a million homes over 12 years, within a 2km proximity of large wind farms, finding that their property values fell by 11 per cent.

According to Knopper and Ollson (2011) concerns have been raised that wind power projects could lead to impacts on human health, as it is with any new technology. Pierpoint (2009) describes 'Wind Turbine Syndrome' as the effect of low frequency sound 'deceiving the body into thinking it is moving'. Sullivan quoting Bonner (2014) states that there is a consistent cluster of symptoms related to wind turbine syndrome which occurs in a number of people living in the vicinity of industrial wind turbines. Results

such as impaired sleep, tinnitus, nausea, dizziness, impaired memory and impaired cognitive function have been recorded for people living in the vicinity of industrial wind turbines, and there is evidence to suggest that children and the elderly are more susceptible to these symptoms. This is reinforced by a conclusion published in the British Medical Journal in April 2012 stating that a large body of evidence now exists to suggest that wind turbines disturb sleep and impair health. This conclusion was also reached by Yano *et al.* (2013) in a Japanese research paper which specifically assessed the severity of annoyance to residents, caused by wind turbine noise. A recommendation from that study was that a minimum one and a half kilometre separation distance be required to minimise severe annoyance. As a result, minimum setback distances have been established worldwide to reduce or avoid potential effects for people living in close proximity to industrial wind turbines. Moller & Pederson (2011) found that the spectrum of wind turbine noise moves down in frequency with increasing turbine size and the low frequency part of the spectrum associated with these turbines plays an important role in the noise problem. The Danish Government enacted a statutory order in January 2012 setting the indoor limit for low frequency noise to a maximum of 20 dB(A). An operating scheme has also been enacted whereby if a property loses more than 1 per cent in value the owner is ensured full compensation for his loss (Akhmatov & Eriksen, 2007).

Self-reported health outcomes and annoyance in popular literature are related to distance from turbines and the claim is made that infrasound is the cause for the reported effects, even though sound pressure levels are not measured. Knopper and Ollson (2011) suggest that 'annoyance appears to be more strongly related to visual cues and attitude than to noise itself', thus those reporting health effects are more likely attributing this physical manifestation due to their annoyed state than from infrasound. Pierpoint's studies on wind turbine annoyance and reported health effects have been statistically associated with wind turbine noise, especially at sound pressure levels greater than 40 dB (A). However, these studies also found the health effects were more strongly related to subjective factors like visual impact, attitude to industrial wind turbines in general and sensitivity to noise. The Australian Medical Association (AMA) released a statement in 2014 regarding 'Wind Farms and Health' discussing its position on 'wind turbine syndrome' at which Professor Geoffrey Dobb, Chair of the AMA Public Health Committee said, "The available Australian and international evidence does not support the view that wind farms cause adverse health effects." He went on to say that any negative connotations associated with wind turbines and public health are far outweighed by the benefits to the environment through green energy generation and 'the concern has been created by anti-wind groups' with ill effects experienced created by misinformation and subsequent anxiety.

RESEARCH DESIGN AND METHOD

As this research aimed to investigate the nature of the impact of the industrial wind turbines on residents in BHB as well as the effects on property values, quantitative data collected via paper questionnaires using Likert scale questions, based on similar studies carried out internationally, was deemed to be the most appropriate method. The questionnaires were set out to evaluate the quality of the residents' current general health and well-being, in comparison to their general health and well-being one year ago when the wind turbines started operating. The Likert scale provides an opportunity for all the data to be compared in frequency tables and the computation of a measure of central tendency in the form of a mean score to enable comparison of responses to various factors as well as the ranking of such factors. Not all the three hundred and seventy residents in BHB are permanent occupants, therefore the Stratified random sample only consisted of residents who permanently reside in BHB and have been residing in BHB since before the development of the wind farm took place. In addition, the sample only consisted of residents residing within a two-kilometre radius of a wind turbine as measured using Google map. Questionnaires were hand delivered accompanied by a cover letter and collected at an arranged time and date. Ethical issues relating to maintaining the anonymity of respondents was critical to achieving reliable data, so only limited demographic information was collected. A second quantitative survey was conducted amongst property experts in the Eastern Cape. The questionnaire was sent to seven randomly selected BHB and NMB Real Estate Agents and South African Property Owners Association (SAPOA) Registered Property valuer's. Although triangulation of the property value results through a review of property prices from before and after the installation would have been ideal, the small sample size of property in BHB as well as the short period since the installation meant this was not a viable option as part of this study.

The residents' questionnaire consisted of five questions, three of which were five-point Likert-scale type questions, designed to determine the residents' perceptions regarding their current health, sleep patterns and feelings towards the wind farm. The remaining two questions provided limited but relevant demographics of the sample alongside an open-ended question that solicited general comments from the residents. Of the thirty-three questionnaires returned, thirty questionnaires were deemed to be valid and reliable. The property expert's questionnaire was emailed to seven randomly selected experts from the provided supplier lists (2 each from the BHB and NMB lists, 3 from the SAPOA list). The questionnaire consisted of two questions, both of which were five-point Likert scale questions, set to determine if and how wind farms have affected property values of the local community. All seven questionnaires were returned.

RESEARCH RESULTS

The research first looked at any changes in the health of residents in order to address the assertion that the wind turbines have had a negative impact on the general health and well-being of residents. Table 1 indicates the extent to which the general health of the residents has been affected in the terms of percentage responses on a scale of 1 (minor) to 5 (major). The MS of 2.67 is within the > 2.60 to ≤ 3.40 range, indicating there is a near minor extent to some extent a decrease in the quality of the residents' general health.

Table 1, Extent to which the residents' general health has changed in the past year.

Response (%)					MS
Minor…….Major					
1	2	3	4	5	
3.3	30	63.3	3.3	0	2.67

In addition, 70% of respondents indicated that they are free from any new medical conditions whilst 80% indicated that they had not been prescribed with any new medications to get through an ordinary day in the past year, neither showing a specific negative trend.

Table 2 shows a list of the internationally reported common health symptoms caused by wind farm developments. The health symptoms are indicated in terms of percentage responses on a scale from less to more. MS values are all in the more range, although only slightly for 4 of the 7 and then with a notable unsure %. What can be discerned from the responses is that the emotional symptoms score more highly than the physical symptoms, with these MS's above 2.4, indicating that the effects are more mental than physical on the residents.

Table 2, Change in health symptoms over the past year.

Symptoms	Response %				MS	Rank
	Less…….More			Unsure		
Feelings of stress	0.0	46.7	36.7	16.7	2.44	1
Feelings of anxiety	3.3	40.0	40.0	16.7	2.44	2
Feelings of anger	0.0	50.0	33.3	16.7	2.40	3
Vertigo/Imbalance	0.0	60.0	16.7	23.3	2.22	4
Nausea	0.0	66.7	10.0	23.3	2.13	5
Feelings of irritability	0.0	66.7	10.0	23.3	2.13	6
Heart Palpitations	0.0	76.7	10.0	13.3	2.12	7

'Wind turbine syndrome' symptoms were recorded in terms of percentage responses on a scale of 1 (minor) to 5 (major). The MS of 3.63 for interrupted sleep shows that there is to some extent to a near major extent an impact in

terms of the turbines waking residents up in the night. The other MS of 2.53 would suggest that there is only a near minor extent to some extent impact on residents' ability to fall asleep within 30 minutes of going to bed over the past year compared with previous years.

Table 3, Factors affecting sleep patterns.

Response (%) Minor……..Major							
Factor	1	2	3	4	5	MS	Rank
Interrupted sleep	20.0	3.3	13.3	20	43.3	3.63	1
Falling Asleep	33.3	26.7	13.3	6.7	20	2.53	2

Aligned to this, residents were also asked as to their perceived quality of sleep since the turbines were commissioned when compared to before the installation. A MS of 3.17 indicates that they deem their sleep quality to be to some extent impacted on by the turbines. More than three-quarters indicated only a minor or near minor need to take new medication to sleep.

With respect to the consultation process conducted for the installation of the turbines, residents were given three statements regarding the planning and presence of the wind farm. Half of the respondents stated they strongly agree with Statement A: "Residents were not notified in time to object to the location of the wind farm". This was also ranked first in the table with an MS of 3.78 indicating residents agree to strongly agree that they were not notified in time. When it came to statement B: "If residents were notified in time, they would have objected to the location of the wind farm" an MS of 3.56 was achieved, the major difference being that only 30% of residents strongly agree they would have objected if notified in time. Statement C asked residents if they would move further away from the wind farm if they could afford to and more than a third of respondents strongly disagreed with this statement, whilst around a quarter of respondents strongly agree that they would move away if they could afford to.

The property experts were asked whether they agreed or disagreed with a similar set of statements as follows: **A** - Buyers are wary of purchasing residential property in close proximity to an already developed wind farm development; **B** - Once a wind farm is completed, the negative impact on property values continues but becomes less severe after two years or more after completion; **C** – Blue Horizon Bay homes and properties are currently worth less than comparable properties in the market which are unaffected by wind farms.

Table 4, Effects of wind farm developments on BHB property values.

	Response %						
Circumstance	Disagree……				Agree	MS	Rank
A	0.0	0.0	14.3	14.3	28.6	3.29	1
B	14.3	14.3	0.0	71.4	0.0	3.29	2
C	28.6	28.6	28.6	0.0	14.3	2.43	3

Property experts were also asked to agree or disagree with the stated factors, derived from previous studies, which could affect the values of properties in BHB: A - The infrasound caused by the turbines; B - The proximity of a property to a wind farm; C - Visual impact of the wind farm after completion; D - The size of the wind farm.

Given that the MS's are between 3.75 and 3.43 for A and B it can be said that infrasound proximity and the visual impact are very important factors that can decrease residential property values. Given that the size of a wind farm MS is 3.14, it can be said that it has a lesser impact on the decrease in value on residential properties.

Additional comments from residents highlight the perception aspect to the impact of the installation specifically from a noise and visual pollution perspective:

"The wind turbines are beautiful to look at, but the noise is horrible and unbearable sometimes."

"The biggest way the wind farm affects my quality of life is through the noise the turbines create and by their truly unsightly appearance on the landscape."; "I can hear the terrible noise the turbines make, especially at night, but my health has not been affected drastically."; "In the beginning it was thought that the turbines would be an invasion to my view, but have now become acceptable and hardly noticed."; "This house is virtually closest to the wind turbines. We rarely hear the rotation noises as the sea-sounds are louder."; "I live in the second street from the entrance and I don't hear the wind turbines, but I do wake up from the sound of the sea."; "Since the wind farm was erected, it feels as if we are living in an industrial area. It spoils the tranquillity of the village. Even from the beach it is an 'eyesore' to visitors in our village."; "We have no problems with wind farms except that they are right under our noses… I mean 650 metres away from our home…Helloooo?"; "I cannot fall asleep in summer when windows are open and turbines are running. Also, shitty when braaiing on deck and hearing the blady sound!"; "Not opposed to the wind farm but I do feel that some of the turbines should have been erected further away from BHB in case of any long-term effects that they might have."

DISCUSSION

Pierpoint, The British Medical Journal, Danish Government and Yano *et. al* all agree that wind turbines disturb sleep and impair health. In addition, Hanning (Nissenbaum *et al.*, 2011), a consultant in Sleep Disorders, discusses adverse impacts of turbines on sleep at distances of up to 2km's and greater. The empirical findings, including the comments provided by respondents, support this, although, just as per the literature, conflicting evidence, such as the AMA Public Health Committee statement suggest that any result will be subjective depending on your worldview. The main evidence supporting the sub-problem is that respondents had increased feelings of anger, anxiety and stress over the past year, as described in Table 2. According to Basner *et al.* (2014), annoyance is the most prevalent

community response in a population exposed to environmental noise. Noise annoyance can result from noise interfering with daily activities, feelings, thoughts, sleep, or rest, and might be accompanied by negative responses, such as anger, displeasure, exhaustion, and by stress-related symptoms. Respondents indicated in Table 3 that they have to some extent to a near major extent been woken in the middle of the night, a phenomenon they had not experienced on a regular basis prior to the erection of the wind turbines. The evidence in Table 1 partially supports the hypothesis.

When it came to the public consultation process, despite this being the main area that the wind farm was being challenged in the courts, the results were somewhat underwhelming. Respondents indicated a MS of 3.78 in relation to not being notified about the development, within the agree to strongly agree range. When it came to asking them whether they were of the opinion that had they been given the chance to object to the proposed location of the development they would have, an MS of only 3.56 was achieved and only 30% of the respondents strongly agreed they would have objected if notified in time. This corroborates the literature view that perception of a problem and the noise generated as a result of that can far outweigh the actual situation within the communities involved.

This leads us to then look at how the three potential stigmas identified (Scenic Vista, Area and Nuisance stigma) can affect the value of residential homes. The literature would suggest that there is a correlation between the distance from the wind turbines and value loss on the residential properties, besides a general demand decrease for all property located within the view sheds. This is based on perceptions of both visual impact, noise/sound and health concerns, so each of these impacts should be considered when performing an EIA and analysing the effects of wind farms on residential sales prices. The empirical findings support this, with Table 4 indicating that property experts were of the opinion potential buyers were wary of purchasing properties in close proximity to wind farms. However, given the MS of 3.29, this factor is less than important to important. The same MS score was achieved when reviewing property experts' opinion towards the value of residential properties in close proximity to wind farms and their ability to recover any loss within two years. The MS of 2.43 with relation to whether the value of properties in BHB are worth less than comparable properties unaffected by wind farms indicates that they somewhat disagree with the statement.

In terms of the decrease in value caused by factors such as infrasound, the visual impact, and the size of the wind farm, the MS of 3.75 (infrasound) and 3.43 (visual impact) suggest that they are somewhat of a major importance factor when it comes to the decrease in residential property values. This aligns to the literature and in particular research by Professor Steve Gibbons finding that property values fell by 11% within a 2km proximity due to these factors.

CONCLUSION

The wind energy industry has a large potential for growth in Africa, South Africa and especially in the Eastern Cape. However, concerns raised by disgruntled residents of Blue Horizon Bay regarding the public consultation process around the MetroWind Van Stadens Wind Farm and the perceived negative health and well-being resulting from its erection need to be better understood to protect the public from potentially negative consequences of this green energy. The research thus set out to address residents' concerns regarding perceptions that noise and vibration from infrasound affect human health and well-being; identify whether residents experienced similar health symptoms found in previous international studies; and clarify the perception that the presence of industrial wind turbines would cause the value of homes and properties to diminish and/or become impossible to sell. However, the biggest concern is that residents were not properly consulted, specifically in terms of the position of the turbines.

Industrial wind turbines are huge structures that can be seen from a far distance away and have a visual impact on the environment in which they are situated, which the literature and results confirm. The planning processes for wind energy developments should thus involve the public participation from the beginning with the developers siting turbines in order to have the least visual effect on all residents affected. Providing visualisations of the structures will illustrate to them what the landscape will look like so as to gain support of the development from inception, reducing the potential for public objections. The setting of reasonable guidelines for proximity of turbines to residential dwellings, as is the case in a number of countries, will reduce the scope of any EIA, saving time and money, as well as reducing the negative perception amongst the public, allowing industrial wind turbines to be perceived as a benefit to the community and not as a nuisance in their backyard. A public health ethics analysis of how industrial wind turbines should be licensed and installed if the health of the few is to be balanced with, traded off or sacrificed for the health of the many, leads to the conclusion that the present methods of proposal evaluation need to be critically reviewed (Shain, 2011).

The results from this study indicates that the development of the wind farm has had a relatively small impact on a minority of the Blue Horizon Bay residents, which based on the statements received during the interviews, is centred around the visually unappealing industrial wind turbines installation in a nature conservancy. A percentage of the residents see wind energy having a negative impact on the environment because of the noise and their appearance, with a minority of residents being physically and mentally affected by the structures. This negative health impact may further be exacerbated by a belief that the value of their properties is perceived to have dropped due to the noise and visual interference caused by the turbines being installed within a kilometre of their homes.

REFERENCES

Akhmatov, V. and Eriksen, P.B. (2007). A large wind power system in almost island operation—A Danish case study. *IEEE Transactions on Power Systems*, *22*(3), 937-943.

Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S. & Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. *The Lancet, 383*(9925), 1325-1332.

Berry, R. and Higgs, G. (2011). Gauging levels of public acceptance of the use of visualisation tools in promoting public participation: A case study of wind farm planning in South Wales, UK. *Journal of Environmental Planning and Management, 55*(2), 229-251.

Berry, R., Higgs, G., Fry, R., and Langford, M. (2011). Web-based GIS Approaches to Enhance Public Participation in Wind Farm Planning. *Transactions in GIS, 15*(2), 147-172.

Breukers, S., & Wolsink, M. (2007). Wind power implementation in changing institutional landscapes: an international comparison. *Energy policy*, *35*(5), 2737-2750.

Butler, L. (2013). Residents lose appeal – Several attempts to stop the erection of the wind farm have failed. *The Weekend Post*. 31 August 2013, 5.

Eltham, D.C., Harrison, G.P., and Allen, S.J. (2008). Change in public attitudes towards a Cornish wind farm: Implications for planning. *Energy Policy, 36*(1), 23-33.

Firestone, J. and Kempton W. (2006). Public opinion about large offshore wind power: underlying factors. *Energy policy, 35*(3)1584-1598.

Furze, J. (2002) Stealth wind-turbines. Designs and technologies to reduce visual pollution, *REFOCUS*, March/April 18–20.

Nissenbaum, M., Aramini, J. and Hanning, C. (2011). Adverse health effects of industrial wind turbines: a preliminary report. In *Proceedings of 10th International Congress on Noise as a Public Health Problem (ICBEN)*, 1-6.

Hoen, B., Wiser, R., Cappers, P., Thayer, M. and Gautam, S. (2009). The impact of wind power projects on residential property values in the United States: A multi-site hedonic analysis. *Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory*.

Hoen, B., Brown, J., Jackson, J., Wiser, M. and Cappers, R. (2013). A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States. *Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory*.

Jackson, T. (2009). *Prosperity without Growth? - The transition to a sustainable economy*, Sustainable Development Commission

Knopper and Ollson (2011). Health effects and wind turbines: A review of the literature. *Environmental Health,* 10, 78.

Moller, H and Pedersen, C.S. (2011). Low-frequency noise from large wind turbines. *The Journal of the Acoustical Society of America,* 129, 3727.

Molnarova, K., Sklenicka, P., Stiborek, J., Svobodova, K., Salek, M. & Brabec, E. (2012). Visual preferences for wind turbines: Location, numbers and respondent characteristics. *Applied Energy*, 92 (C), 269-278.

O'Sullivan, C. (2014). *Warning over wind turbine syndrome*. Irish Examiner, 3rd March 2014

Parks, J. and Theobald, K. (2011). Public engagement with information on renewable energy developments: The case of single, semi-urban wind turbines, *Public Understanding of Science*, 22 (1), 49-64.

Pierpoint, N. (2009). *Wind Turbine Syndrome*. Johns Hopkins University School of Medicine.

RenewableUK & Cebr Study (2014). *The effect of wind farms on house prices*, 29 March 2014.

Republic of South Africa (1996). *Constitution of the Republic of South Africa,* Act No.108

Republic of South Africa (1998). *National Environmental Management Act*, Act No.107

Shain, M. (2011). Public health ethics, legitimacy, and the challenges of industrial wind turbines: The case of Ontario, Canada. *Bulletin of Science, Technology & Society, 31*(4), 346-353.

Sims, S. and Dent, P. (2007). Property stigma: Wind farms are just the latest fashion. *Journal of Property Investment & Finance, 25*(6), 626-651.

Sims, S., Dent, P., and Oskrochi, G. R. (2008). Modelling the impact of wind farms on house prices in the UK. *International Journal of Strategic Property Management, 12*(4), 251-269.

Stone, N. (2012). Local Government Regulation of Wind Energy Development in Montana. *The Land Use Clinic, University of Montana School of Law.*

Vermaak vs The Minister of Water and Environmental Affairs of the Republic of South Africa (2013) Case number: 224/2013 (High Court, Port Elizabeth), p.1-4 [Online] Available: http://www.saflii.org/za/cases/ZAECPEHC/2013/16.html [Accessed: 12 September 2014].

Wolsink, M. (2007a). Planning of renewables schemes: Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. *Energy policy, 35*(5), 2692-2704.

Wolsink, M. (2007b). Wind power implementation: the nature of public attitudes: equity and fairness instead of 'backyard motives'. *Renewable and sustainable energy reviews, 11*(6), 1188-1207.

Yano, T., Kuwano, S., Kageyama, T., Sueoka, S. and Tachibana, H. (2013). Dose-response relationships for wind turbine noise in Japan. In *Proc. Inter-noise.*

THE PREVALENCE OF LEADERSHIP OVER MANAGEMENT FEATURES AMONGST CONSTRUCTION PROJECT MANAGERS IN THE UAE

Hamad A AlShamisi[1], Ezekiel Chinyio[2], David Oloke[3], Sabah Mushatat[4], Paul Wilson[5], Nii Ankrah[6], and Zoya Evans Kpamma[7]
[1]Secure Engineering, Abu Dhabi, United Arab Emirates
[2,3]University of Wolverhampton, Wolverhampton, UK
[4]Heriot Watt University, Dubai, United Arab Emirates
[5,6]University of Wolverhampton, Wolverhampton, UK
[7]Sunyani Technical University, Ghana

Leaders and managers are different; and their traits are also different. Construction project managers (CPMs) often provide vision and direction on how their projects should be executed, which is leadership. CPMs also plan and deliver projects, as 'Managers'. Thus, CPMs have both leadership and management abilities. A research investigated if the leadership traits of CPMs outweigh their managerial features, or vice-versa. The research was carried out in the United Arab Emirates (UAE) where 145 CPMs were asked to describe themselves in terms of 13 comparative 'leadership versus management' features. Ninety (62%) of the people approached responded. Analysis of the data collected, by means of descriptive and inferential statistics, showed that 11 (85%) of the 13 leadership traits scored higher than their management counterparts; and 9 (69%) of these higher scores were statistically significant. This suggests that more of the CPMs which were surveyed have prevalent leadership traits. In this regard, the respondents felt that they were e.g. creative, inspiring, trusting and passionate; which are all qualities of leadership. The survey has identified current CPMs who are potential leaders; and contractors and indeed other organisations can adopt our analysis for identifying their future leaders.

Keywords: leadership, management, project management, self-evaluation, skills, traits

[1] al_asri007@yahoo.com
[2] e.chinyio@wlv.ac.uk
[3] d.a.oloke@wlv.ac.uk
[4] s.a.mushatat@hw.ac.uk
[5] pauljwilson@wlv.ac.uk
[6] Nii.ankrah2@wlv.ac.uk
[7] evanskpamma@yahoo.co.uk

AlShamisi, H. A., Chinyio, E. Oloke, D. Mushatat, S., Wilson, P., Ankrah, N. and Kpamma, Z. E. (2017) The prevalence of leadership over management features amongst construction project managers in the UAE *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1314-1326

INTRODUCTION

The nexus between leadership and management is discussed in this article with an empirical focus on the disposition of some project managers towards either or both of these two roles. In the past, the two functions were described interchangeably but now they are often differentiated. Leaders and managers are both found in organisations and, it has often been assumed that everyone in a management position is a leader but this may not necessarily be the case (Lunenburg, 2011).

It is useful for an individual to know if his/her ability makes him/her a manager or leader. It is also important for an organisation to know if an individual's ability makes him/her a manager or leader. That way, the organisation will be able to put people in positions that are most appropriate for them and thus maximise the gains from their abilities. This consideration is not a question of whether a manager is better than a leader or vice-versa, rather it is a quest to put round pegs in round holes, i.e. people who have leadership abilities and potentials should be given the opportunity to lead. Likewise, people with management capabilities should be given the chance to manage.

Against the foregoing context, a research was carried out on leadership in construction project management in the UAE. As some people may have more leadership than management ability, or vice-versa (Bass, 2008), one of the research objectives considered the 'leadership versus management' strengths of construction project managers in the UAE. Regarding this specific research objective being reported in the paper, some project personnel who were in management and/or leadership position were asked to assess their traits and some skills in order to determine if they were leaders or managers by inclination. This assessment was part of the wider study into leadership and is described in more detail in a subsequent section. Meanwhile the research aimed to investigate the efficacy of distributed leadership in UAE construction and its other objectives the study of the leadership styles of project managers as well as the impact of culture on leadership style and the benefits and challenges of distributed leadership. The paper has limited the discussion of theory and especially the empirical findings to one research objective only due to word-count.

The section immediately below reviews the theoretical perspective of the differences between leadership and management and generates a template for distinguishing the two. It culminates with an introduction of a research into leadership in construction in the Middle East. The research method used is thereafter explained followed by the results of how the research participants rated themselves on the two dimensions of leadership versus management. The results are explained and then the paper is wrapped up.

LITERATURE REVIEW ON LEADERSHIP AND MANAGEMENT

At some point some scholars felt that leaders and managers were the same. By and large however, literature has distinguished leadership from management. Although the two concepts are related and often complement each other (Toor, 2011) they still have different functions and require different sets of skills (Reynolds and Warfield, 2010). While leaders are good at providing direction, solving problems and making strategic decisions, managers are good at working within established guidelines and often implement the decisions of leaders (Sweeney, 2001; Haslam, Reicher and Platow, 2011). There are many definitions of leadership (Bass, 1990). The concept has been defined in terms of traits, behaviour, influence, interactional patterns and role relationships; and most definitions take the position that leadership involves a process whereby intentional influence is exerted by one person over other people in order to guide, structure, and facilitate their activities towards achieving common goals (Yukl, 2006; Northouse, 2016). On the other hand, managers are tasked with getting things done. Managers would therefore plan, organize, and control activities in a project. This would involve finding appropriate staff and directing their actions.

A leader leads people and tends to inspire them to follow, while a manager manages tasks and subordinates (Zaleznik, 1977). A leader would produce change and movement while a manager would seek order and consistency in an organization (Northouse, 2016). A leader would concentrate on strategic issues while a manager dwells on operational affairs. People would voluntarily follow a leader on the basis of his/her characteristics while they may follow a manager on the basis of formal authority. Some people may be very good leaders while others are very good managers but the gap between these two is ever narrowing. In this regard, you would find good leaders with management skills and good managers with some leadership skills (Plucknette, 2014).

Leadership

Leadership is a process whereby one individual influences other group members toward the attainment of defined group or organizational goals (Bryman, 1992; Yukl, 2010). According to Gardner (1987), leadership is all about 1) envisioning goals 2) affirming values 3) motivating people 4) managing 5) achieving a workable level of unity 6) explaining 7) serving as a symbol 8) representing the group externally 9) renewing. Northouse (2016) explained leadership as a process that: (a) involves influencing others, (b) occurs within a group context, and (c) involves goal attainment.

Leadership is seen as a process of influence, which means the ability to affect the perception, attitudes or behaviour of others. People will willingly respond to the directions and requests of a leader (Bertocci, 2009). Leaders tend to focus on long-term perspectives, show originality and ask ‘what’ and ‘why’ type questions (Reynolds and Warfield, 2010). In order to influence people to follow them leaders are assertive or charismatic, persuasive and

able to build relationships easily (Ibrahim and Cordes, 1996; Sweeney, 2001). Theory acknowledges different leadership styles which according to the U.S. Army Handbook (1973) now include:

- Authoritarian or Autocratic,
- Participative or Democratic
- Delegative or Free Reign.
- The Laissez-Faire leadership style
- The Paternalistic Leadership style

Each style has the effect of influencing the behaviour of others as well as advantages and disadvantages. A more detailed highlight of these styles is covered in AlShamisi et al. (2015). According to Van Seters and Field (1990), different eras of leadership have been witnessed over time i.e. personality, influence, behavioural, situational, Contingency, Transactional, Anti-Leadership, Culture and Transformational. Some of these eras overlap. Some of these eras overlap with each other.

Management

Managers will oversee the affairs of a unit of an organisation (Mintzberg, 1990). Management is more focussed on daily operations (Capowski, 1994) and its implementation would involve planning, organizing, staffing, directing and controlling the operations of an organization or a unit of it so as to realize certain goals (Kotter, 1990). Managers are mostly responsible for getting things done (Tschohl, 2014) hence they set goals, administer tasks, expect compliance from subordinates and control their performance. The nature of their work is such that managers are constantly receiving, processing and transmitting information (Mintzberg, 1990).

Managers have authority over subordinates and can punish or reward them (Ackoff, 2003). Managers focus on the short-term perspective and ask 'how' and 'when' types of questions (Reynolds and Warfield, 2010). The organisational structure of an establishment will position and empower a manager to direct or exercise authority over followers (Bertocci, 2009). A good manager with the right skills can transform a leader's vision into action and successful implementation (Lunenburg, 2011).

Leadership versus management

The main idea of differentiating between leadership and management is to show that followers willingly comply with what their leaders require without using any type of formal or informal authority. In contrast, managers may have to depend on formal authority to get their staff to carry out their objectives.

A leader is people-oriented while a manager is task-oriented (Bawany, 2014). Leaders are good at providing direction, solving problems and making strategic decisions while, managers are good at working within established guidelines (Sweeney, 2001). Leadership is purpose-driven, resulting in change based on values, ideals, vision, symbols, and emotional exchanges

while management is objectives-driven, resulting in stability based on rationality, bureaucratic means, and the fulfilment of contractual obligations (Bryman, 1992). The manager controls while the leader motivates (Ibrahim and Cordes, 1996). A leader is often assessed by his/her accomplishment of goals while a manager is assessed on profit margins (Bertocci, 2009).

The differences between leaders and managers have been teased out in different ways (e.g. Ibrahim and Cordes, 1996; Kotter, 1990b; Lunenburg, 2011; Algahtani, 2014). Table 1 provides an attempt to distinguish the characteristics of leaders from managers. Some scholars have discussed either leadership or management alone and the contemporary descriptors they use for the two align with the differences in Table 1. For example, Sunindijo *et al*. (2007) reviewed thirteen leadership attributes in construction project management which are: providing vision, inspiring others, stimulating or motivating others, coaching people, rewarding people, exacting punishment, delegating responsibilities, leading by example, sharing and open communication, listening well, directing effectively, participating in activities and being proactive. Most of these attributes can be identified in Table 1.

Table 1: Comparison of managers and leaders

Relative Attributes	
Manager	Leader
Rational	Visionary
Persistent	Creative
Analytical	Innovative
Stabilizer	Independent
Deliberative	Imaginative
Structured	Courageous
Business-like	Passionate
Cold and reserved	Warm and radiant
Rarely admit being wrong	Express humility
Centralized information	Share Knowledge
Tough Minded	Inspiring
Guarded	Trusting
Acting as a boss	Acting as coach, teacher or consultant

(Compiled from Capowski, 1994; Buchen, 2005; Lunenburg, 2011; Kotterman, 2006)

Leadership and management are complementary

Both leadership and management are needed for success in organisations (Kotter 1990b; Northouse, 2016). It may be difficult to find someone who is purely a leader and not a manager, and vice-versa. According to Tschohl (2014) "all managers have to do some leading and all leaders have to do some

managing. Finding the right balance for the job is what is really important. Managers are necessary and leaders are essential" (pp.48). According to Mintzberg (1990) and Kotter (1990), managers must know how to lead as well as manage. A manager must be able to inspire and motivate employees because that is the figurehead whom they see and interact with (Bawany, 2014). This disposition applies to construction project management (Gharehbaghi and McManus, 2003). Meanwhile leaders inspire and motivate their followers hence there is an overlap between leadership and management (Northouse, 2016).

Both leadership and management embroil identifying what needs to be done, aligning people and resources, playing active roles and aiming for success (Young and Dulewicz, 2008). Beyond their similarities; leaders would strive to make organizations survive in the marketplace (Heames and Harvey, 2006). Leaders would inspire followership while managers would plan, control, organise and staff operations (Northouse, 2016). Lunenburg (2011) reckons that not all managers exercise leadership and not all leaders manage. Some excellent leaders may not be excellent managers and vice versa. However, a manager can transform into a leader and vice-versa.

Towards manager ~ leaders

Leadership and management are distinct, yet they overlap. So what organisations and wider society need most are better leaders and better managers rather than which is better (Capowski, 19994). This suggestion applies to organizations in construction in the UAE also. A good leader in UAE construction will provide the benefits of right directions to his/her organisation, e.g. what type or size of project to tender for; what profit margins their organisation should charge; etc. Likewise, a good and effective manager will contribute several benefits to (UAE) organisations by e.g. making sure that projects are delivered on time, within budget and the eventual outcomes of his/her projects are pleasing to the client. Therefore, both leaders and managers contribute positively to the construction industry, both within and beyond the UAE.

It would be ideal if all managers were good leaders as well, however people who double up as manager-leader are quite rare (Plucknette, 2014). Both management and leadership can be learned on the job (Ackoff, 2003). Leaders can hone their management skills and likewise, managers can develop their leadership skills. Meanwhile, some individuals are natural leaders as well as management leaders (Bawany, 2014). Natural leaders are born with many leadership qualities while management leaders have developed their leadership qualities (Allen, 1984). Managers often have some discretionary powers to take some decisions on behalf of an organisation. This discretionary power gives room for leadership skills in a manager to emerge and the more this happens, the more the manager will translate into a leader. Northouse (2016) describes this metamorphosis as 'emergent leadership'. So, managers can learn to become emergent leaders (Turk, 2007) and their transformation can be studied.

Researching leadership and management jointly

Empirical comparisons of leaders and managers in construction are especially scant (Toor, 2011). Exemplar studies of the two concepts have included: Perrin (2010), Toor (2011) and Butkevičienė, Vaidelytė and Šnapštienė (2011). Taking a lead from these, a study of leadership in construction projects in the UAE was undertaken. The study examined different facets of leadership i.e. styles and types of leadership in vogue, the efficacy of distributed leadership, the impact of leadership on project outcomes and the impact of culture on leadership. Some of the findings of these aspects have been disseminated, i.e. leadership styles (AlShamisi *et al*., 2015) and efficacy of distributed leadership (AlShamisi *et al*., 2016). Another facet of the findings of the study is discussed here i.e. the leadership versus management characteristic of the project managers. In this regard, the study sought to know if the characteristics of the participants in the research portrayed them as predominant leaders or managers. In context therefore, the findings reported here are part of a wider study into the use of distributed leadership in the UAE. The specific question being addressed is: how do the management features of project managers compare with their leadership qualities?

RESEARCH METHOD

The study used mixed-methods where a quantitative study was initially carried out to establish the leadership features and opinions of project managers in the UAE. Following the quantitative study, focus group discussions were used in a qualitative phase to validate both the findings of the first phase survey as well as subsequently validate a practice framework that was developed in the course of the research.

The questionnaire asked the respondents to rate themselves on the 13 comparative constructs of Table 1. The intention was to see if these project managers were by inclination more of leaders or managers. The respondents were not told that one group of attributes referred to a manager while the other depicted a leader. The paired features of Table 1 were presented to them and with each pair, a respondent was asked to choose one that most described him or her.

The study was conducted in the UAE and based around projects executed by a very big client in Abu Dhabi, which is the 'Police Force' (Abu Dhabi Police). In this regard, non-probability convenience sampling was used. Project managers and perceived leaders who have either had previous involvement or are having current involvement with Abu Dhabi Police (ADP) projects were asked to fill the questionnaire. People associated with past and current projects of ADP were targeted for data collection because this client has proactively used distributed leadership. Hence those targeted could potentially answer all questions. A database of ADP's projects was used to identify people who have managed their projects where distributed leadership was used. Also, senior employees of ADP who have had involvement in such projects were identified and included in the target

sample. Ultimately, 145 potential respondents were sent the questionnaire and follow-up emails and phone calls were made to try and get all the recipients to respond. Eventually, data was collected from 90 people, which is a 62% response rate.

The responses collected were analyzed by means of descriptive and inferential statistics. The demographics of the 90 respondents include the following: 83% males and 17% females 48% were UAE indigenes while 52% were not; 91% spoke Arabic while 9% did not; 22% had experience of 5 years or less; 77% had over 5 years of construction experience while 1% did not answer; 12% were currently not in leadership; 36% were leading 1-5 persons; 17% were leading 6-10 people; 8% were leading 11-20 people; 26% were leading over 20 people and 2% did not answer.

RESULTS

Attributes of the respondents

The arithmetical collations in Table 2 show how the respondents perceived themselves in terms of 'leader versus manager' attributes. In general people tended to classify themselves as leaders rather than managers, for example there were many more visionary (60%) than rational (40%) people, many were creative (81%) rather than persistent (19%), etc. Overall the observed responses classified more respondents in the leader category, i.e. in 11 out of 13 cases. The two exceptions being questions 3 and 6 of Table 2, where the preference for manager was marginal.

Data analysis and further results

In order to test the significance of the differences between the corresponding entries in columns 3 and 5 of Table 2, an `exact binomial test' (Howell, 2016) of the null hypothesis $p=0.5$ against the alternative $p>0.5$ where p is the probability that a respondent will choose the response that indicates 'leader' was run for each of the thirteen questions. The 'R' software was used for the analysis. The p-values associated with each test are shown in the last column of Table 3; as is apparent, the null hypothesis was rejected in nine out of the thirteen instances, indicating that respondents overwhelmingly classify themselves as leaders rather than managers.

Discussion of results

The characteristics of the sample shows a lower representation of women, which conforms to Abdalla's (2015) discussions. Not many women in the Arab countries are currently in managerial positions. Albeit, the sample may be a true reflection of the gender mix in the working population studied.

The characteristics of the sample also seem to show many more leadership qualities in the pack. It is possible that their current and past roles have placed them in position/s of leadership which have in turn led to the strengthening of their leadership features. The potential respondents approached for participation in the research were mostly project managers, i.e. their functions should mainly be management. However, the literature review indicated that a management role provides some level of freedom for a manager to exhibit leadership abilities (Northouse, 2016). It might thus

be that while the respondents were managers by function, their leadership skills are showing forth. Also, managers can learn to become emergent leaders (Turk, 2007) and those studied might have learnt accordingly. It is not clear if the leadership characteristics of the respondents are attributable to innate or learnt qualities. This puzzle goes back to the long-time debate of whether leaders are born or made (Ackoff, 2003; Turk, 2007). While some people may grow up to have leadership instincts like trusting others, being passionate, courageous and humble; literature suggests that such characteristics can be learnt to some extent through e.g. family, culture, formal education and circle of interaction (Bontas, 2012). In this regard, 77% of the respondents in the study had over 5 years of construction experience which might have developed their leadership skills.

The top-rated 3 leadership attributes outscored their management counterparts by far. This may suggest the presence of many natural or emergent leaders and either way support the view that managers would expectedly lead (Tschohl, 2014). The respondents may also be a good reflection of leader-managers (Plucknette, 2014) that seems to be like an emerging discipline. The top-rated 3 management attributes i.e. being analytical, structured and rational suggest the respondents know how to plan and organise activities and get works done. They can therefore function effectively in management as well as leadership. It is not a question of whether they are better leaders or better managers (Capowski, 19994) but ability to do the present job well and having the potential to advance in any direction their organisation might want them to.

Table 2: Characteristics of the project managers

No	**Comparative choices of the respondents to each question**				**Respondents who did not answer**
	Attribute (Manager)	**Responses**	**Attribute (Leader)**	**Responses (%)**	
1	Rational	31	Visionary	47	12
2	Persistent	15	Creative	62	13
3	Analytical	38	Innovative	37	15
4	Stabilizer	27	Independent	44	19
5	Deliberative	30	Imaginary	39	21
6	Structured	37	Courageous	34	19
7	Business-like	27	Passionate	40	23
8	Cold and reserved	10	Warm and radiant	41	39
9	Rarely admit being wron	5	Express humility	42	43
10	Centralized information	7	Share Knowledge	71	12
11	Tough Minded	8	Inspiring	47	35
12	Guarded	5	Trusting	68	17
13	Act as a boss	11	Act as coach or consultant	51	28

Table 3: Characteristics of the project managers

No	Comparative choices of the respondents to each question				Analysis (p-value)
	Attribute (Manager)	Responses	Attribute (Leader)	Responses (%)	
1	Rational	31	Visionary	47	0.0444
2	Persistent	15	Creative	62	0.0000
3	Analytical	38	Innovative	37	0.4933*
4	Stabilizer	27	Independent	44	0.0284
5	Deliberative	30	Imaginary	39	0.1678*
6	Structured	37	Courageous	34	0.6823*
7	Business-like	27	Passionate	40	0.0710*
8	Cold and reserved	10	Warm and radiant	41	0.0000
9	Rarely admit being wron	5	Express humility	42	0.0000
10	Centralized information	7	Share Knowledge	71	0.0000
11	Tough Minded	8	Inspiring	47	0.0000
12	Guarded	5	Trusting	68	0.0000
13	Act as a boss	11	Act as coach or consultant	51	0.0000

*Could not reject the null hypothesis with these comparators

Limitations

The sampling of respondents was limited to those known by the researchers and associated with ADP. A wider pool of other project managers with leader-manager capabilities and experience of distributed leadership might have been side-lined. Thus, while the findings of the present study can be generalised, in some respects, a statistical inference to project the pattern of results to the entire UAE was not attempted.

Another limitation was the 'timed' element of the research which did not permit further investigation into e.g. how or when the leadership qualities of the respondents manifested or evolved. These considerations can be investigated in subsequent research.

CONCLUSION

Since most of the respondents were albeit leaders by perception, they could, on face value, provide reliable answers in the survey as the ultimate emphasis of the research concerned leadership. Most of the respondents were either operating or had operated as leaders and as such had either developed their leadership abilities by virtue of their functions; or their leadership features had influenced their appointment. Either way, their leadership skills can effectively be harnessed.

Most of the respondents are project managers, which suggest that they should have more manager instincts; however, literature suggests that people who are pure managers or pure leaders are rare. A manager should have some leadership skills and likewise a leader should have some

management skills. Scholars like Plucknette (2014) are beginning to advocate for role of manager~leader and maybe some of our respondents fit into this category.

The prevalence of leadership features identified by some of the project-manager respondents puts them in a prime position to transition to full-fledged leadership roles. Their current roles may inadvertently be preparing them for something greater. Meanwhile, distributed leadership which was the overarching emphasis of the research was found to be acceptable and beneficial (AlShamisi et al., 2016); its concept can be trialled or even implemented in construction projects in Ghana and Africa at large. Where construction projects are large in scope, the concept is most especially viable.

REFERENCES

Abdalla, I.A. (2015) Being and Becoming a Leader: Arabian Gulf Women Managers' Perspectives. *International Journal of Business and Management*, 10(1), 25-39.

Ackoff, R.L. (2003) The opportunity quest separates real leaders from managers. *Strategy & Leadership*, 31(5), 39-40.

Algahtani, A. (2014) Are Leadership and Management Different? A Review. *Journal of Management Policies and Practices*, 2(3), 71-82.

Allen, L.A. (1984) How leaders become managers. *IEEE Potentials*, 3(1), 37-40.

Alshamisi, H.; Chinyio, E.; Oloke, D. and Mushatat, S. (2016) The implementation and assessment of distributed leadership in UAE construction. In P. Manu, T. Westcott and A. Spedding (Eds) *Proceedings of CASLE (Commonwealth Association of Surveyors and Land Economy) Conference*, 21-23 April, Abuja-Nigeria. p.39-48.

Alshamisi, H.; Chinyio, E.; Oloke, D. and Mushatat, S. (2015) Leadership styles in UAE construction projects. In Proceedings of RICS COBRA Conference, AUBEA, 8–10 July, Sydney, N.S.W. CD Edition

Bass, B.M. & Bass, R., (2008). *The Bass Handbook of Leadership: Theory, Research, and Managerial Applications.* New York: Free Press.

Bawany, S. (2014) From Manager to Leader: Stop doing what's made you successful. *Leadership Excellence Essentials*, 31(6), 34-35.

Bertocci, D.I. (2009) *Leadership in Organisations: There is a difference between leaders and managers*. Lanham, USA: University Press of America.

Bontas, D. (2012) Management and Leadership in Business. *Economy Transdisciplinarity Cognition*, 15(2), 83-92.

Buchen, I.H. (2005) Training Future Manager-Leaders. *Performance Improvement,* 44(8), 20-22.

Butkevičienė, E.; Vaidelytė, E. and Šnapštienė, R. (2011) A manager or a leader? Analysis of managerial and leadership competences in Lithuanian civil service. *Filosofija. Sociologija*. 22(2), 139–148

Bryman, A. (1992) *Charisma & Leadership in Organizations*. London: Sage

Capowski, G. (1994) Anatomy of a leader: Where are the leaders of tomorrow? *Management Review*, 83(3), 10-17.

Gardner, J.W. (1987) *Leadership papers 6: Attributes and context*. Washington, DC: Independent Sector.

Gharehbaghi, K. and McManus, K. (2003) The Construction Manager as a Leader. *Leadership and management in engineering*, 3(1), 56-58.

Haslam, S.A.; Reicher, S. and Platow, M.J. (2011) *The New Psychology of Leadership: Identity, Influence and Power*. Hove, UK: Psychology Press.

Heames, J.T. and Harvey, M. (2006) The Evolution of the Concept of the 'Executive' from the 20th Century Manager to the 21st Century Global Leader. *Journal of Leadership & Organizational Studies*, 13(2), 29-41.

Howell, D.C. (2016) *Fundamental Statistics for the Behavioral Sciences* (9th Ed). Belmont: Wadsworth

Ibrahim, H. and Cordes, K. (1996) Leader or manager? *Journal of Physical Education, Recreation & Dance*, 67(1) (January), p41.

Kotter, J.P. (1990) What Leaders Really Do. *Harvard Business Review*, 68(3), p103-111.

Kotter, J. P. (1990b). *A force for change: How leadership differs from management*. New

York, NY: Free Press.

Kotterman, J. (2006), Leadership vs Management: What's the difference? *Journal for Quality & Participation*, 29(2), 13–17.

Lunenburg, F.C. (2011) Leadership versus Management: A Key Distinction - At Least in Theory. *International Journal of Management, Business and Administration*, 14(1), 1-4.

Mintzberg, H. (1990). The manager's job: Folklore and fact. *Harvard Business Review*, 68(2), 163-176.

Northouse, P.G. (2016) *Leadership: Theory and Practice* (7th Ed). London: Sage

Perrin, C. (2010) Leader vs. manager: What's the distinction? *Catalyst*, 39(2), 6-8.

Plucknette, D. (2014) 4 differences between managers and leaders. *Plant Engineering*, December 1, 16-18.

Randeree, K. and Chaudhry, A.G. (2012) Leadership–style, satisfaction and commitment: An

exploration in the United Arab Emirates' construction sector. *Engineering, Construction and Architectural Management*, 19(1), 61-85.

Reynolds, J.G. and Warfield, W.H (2010) Discerning the Differences Between Managers and Leaders. *Education Digest*, 75(7), 61-64.

Sunindijo, R.Y.; Hadikusumo, B.H.W. and Ogunlana, S. (2007) Emotional Intelligence and Leadership Styles in Construction Project Management. *ASCE Journal of Management in Engineering*, 23(4), 166-170.

Sweeney, P. (2001) What's the difference between leaders and managers? *Franchising World*, 33(4) (May/Jun): 64-65.

Toor, S. (2011) Differentiating Leadership from Management: An empirical investigation of leaders and managers. *Leadership and Management in Engineering*, 11(4), 310-320.

Tschohl, J. (2014) Effective Leadership vs. Management. *Leadership Excellence Essentials*, 31(11), p.48.

Turk, W. (2007) Manager or Leader? *Defense AT&L*: July-August 20-22.

U.S. Army Handbook (1973) *Military Leadership Manual*. Washington: U.S. Military

Van Seters, D.A. & Field, R.H.G. (1990) The Evolution of Leadership Theory. *Journal of Organizational Change Management*, 3(3), 29-45.

Young, M. and Dulewicz, V. (2008) Similarities and Differences between Leadership and Management: High-Performance Competencies in the British Royal Navy. *British Journal of Management*, 19, 17–32.

Yukl, G. (2010). Leadership in organizations (7th ed.). New York, NY: Pearson Prentice Hall.

Zaleznik, A. (1977). Managers and leaders: Are they different? *Harvard Business Review*, 55(5), 67-78.

THE RELATIONSHIP BETWEEN CONSTRUCTION SECTOR AND ECONOMIC GROWTH IN NIGERIA: 1981-2013

Moses A. Ogunbiyi[1], S.O. Olawale[2] and Rasheed Oyaromade[3]

[1&2]Department of Civil Engineering, College of Science, Engineering and Technology, Osun State University, Osogbo, Osun State, Nigeria

[3]Department of Economics, College of Management and Social Sciences, Osun State University, Osogbo, Osun State, Nigeria

Construction has been acknowledged to be a major driver of economic growth in most countries of the world, especially, the developing ones. Given its labour-intensive nature, the construction sector influenced other sectors of the economy through direct and indirect employment. Since the early 1970s, several studies have attempted to examine the relationship between the construction output and economic growth. The results from these studies have been mixed. While some observed a uni-directional relationship running between the construction output and economic growth in either direction, others have suggested that the relationship between the two variables is bi-directional. However, most of these studies have focused on developed economies with only a few addressing the relationship between construction output and economic growth in developing countries. This paper investigated the relationship between construction output and economic growth in Nigeria. The dataset employed in the study consists of quarterly data on construction output and GDP from 1981 to 2013. Data on construction output and GDP were obtained from the Central Bank of Nigeria Statistical Bulletin for 2015. The two variables were expressed in natural logarithms, thus allowing the estimated coefficients to be considered as the elasticity of the relevant variables. The co-integration analysis of the data for the study indicated that a long run relationship exists between the construction output and economic growth in Nigeria. To actually determine the direction of causality, the Granger Causality test was conducted on the data. The results showed that a uni-directional causality exists between the construction output and economic growth in Nigeria with the causality running from the latter to the former. To improve the performance of the construction sector and enhance its relevance in the growth process, few policy recommendations were offered.

Keywords: causality, construction sector, GDP, Nigeria

[1] mosesogunbiyi@gmail.com

[2] olawales@hotmail.com

[3]

Ogunbiyi, M. A., Olawale, S. O. and Oyaromade, R. (2017) The relationship between construction sector and economic growth in Nigeria: 1981-2013 *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1327-1343

INTRODUCTION

Construction is a major industry throughout the world accounting for a sizeable proportion of most countries Gross Domestic Product (GDP) and Gross National Product (GNP) (Dlamini, 2011). The importance of the construction sector is not only related to its size but also to its role in economic growth. According to UN (1996) International Standards Industrial Classification (ISIC), Rev 3, construction is defined generally as an economic activity directed to the creation, renovation, repair or extension of fixed assets in the form of buildings, land improvements of an engineering nature, and other such engineering constructions as roads, bridges, dams etc. The construction industry consists of every kind of building that is necessary for the physical needs of humans from dwelling to the structures that meet the economic need of humankind. The construction industry makes a hefty contribution to the economy as a whole as well as having an extensive connection to the other sectors of the economy (Khan, 2008). The forward and backward linkages of the construction industry are quite powerful.

According to Hillebrandt (2000), the most significant factor that affects construction demand is the general economic situation and expectations about how it will change. In a buoyant economy with a high and growing GDP, a satisfactory balance of payments and a reasonable level of employment – and with expectations that this situation will continue – generally standards of living rise, consumer expenditures increase and the government is able to spend to improve services to the community. In a depressed situation, the entire position is reversed and less demand for construction will be created. In other words, when the construction industry livens up, an effective improvement in the economy can be detected. Therefore, the construction industry has a pull force/drag force for the material industry, that is, it creates indirect employment together with the direct employment in the production of the buildings (Kargi, 2013).

Construction contributes to economic development by satisfying some of the basic objectives of development including output generation, employment creation, and income generation and re-distribution. It also plays a major role in satisfying basic physical and social needs, including the production of shelter, infrastructure, and consumer goods.

According to Oladinrin et al (2012), construction industry plays an important role in the economy and the activities of the industry are also vital to the achievement of national socio-economic development goals of providing shelter, infrastructure and employment. Construction activities affect nearly every aspect of the economy and the industry is vital to the continued growth of the economy. Unfortunately, and surprisingly, the construction industry in Nigeria was left out from the list of major growth drivers of the national economy.

Many studies on construction economics (Turin 1969; Wells 1986; Bon and Pietroforte 1990; Bon 1992; Green 1997; Hillebrandt 2000; Lean 2001;

Dlamini 2011) emphasized the important role of the construction sector in national economic growth. They all argued that construction makes a noticeable contribution to the economic output of a country. Construction generates employment and income for the people; therefore, the effects of changes in the construction industry on the economy occur at all levels and in virtually all aspects of life. These studies also emphasized that construction has a strong linkage with many economic activities, and that whatever happens to the industry directly and indirectly influences other industries and, ultimately, the wealth of a country. Hence, the construction industry is regarded as an essential and highly visible contributor to the growth process (Khan 2008). However, many of these studies are largely restricted to developed nations. Little consensus seems to exist on the relationship between the construction sector and economic growth in developing nations.

The main aim of this paper is to examine the relationship between the construction sector and economic growth in Nigeria. To achieve this, quarterly data from 1981 to 2013 was analysed using the Granger Causality test technique. The rest of the paper is organized into four sections. Section two reviews literature on the relationship between construction sector and economic growth and provides an overview of the construction industry in Nigeria. Section three contains the research methods for the study while section four presents analysis and results from the study. The last section concludes the paper with a few recommendations for improving the construction sector in Nigeria.

LITERATURE REVIEW AND OVERVIEW OF THE CONSTRUCTION INDUSTRY IN NIGERIA

There is a complex relationship between an economy's level of construction activity and the stages of economic development. Hence, empirical and theoretical relationship has been assessed by various scholars and international bodies since the 1970s (e.g. Turin, 1973; Drewer, 1980; Wells, 1985). Development organizations, researchers and policy makers maintain that construction sector is an essential component of national economic growth and development because of its strong linkages to other economic sectors (Hirschman, 1958; World Bank, 1984; Bon and Pietroforte, 1990; ILO, 2001; Ewing and Wang, 2005; Khan, 2008; Jackman, 2010).

There are opposing views with regard to the relationship between construction and the economy of a country. One view is that construction causes the economy to grow as it creates physical facilities that are needed in the development of other productive activities (Anaman and Osei-Amponsah, 2007; Hosein and Lewis, 2005; Lean, 2001; Ofori, 1990). The opposing view holds that Gross Domestic Product (GDP) causes the construction output growth (Tse and Ganesan, 1997; Yiu et al 2004; Lopes, Nunes and Balsa, 2011). Interestingly, some other studies suggested a bi-directional relationship between different sub-sectors of the construction

industry and the national economy (Ozkan, Ozkan and Gunduz, 2012; Jackman, 2010; Hongyu, Pack and Siqi, 2002; Green, 1997).

Turin (1978) using time series analysis examined the place of construction in the world economy using a sample of 87 countries and spanning 1960-1978. He concluded that the share of construction in the national product and the value added in construction per capita grow with economic development. He found that an S-shaped relationship exists between value added in construction and GDP per capita. Bon (1992) discussed the changing role of the construction sector at the various stages of economic development. He studied the construction activity since World War II in Finland, Ireland, Italy, Japan, the UK, and the USA. The data underlying his analysis spanned a 50-year period and appears to place special emphasis on Europe. He argued that construction follows the bell-shaped pattern of development or an inverted U-shaped relationship. This assumption is founded on the observation that the share of construction in GNP first grows and then declines with the level of economic development. The inverted U-shaped relationship is associated with less population growth, less migration and the assumption that most physical capital is already in place in later stages of economic development. Of interest to note is that the output data used by Bon excludes housing as well as repairs and maintenance (R&M)

The inverted U-shaped relationship presented by Bon (1992) is very different from the S-shaped relationship found by Turin (1978). Bon argued that the main reason for Turin's S-shaped relationship is that his sample is dominated by less developed countries (LDCs) and newly industrialised countries (NICs), so that the trends characteristic of advanced industrial countries (AICs) were obscured. It may be argued that Bon's study gave emphasis to AICs primarily due to the paucity of reliable economic data concerning NICs and LDCs. This therefore presents the need for further holistic study of the relationship between the construction sector and economic growth.

Anaman and Osei-Amponsah (2007) analyzed the causality links between the growth in the construction industry and the macroeconomic growth in Ghana using data from 1968 to 2004 and showed that the growth in the construction industry Granger-causes growth in GDP, with a three-year lag. The authors concluded that although the government aims to use the agricultural sector as the major vehicle for achieving high growth rates in the aggregate economy, the construction industry needs to be considered as one of the major drivers of economic growth in Ghana.

Tiwari (2011) examined the causal relationship between construction flows and economic growth in India under a static and dynamic framework. His static causality test results provided the evidence of bi-directional Granger causality between construction flows and economic growth in India while his dynamic causality analysis indicated that for the first ten years, a standard deviation innovation in construction had positive impact on the GDP but the long run impact was negative. Akintoye and Skitmore (1994)

suggested that there is a derived demand for construction investment which is dependent on the economic growth. However, results they found from empirical analysis of the relationship between national output and construction demand are mixed.

In a recent study, Erol and Unal (2015) investigated the causal relationship between construction investments and economic growth in Turkey from 1998Q1 to 2014Q4 using Granger causality technique. The results from their study indicated that for the entire sample period economic growth in Turkey has preceded construction activities with two to four quarter lags but not vice versa. They concluded that construction industry is not a driver of GDP growth but a follower of fluctuations in the macro-economy. Erol and Unal (2015) further observed that the sub-sample analysis of their study revealed that the causal relationship between economic growth and construction investments varied noticeably across the sub-periods in the Turkish economy.

Ofori (2012) listed six key importance of the construction industry to include:

- The construction industry is important because of the output and outcomes of its activities;
- It constitutes a large part of the economy of every country;
- Governments can vary the levels of their spending in construction to introduced desired changes in the economy;
- Construction industry has many complex linkages to the other sectors of the economy;
- The nation's stock of constructed items is a large proportion of its savings;
- Construction activity is relatively labour intensive.

Hillebrandt (1985) defined construction as a complex sector of the national economy that involves a broad range of stakeholders and linkages with other economic activities. Park (1989) argued that the construction industry generates one of the highest multiplier effects through its extensive backward and forward linkages with other sectors of the economy while the World Bank (1984) stated that the importance of the construction industry stems from its strong linkages with other sectors of the economy.

In most developing countries, the construction industry has failed to play its expected role of providing the basis for socio-economic development, and securing improvements in the living conditions of the citizenry (Ofori 2006).

Olanrewaju (2014) observed that construction industry and activities are major sources of economic growth, development and economic activities. Ogunbiyi and Oginni (2014), noted that the construction industry in Nigeria is not well structured and organized to ensure quality. Ogunbiyi and Oginni (2014) also noted that construction industry is regarded and recognized as the largest employer of labor the world over. According to Fashola (2012)

like other nations of the world, the economic growth of Nigeria, and advancement in infrastructural development, is largely contributed by the construction sector. Ogunlana (2015) suggested that the construction industry holds the ace in Nigeria's economic development and revival. He further stresseed that the industry remains relevant in both seasons of boom and depression. In the seasons of boom, new constructions are in the upswing. In season of depression, emphasis is on maintenance, keeping the infrastructures in functional conditions.

Nigeria's construction sector accounted for a mere 1.5% of its GDP in 2013 compared with the sectors contributions of 5.7% and 4.8% in 1981 and 1982 respectively. More important, is the fact that despite the growth seen in the construction sector output, its contribution to GDP has remained at abysmally low levels. In the last three decades, Nigeria's total GDP has risen to approximately 495 times its size. On the contrary, construction sector GDP has only grown to 125 times its size in 1981. Notably, the drivers of Nigeria's GDP over the last three decades have remained the same – Agriculture (crop production), Crude oil production and Wholesale and Retail trade (Vetiva, 2011). As shown in Figure 1, Nigeria's construction output as a share of GDP has been decreasing since 1981. This shows that the construction sector in Nigeria is yet to realise its potentials despite the country's huge deficit in infrastructure.

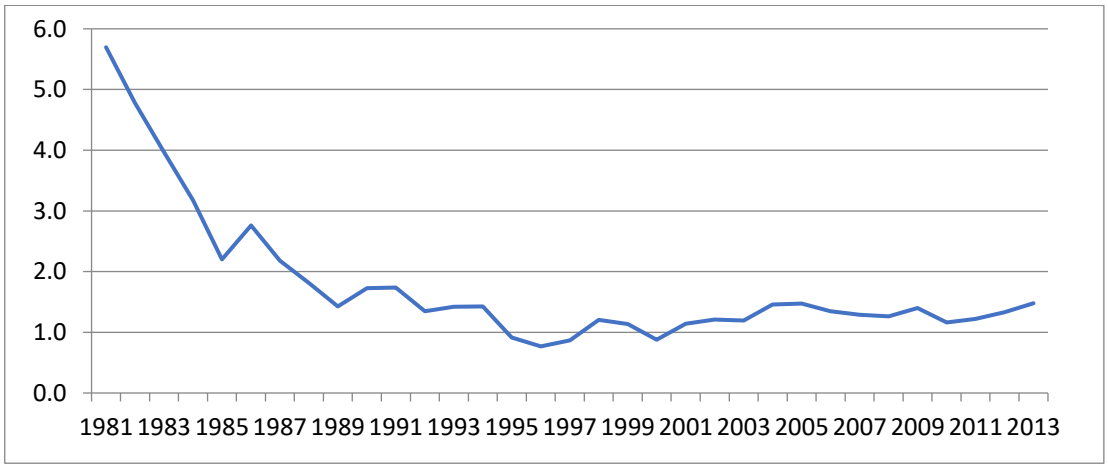


Figure 1: Nigeria's Building and Construction Output as % of GDP

According to Ogunbiyi (2004), the Nigeria construction industry evolved from the colonial era Public Works Department (PWD) which metamorphosed into the Federal Ministry of Works and Housing. Since Nigeria operated an agro based economy immediately after independence, the Ministry was responsible for all infrastructural needs of the country through the 70s especially before the oil-boom era. At the beginning of the oil boom era, all shades and colors of people transformed into contractors overnight and the likes of Julius Berger and other foreign construction companies jumped at the bounty to start what is now the Nigerian construction industry.

The major clients of the industry that provide almost 80% of the total work available in the construction industry in Nigeria are the Federal, State and

Local governments either directly or through their subsidiaries such as, Universities, Police, the Military, Corporations, Ministries etc. Individuals and corporate bodies are responsible for the remaining 20%. A mono economy such as that of Nigeria that provides almost all the works needed for the industry to thrive will be seriously impacted during an economic depression as being witnessed now in Nigeria where the Naira has fallen to its lowest ebb since independence. Nguyen et al (2004) highlighted the fact that the construction industry is considered to be one of the most important industries in an economy. It impacts nearly all areas of human activity. In developing countries such as Nigeria, this role is very significant especially when one reflects on the characteristics of the country in question, considering economic parameters for development.

During the oil boom era of the 1970s, instead of diversification of the economy and infrastructural development of the country; the government neglected the agricultural sector which was the mainstay of the economy and development. In 1971, agricultural input into the GDP stood at 48.23%. By 1977, agricultural input has declined to about 21%. Agricultural exports, which stood at 20.7% in 1971, reduced to 5.71% in 1977 (NBS, 2003). The discovery of oil in commercial quantity in Oloibiri, Delta State of Nigeria in the mid-1950s, coupled with the oil boom as a result of the Arab embargo on oil exportation to the U.S.A especially by Saudi Arabia in 1973, affected the agricultural sector adversely. Regions/states abandoned the production of agricultural produce and almost every Nigerian both intellectual and peasants became heavily dependent on oil. By this time, oil revenue represented almost 90% of foreign exchange earnings and about 85% of total exports (Ogunlana, 2015). While the boom afforded the government much desired revenue, it also created services and structural problems due to poor planning and ill-advised economic policies.

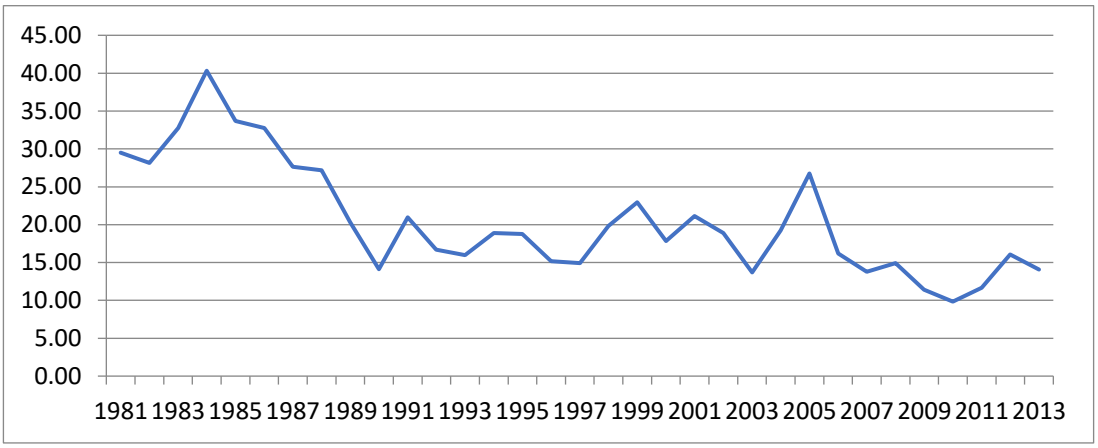


Figure 2: Nigeria's Construction Output as share of total Investment (%)

Onwualu et. al. (2014) stated that Nigeria is a nation naturally endowed with abundant natural and human resources. Since independence in 1960, Nigeria has formulated and implemented various development plans such as; the structural adjustment programme (SAP), the National Rolling Plan (NRP), the National Economic Empowerment Development Strategy (NEEDS), vision 2010, 7-point agenda, vision 2020, Millennium

Development Goals (MDGs) and various other programmes. Although some progress have been made over the years, the development process has not been sustainable, resulting in non-inclusive growth, infrastructure deficits and a situation where significant percentage of the populace still live below the poverty line.

In terms of players, the Nigerian construction industry is dominated by international construction firms, although a number of smaller local companies are emerging. Julius Berger Nigeria Plc remains the market leader, as it controls a large chunk of public sector construction. With the entrant of Chinese Construction giants however, the dominance of Julius Berger faces significant threat in the long term. As an example, China Civil Engineering Construction Company was appointed by the Lagos State Government as the contractor for the Lagos Light Rail Project. The firm was also awarded the rehabilitation of Lagos-Jebba rail track by the federal government. The growing popularity of PPPs also means more international construction firms are likely to come into the Nigerian market. Other medium-size (based on scale of operation) constructions firms in Nigeria are as follows Costain W.A Plc, PW Nigeria, Cappa and D"Alberto, Stabilini Visinoni, Bi-Courtney Limited, Lekki Concession Company, Reynolds Construction Company Ltd and Setraco Nigeria Limited, Gerrawa Global Engineering Limited, Piccolo-Brunelli Eng. Ltd, Philco Nigeria Ltd, Kopek Construction, Niger Construction Ltd, , Enerco Limited, Borini Prono and Company Limited, Arab Contractors Limited, Triacta Limited, CGC Nigeria Limited, Standard Construction Limited, Dantata and Sawoe Construction Company Nig, Ltd, and Mother Cat Limited (Vetiva, 2011).

RESEARCH METHODS

Given the main objective of this study which is to investigate the relationship between the construction sector and economic growth in Nigeria, the dataset employed consists of quarterly data on construction output and GDP from 1981 to 2013. Data on construction output and GDP were obtained from the Central Bank of Nigeria Statistical Bulletin for 2015. The two variables were expressed in natural logarithms, thus allowing the estimated coefficients to be considered as the elasticity of the relevant variables. The main justification for focusing on the period 1981-2013 is to include the period before economic reforms of 1986 in the analysis while data for 2014-2016 are not available during estimation.

The maximum likelihood estimation technique of Johansen and Juselius (1990) is employed to determine the existence of a cointegration equation. This cointegration technique determines only the existence of a relationship between variables and not the direction of causality. Hence, Granger causality was employed to determine the direction of causality. A basic estimation model is presented as follows:

$$Ln(GDP_t) = ß_0 + ß_1 Ln(Const_t) + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

$$Ln(Const_t) = \alpha_0 + \alpha_1 Ln(GDP_t) + v_t \quad \ldots\ldots\ldots\ldots\ldots\ldots 2$$

where coefficient ($\beta_1;\alpha_1$) is expected to positively determine construction ($LnConst$) and economic growth ($LnGDP$) in both the long run and the short run.

It suffices to note that the Johansen and Juselius cointegration technique only determines the existence of cointegration between variables, but not the direction of causality. The Granger causality test was employed to determine the direction of causation. If a variable Y is found to Granger-cause U, this means that past values of Y are useful in forecasting values of U without considering past values of U. Similarly, for a variable Y that is found to Granger-cause U, this means that past values of U are useful in forecasting values of Y without considering past values of Y. The Granger causality test consists of estimating the following equations:

$$\Delta LnGDP_t = \beta_0 + \sum_{t=1}^{n} \beta_{1i}\, LnGDP_{t-1} + \sum_{t=1}^{n} \beta_{2i}\, LnConst_{t-i} + U_t \ldots\ldots\ldots\ldots 3$$

$$\Delta LnConst_t = \alpha_0 + \sum_{t=1}^{n} \alpha_{1i}\, LnConst_{t-1} + \sum_{t=1}^{n} \alpha_{2i}\, LnGDP_{t-i} + V_t \ldots\ldots\ldots\ldots 4$$

where U_t and V_t are uncorrelated and white noise error term series. Causality may be determined by estimating equations (1) and (2) and testing the null hypothesis that ($\beta_{2i};_{2i} = 0$) against the alternative hypothesis that ($\beta_{2i};\alpha_{2i} \neq 0$) for equation (3) or (4) respectively. If the coefficients of β_{2i} are statistically significant, but those of α_{2i} are not statistically significant, then economic growth (GDP) is said to have been caused by construction growth (uni-directional causality relationship). The reverse causality holds, if the coefficients of α_{2i} are statistically significant while those of β_{2i} are not. However, if both β_{2i} and α_{2i} are statistically significant, then causality runs both ways (bi-directional causality relationship) (Alhowaish, 2014). It is however important to note the limitations of Granger causality test. As its name implies, Granger causality is not necessarily true causality. In fact, the Granger-causality tests fulfill only the Humean definition of causality that identifies the cause-effect relations with constant conjunctions. If both *X* and *Y* are driven by a common third process with different lags, one might still fail to reject the alternative hypothesis of Granger causality. Yet, manipulation of one of the variables would not change the other. Indeed, the Granger-causality tests are designed to handle pairs of variables, and may produce misleading results when the true relationship involves three or more variables.

ANALYSIS AND RESULTS

The results of the stationarity test on the data are presented in Table 1. As shown in the Table, the two variables of the study are not stationary at levels but are found to be stationary after first differencing.

Table 1: Stationarity Test Results

Variables	ADF	Phillips Peron	Decision
lngdp	-1.099	-1.039	I(1)
Δlngdp	-4.494**	-19.552**	I(0)
lnconst	0.296	0.678	I(1)
Δlnconst	-3.521**	-13.329**	I(0)

Note: **(i)** Δ represents the first difference operator

(ii) Critical values (1% and 5%) ADF and PP are -3.482 and -2.884 respectively

(iii) ** (*) means significant at 1% and 5% level respectively.

(iv) lngdp = log of GDP lnconst = log of construction output

The Johansen and Juselius cointegration test result is presented in Table 2. The result showed that one co-integrating equation exists between GDP and construction output in Nigeria showing that a long run relationship exists between the two variables.

Table 2: Co-Integration Test Result

Null	Alternative	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob
r = 0*	r=1	0.123	18.557	15.494	0.016
r ≤ 1	r=2	0.014	1.779	3.841	0.182

Trace test indicates 1 cointegrating eqn at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

The Granger causality results are presented in Table 3. As shown in the Table, the null hypothesis that GDP does not Granger cause construction output is rejected at 1% critical value implying that overall output growth in Nigeria precede construction output. On the other, the mull hypothesis that construction output does not Granger cause GDP in Nigeria is accepted meaning that construction output is not a driver of GDP in Nigeria. The seemingly non-significance of construction output in influencing overall GDP in Nigeria may be attributed to the preponderance of imported materials being used for construction activities. A major implication of this result is that to make construction a key driver of growth in Nigeria, the local contents of construction works in the country must be enhanced. This causality result was in contrast with Oladinrin et. al. (2012) whose result indicated that construction output is Granger caused by GDP, while the construction output also granger causes the GDP.

Table 3: Results of Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
LNGDP does not Granger Cause LNCONST	127	3.130	0.011	Rejected
LNCONST does not Granger Cause LNGDP		1.349	0.249	Accepted

Note: (i) A probability value less than 0.05 implies the rejection of the null hypothesis
(ii) Variables are as defined in Table 2

CONCLUSION AND RECOMMENDATION

This paper examined the relationship between construction sector and economic growth in Nigeria. In reviewing several literatures on the subject matter, it was observed that there was no unanimity on the relationship between construction sector and economic growth across countries. The data on the share of construction output in GDP in Nigeria showed an abysmal performance of the sector since 1981. Specifically, the share of construction output in GDP decreased systematically from 5.7% in 1981 to 1.5% in 2013. The share of construction output in gross fixed capital formation (total investment) was found to be 29.5%, 17.8% and 14.1% in 1981, 2000 and 2013. The co-integration analysis of the data for the study indicated that a long run relationship exists between the construction output and economic growth in Nigeria. To actually determine the direction of causality, the Granger Causality test was conducted on the data. The results showed that a uni-directional causality exists between the construction output and economic growth in Nigeria with the causality running from the latter to the former. To improve the performance of the construction sector and enhance its relevance in the growth process, we suggest the following recommendations:

- There is need for a holistic review of the land tenure system in Nigeria to make land acquisition seamless and problem free;
- Strategies should be evolved to provide the necessary support and incentives for the production of local building materials to promote appropriate technology and ensure collaboration between research and industry;
- Ensure prompt payment for executed construction projects and improved provision of funds for the sector;
- Need for the establishment of a central agency to be responsible for the regulation and development of the construction sector; and
- Finally, there is a need to enhance productivity through appropriate mechanization to build up the sector's capacity and deliver the critical infrastructure needed for economic development.

REFERENCES

Akintoye, A. and M. Skitmore. 1994. Models of UK private sector quarterly construction demand. *Construction Management and Economics* 12 (1): 3-13.

Alhowaish K. Albdulkarim, (2014), "Causality between the Construction Sector and Economic Growth: The Case of Saudi Arabia", *International Real Estate Review,* **17**

Anaman, K.A. and Osei-Amponsah, C. (2007). Analysis of causality links between the growth of the construction industry and the growth of the macro economy in Ghana. *Construction Management and Economics*, 25: 951-61.

Bon, R (1992), The Future of International Construction: Secular Patterns of Growth and Decline, *Habitat International*, Vol. 16, No. 3, pp. 119-128.

Bon, R. and Pietroforte, R. (1990). Historical Comparison of Construction Sectors in the United States, Japan, Italy and Finland Using Input-Output Tables, *Construction Management and Economics,* **8**, 233-247.

Dlamini, S. (2011), Relationship of Construction Sector to Economic Growth, School of Construction Management and Engineering, University of Reading, UK.

Drewer, S. 1980. Construction and development: a new perspective. *Habitat International* 5 (4): 395–428.

Erol, I and U. Unal (2015), Role of Construction Sector in Economic Growth: New Evidence from Turkey, *Munich Personal Repec Archive* (MPRA) Paper No. 68263.

Ewing, B.T., and Wang, Y. (2005). Single Housing Starts and Macroeconomic Activity: An Application of Generalised Impulse Response Analysis, *Applied Economics Letters,* **12,** 187-90.

Fashola, B.R., (2012). Pledges Commitment to Economic Growth: Speech delivered at the reception of civil engineers at the 2012 Distinguished Public Lecture at the Lagos Airport Hotel, Awolowo Way, Ikeja, 5th July 2012.

Green, R.K. (1997). Follow the leader: how changes in residential and nonresidential investment predict changes in GDP. *Real Estate Economics*, 25(2): 253-70.

Hillebrandt, P. (2000). *Economic Theory and the Construction Industry*. Third Edition. London: Macmillan Press LTD.

Hillebrandt, P. (1985). *Analysis of the British Construction Industry*, Macmillan, London.

Hirschman, A. O. 1958. *The Strategy of Economic Development*. New Haven: Yale University Press.

Hongyu L., Park, Y.W. and Siqi, Z. (2002). The Interaction between Housing Investment and Economic Growth in China, *International Real Estate Review,* **5**, 40-60.

Hosein, R. and Lewis, T.M. (2005). Quantifying the relationship between aggregate GDP and construction value added in a small petroleum rich economy – a case study of Trinidad and Tobago. *Construction Management and Economics*, 23:185-197.

ILO Geneva (2001). The construction industry in the twenty first century: Its image, employment prospects and skill requirements, *International Labor Office Geneva*

Jackman, M. (2010). "Investigating the Relationship between Residential Construction and Economic Growth in a Small Developing Country: The Case of Barbados", *International Real Estate Review,* **13**, 109-116

Johansen, S., & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, **52**, 169-210.

Kargi, B. (2013), Interaction between the Economic Growth and the Construction Industry: A Time Series Analysis on Turkey (2000-2012), *Emerging Markets Journal*, Vol. 3pp 19-34.

Khan, R. A. (2008). Role of Construction Sector in Economic Growth: Empirical Evidence from Pakistan Economy. *First International Conference on Construction in Developing Countries (ICCIDC–I),* Karachi, Pakistan: 4-5 August, pp.279-290.

. Lean, S.C. (2001). Empirical tests to discern linkages between construction and other economic sectors in Singapore, *Construction Management and Economics*, **13**, 253-262

Lopes, J., Nunes, A. and Balsa, C. (2011). The long-run Relationship between the construction sector and the national economy in Cape Verde. *International Journal of Strategic Property Management*, 15(1),48-59.

National Bureau of Statistics – NBS (2003). Nigeria Living Standard: Summary Report 2003-2005 available online and accessed on December 27th, 2016.

Nguyen, L.D., Ogunlana, S.O. and Lan, D.T.X. (2204). A Study on Project Success Factors in Large Construction Projects in Vietnam *Engineering Construction and Architectural Management,* 11(6), pp. 404-413.

Ofori, G. (1990). *The Construction Industry: Aspects of its Economics and Management*. Singapore University press, Singapore.

Ofori, G., (2006), "Revaluing Construction Industries in Developing Countries. A Research Agenda". *Journal of Construction in Developing Countries*. 11(1) p.1-16

Ofori, G. (2012), Developing the Construction Industry in Ghana: The Case for a Central Agency, A Position Paper, Singapore.

Ogunbiyi, M. A., Bamgboye, O.A., (2016). Factors Affecting the Performance of Indigenous Small-Sized Contractor Firms in Lagos State, Nigeria: *International Journal of Advance Research*, IJOAR.org, Vol. 4, Issue 1, January 2016, Online: ISSN 2320-9186.

Ogunbiyi, M. A. and Oginni, F. A., (2014). Appraisal of the Necessity of Quality Management Plan (QMP) to Building and Civil Engineering Projects*: International Journal of Social Sciences and Entrepreneurship*; Vol. 1, Issue 13, 2014.

Ogunbiyi, M A. (2004). The Nigerian Construction Industry: Prospect of the Labour Force (the Builder's View); *The Professional Builder*, Journal of the Nigerian Institute of Building, ISSN 0795-8854, September 2004.

Ogunlana, S.O. (2015). Sustaining 20:30 Vision through Construction: A Stakeholder Participatory Approach; Being a Public Lecture delivered under the Distinguished Lecture Series of the School of Post Graduate Studies, University of Lagos, in February 10, 2015.

Oladinrin, T. O., D. R. Ogunsemi and I. O. Aje (2012) Role of Construction Sector in Economic Growth: Empirical Evidence from Nigeria, *FUTY Journal of the Environment,* Vol. 17 (1).

Oladiran, O.J., K.T. Odusami, S.A. Ibrahim (2012). Evaluation of Materials Wastage and Control in some Selected Building Sites in Nigeria: *Emirates Journal for Engineering Research*, 17(2), 53-65 (2012).

Olanrewaju, R. A. (2014). Construction Industry and its Role in the National Economy: Being a Project Submitted to the Department of Quantity Surveying, Faculty of Environmental Sciences, University of Ilorin, Ilorin, Kwara State, Nigeria; In Partial Fulfillment for the Award of Bachelor of Science in Quantity Surveying, 2014.

Onwualu, A.P., Ogunwusi, A.A., Olife, I.C. and Iyang, A. (2014). (Eds.) *Raw Materials Development for the Transformation of the Manufacturing Sector in Nigeria*, Published by Raw Materials Research and Development Council. ISBN: 978-978-52367-1-2.

Ozkan, F., Ozkan, O. and Gunduz, M (2012) Causal relationship between construction investment policy and economic growth in Turkey. *Technological Forecasting & Social Change*, (79): 362-370.

Park, S.H. (1989) Linkages between industry and services and their implications for urban employment generation in developing countries. *Journal of Development Economics*, **30**, 359–79

Tiwari, A. K. (2011), A Causal Analysis between Construction Flows and Economic Growth: Evidence from India, *Journal of International Business and Economy,* 12 (2): 27-42.

Tse, R. T. C. and Ganesan, S. (1997) Causal relationship between construction flows and GDP: Evidence from Hong Kong, *Construction Management and Economics*, 15(4): 371-376.

Turin**,** D.A. (1969). Construction Industry, based on the *Proceedings of the International Symposium on Industrial Development* held in Athens in Nov-Dec 1967, New York, Monograph no. 2.

Turin, D A (1973), *The Construction Industry: Its Economic Significance and its Role in Development,* UCERG, London.

Turin, D A (1978) Construction and Development. *Habitat International*, Vol. 3(No. 1/2), 33-45.

UN (1996) International Standards Industrial Classification (ISIC), Rev 3, United Nations Statistical Division.

Vetiva (2011), Nigerian Construction Industry: A Haven of Opportunities, Vetiva Capital Management Ltd,

Wells, J. 1985. The role of construction in economic growth and development. *Habitat International* 3 (1): 33–45.

Wells, J. (1986). *The Construction Industry in Developing Countries: Alternate Strategies for Development,* Croom Helm Ltd, London.

World Bank (1984). *The Construction Industry: Issues and Strategies in Developing Countries,* The World Bank, Washington, D.C.

Yiu, C.Y., Lu, X.H., Leung, M.Y., Jin, W.X. (2004) A longitudinal analysis on the relationship between construction output and GDP in Hong Kong. *Construction Management and Economics*, (22): 339-345.

APPENDIX

Table A1: GDP and Construction Contribution to GDP (₦'Billion)

Year	Building and Construction	GDP	Year	Building and Construction	GDP
1981Q1	1.53	17.61	1989Q1	1.55	80.72
1981Q2	1.35	23.45	1989Q2	1.37	95.36
1981Q3	1.17	23.20	1989Q3	1.18	95.79
1981Q4	1.33	30.07	1989Q4	1.35	110.39
1982Q1	1.37	18.10	1990Q1	1.61	73.59
1982Q2	1.21	25.12	1990Q2	1.42	82.29
1982Q3	1.05	24.93	1990Q3	1.23	83.28
1982Q4	1.20	32.86	1990Q4	1.41	89.45
1983Q1	1.24	19.10	1991Q1	2.69	120.28
1983Q2	1.10	27.35	1991Q2	2.38	136.08
1983Q3	0.95	27.21	1991Q3	2.06	134.91
1983Q4	1.08	36.40	1991Q4	2.35	154.40
1984Q1	1.05	21.18	1992Q1	3.35	198.05
1984Q2	0.93	28.97	1992Q2	2.97	218.12
1984Q3	0.80	29.04	1992Q3	2.56	215.18
1984Q4	0.91	37.08	1992Q4	2.93	244.00
1985Q1	0.84	24.02	1993Q1	4.40	242.58
1985Q2	0.74	33.53	1993Q2	3.89	271.93
1985Q3	0.64	33.60	1993Q3	3.36	272.56
1985Q4	0.73	43.43	1993Q4	3.84	302.61
1986Q1	1.06	27.48	1994Q1	5.66	302.02
1986Q2	0.93	33.65	1994Q2	5.01	349.47
1986Q3	0.81	33.53	1994Q3	4.33	355.36
1986Q4	0.92	39.94	1994Q4	4.94	392.85
1987Q1	1.19	39.34	1995Q1	7.56	681.53
1987Q2	1.06	48.18	1995Q2	6.68	725.34
1987Q3	0.91	48.16	1995Q3	5.77	726.72
1987Q4	1.04	57.45	1995Q4	6.60	773.76
1988Q1	1.36	53.49	1996Q1	8.79	962.86
1988Q2	1.20	65.69	1996Q2	7.78	1,006.12
1988Q3	1.04	66.12	1996Q3	6.72	1,005.24
1988Q4	1.18	77.99	1996Q4	7.68	1,058.08
1997Q1	10.29	984.80	2006Q1	63.42	3,986.28
1997Q2	9.10	1,046.01	2006Q2	58.03	4,426.08
1997Q3	7.86	1,051.39	2006Q3	58.22	4,986.49
1997Q4	8.99	1,107.05	2006Q4	70.66	5,165.74
1998Q1	13.63	907.84	2007Q1	68.18	4,740.81
1998Q2	12.06	997.62	2007Q2	65.17	4,853.84
1998Q3	10.42	1,015.39	2007Q3	63.97	5,524.38

1998Q4	11.90	1,068.59	2007Q4	69.14	5,538.29
1999Q1	15.08	1,087.91	2008Q1	77.05	5,535.96
1999Q2	13.34	1,169.31	2008Q2	76.56	5,720.25
1999Q3	11.53	1,180.99	2008Q3	74.45	6,461.89
1999Q4	13.17	1,241.00	2008Q4	78.52	6,578.22
2000Q1	16.77	1,653.88	2009Q1	88.63	5,460.76
2000Q2	14.83	1,674.67	2009Q2	86.51	5,872.69
2000Q3	12.81	1,654.75	2009Q3	82.64	6,608.44
2000Q4	14.64	1,730.28	2009Q4	89.91	6,852.34
2001Q1	22.32	1,636.69	2010Q1	101.59	7,426.52
2001Q2	19.74	1,723.31	2010Q2	97.61	8,043.20
2001Q3	17.06	1,732.26	2010Q3	92.75	9,055.63
2001Q4	19.49	1,802.94	2010Q4	102.71	9,459.40
2002Q1	26.80	1,860.31	2011Q1	114.72	8,553.99
2002Q2	23.71	1,949.95	2011Q2	121.58	9,444.84
2002Q3	20.48	1,965.44	2011Q3	104.07	9,856.18
2002Q4	23.41	2,020.06	2011Q4	115.91	9,554.85
2003Q1	33.66	2,441.89	2012Q1	124.92	9,142.86
2003Q2	29.77	2,477.78	2012Q2	149.45	9,840.23
2003Q3	25.73	2,475.97	2012Q3	124.88	10,967.27
2003Q4	29.40	2,517.88	2012Q4	140.43	10,593.74
2004Q1	43.50	2,631.26	2013Q1	145.22	9,493.78
2004Q2	37.73	2,592.27	2013Q2	173.24	10,204.84
2004Q3	38.27	2,985.54	2013Q3	144.04	11,166.03
2004Q4	46.58	3,202.00	2013Q4	165.07	11,532.12
2005Q1	54.75	3,169.61			
2005Q2	48.99	3,399.35			
2005Q3	50.39	3,924.77			
2005Q4	61.66	4,078.50			

THE SHARED OWNERSHIP TENURE AND ITS APPLICABILITY TO THE AFRICAN AFFORDABLE HOUSING MARKET

Cynthia Adeokun[1] and Folake Ekundayo[2]
1Colman Architects Ltd., 27 Harcourt Street, London, W1H 4HP, U.K.
2The NHS Estates Design and Technical Services Department, St Marks Hospital, Maidenhead, Berkshire,
SL6 6ES. UK.

A housing scheme aimed at workers employed in key sectors such as the police force, education, and healthcare, which enables affordable home-ownership in stages- Shared-Ownership- has proved to be a viable option in countries such as the United Kingdom, and its suitability for the African market is explored in this paper, in response to housing shortages on the continent. A two-stage questionnaire was administered to a small focus panel of 5 professionals drawn from the construction industry in Ghana, Nigeria, and South Africa, to assess key features, benefits and shortcomings of the shared-ownership scheme in relation to the African housing market. The results revealed a clear need for format-modification in the African context yet highlights that some benefits of the product can assist (African) key workers to own their home during their prime working life. The authors concluded that the scheme offers benefits for the African affordable housing market by allowing immediate occupation of the property and payment in stages. However, any adaptation of the scheme must be compatible with the role of small scale property developers, include maintenance programmes, and have clear and comprehensive legal documentation.

Keywords: affordable homes, housing, key workers, shared ownership

INTRODUCTION

The African context is such that aspirations to home ownership are ingrained, yet the ability of average income earners to afford a primary place of residence, is significantly hampered by the high costs of building/purchasing residential properties and low incomes for a significant section of the population, particularly in urban areas which constitute about 45% of the continent's population (UN-Habitat, 2011). According to a report by the Centre for Affordable Housing and Finance in Africa - CAHF (2016a),

[1] lola.adeokun@yahoo.co.uk
[2] folake.isaacs@live.co.uk

Adeokun, C. and Ekundayo, F. (2017) The shared ownership tenure and its applicability to the African affordable housing market *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1344-1365

rapid urbanisation in Africa has resulted in increasing demand for affordable housing which has been met with scant supply; in part, a result of the low capacity of the construction industry according to Nguena, Tchana and Zeuferk (2016). The CAHF (2016b) report also argues that a fundamental reason for huge inadequacies in housing supply is due to major constraints in both the production and financing of housing through formal channels; a position supported by Jambol, Molwus and Daniel (2013). In addition, modest efforts to provide housing for purchase are mostly targeted at middle income and high income earners in many African countries (Nguena et.al. 2016). These inadequacies are reflected in the levels of homeownership in Nigeria (25%) and South Africa (56%), but are in contrast to Kenya's home ownership rate of around (73%) according to the CAHF (2016a) report. The struggle to produce adequate numbers of affordable housing units and to increase home ownership in urban areas is a significant problem on the continent. This problem is mirrored in other countries such as the United Kingdom, which according to a report by SHELTER (2013) has seen a steady decline in home ownership since 2003, despite the fact that over 75% of renters aspire to home-ownership. The Demographia International Housing Affordability Survey (2017) classified seven of twenty-one housing markets in the U.K as severely unaffordable for middle income households costing well over five times the median household income, highlighting significant problems with providing affordable housing units.

Despite committed efforts of continental initiatives such as Shelter Afrique, a pan-African finance institution that supports housing development and real estate (comprising of 44 African governments, the African Development Bank (AfDB) and others), and the African Union for Housing Finance (AUHF), an association of finance institutions, housing corporations and others, that funds housing in 16 African countries; the huge deficit in housing provision identified in the literature review supports the search for other solutions. Although the availability of financing options for affordable housing has a significant impact on the ability to deliver sufficient numbers of housing units as reflected in CAHF (2016b) and Nguena et. al. (2016), this paper's remit is to investigate a specific housing product- **Shared Ownership Scheme (S-O Scheme)**. This decision is supported by a dearth of housing tenure/delivery options for low and average income earners and it is suggested that this also contributes to low levels of home ownership in many parts of urban Africa. Difficulties with achieving home ownership amongst these groups of earners occur across continents, and it is this situation that this paper specifically addresses. The main premise is that local conditions often differ but, lessons can be learnt from different countries in the quest to increase the production and ownership of affordable housing.

The S-O Scheme was devised in the 1980s to provide affordable housing in the United Kingdom and is typically provided by housing associations, local government councils or medium/large scale housing developers. It has the unique distinction that it allows a 'Key worker' to buy a property in stages,

yet move in immediately. 'Key Workers' are salaried income earners who work in the armed forces, education, healthcare, fire department, and non-managerial civil service positions, and who often struggle to buy 'low-cost' housing or to rent on estates targeted at middle income professional workers. Construction costs are subsidised by the UK government, but borne by public or private developers who recoup their investment by selling the units. Key features, benefits and shortcomings of the Shared Ownership Scheme as it exists in the U.K. are reviewed based on existing literature. This is combined with the use of a panel of construction industry practitioners and senior academics from Ghana, Nigeria and South Africa who reviewed the scheme in relation to their local context. The panellists were purposively chosen, based on considerable experience in housing delivery (design, construction and financing) or in academic (housing) research. The literature review focuses on housing availability, affordability and finance in the case study countries. Affordable housing in this study refers to housing that is affordable to those below the median income level, taking the housing price to income ratio (P.I.R) into consideration.

LITERATURE REVIEW

Introducing the Shared Ownership (S-O) Scheme

At its inception in 1980, the Shared Ownership (S-O) housing scheme was designed by the British government to assist key workers who could not afford to buy on the open market, to purchase a home in stages, whilst allowing for immediate occupation of the completed dwelling unit (Adeokun and Isaacs-Sodeye, 2014). Shared ownership simply means that ownership of the property is shared between the owner who resides in the house, and an organisation that has the financial capability to sponsor the purchase of the house; typically, a Housing Association under the Housing Corporation, or Property Developer. The Housing Corporation (now replaced by the Homes and Communities Agency and the Tenant Services Authority) funded new affordable housing on behalf of the government and regulated housing associations that originally tended to provide social housing. After 2008, property developing companies joined the "affordable housing market" and give a percentage of their development stock to local authorities as affordable homes for lower income and key-workers. Like housing associations, property developers provide finance, but for private clients in the open market. The financing organisation essentially, has 'shares' in the house, however, the 'shared owner' can buy more shares as their financial situation improves, until they own the property outright (100% shares). Variations of the original scheme have evolved over the years (e.g. the D.I.Y-Shared Ownership), however the original format reviewed in this paper, is the most common version of the scheme. Other tenure forms have been introduced by successive U.K. governments to help low and middle income earners towards homeownership over the last 35 years, yet there has been a steady decline in homeownership stated SHELTER (2013). The Shelter (2013) report also stated that the S-O scheme has been a key response to the housing challenge in the U.K., with about 174,000 shared owners in

England alone, but at 0.8% of all households, is nowhere near filling the gap in the market, yet, offers the most hope for key workers.

The Key Features of the Shared Ownership scheme in the U.K. are outlined below: -

a) Initial valuation of the 100% cost of the housing unit, on which the percentage purchase is based, is usually below the market price of an equivalent unit.

b) S-O flats or houses are sold as 99/125 year leaseholds only (www.leaseadvice.org, 2013).

c) The shared owner initially buys a minimum of 25% (and a maximum of 75%) share of the completed flat/house for immediate occupation typically from a Housing Association, and pays subsidised rent on the un-owned share to the housing association.

d) The shared owner can buy more shares in their home at any time in a process known as "Staircasing" in 10% minimum lots, until the property is owned outright. The cost of each new share depends on the worth of the home at the time of the staircasing process. Valuation costs are borne by the shared owner.

e) The shared owner typically finances his purchase by obtaining a mortgage (loan) to be repaid over a specified period (usually between 20-25 years). Most banks also require the prospective buyer to have a 5-10% deposit, based on the shares bought.

f) 100% ownership means that the unit is no longer 'shared ownership' and the owner can sell it themselves. The housing association however retains the right to find a buyer for the unit when the owner owns only a share of the property.

g) The shared owner has normal rights of a full owner-occupier, and is responsible for the full monthly service charge rate (for the upkeep of communal areas).

The scheme has been subsidized in various forms by the British government especially at local authority level, including offering public land to developers at a discounted rate in return for provision of a stipulated number of units for the local authority's use for social housing, and in the form of planning conditions that require that the developer/housing association provides a specific number/percentage of S-O units as part of any commercial residential scheme. Recently, £4.1bn investment has been promised by U.K. central government to deliver 135,000 shared ownership homes by 2021 (Davis and Sinn, 2016).

The main eligibility criteria are as follows: -

Only households with a combined income less than the government's maximum stipulated limit may apply, to avoid richer public sector workers purchasing multiple properties. This also ensures that the mortgagee can afford the mortgage and the rent. The maximum income limit has been

increased to up to £90,000 in London and £80,000 elsewhere in the U.K., to allow more households to benefit from the scheme (Davis and Sinn, 2016). Historically, it had to be the buyer's first and only residence, thereby disqualifying existing shared owners from applying for another S-O home if they needed to move for any reason (e.g. work, or growth in family size), but this restriction has been removed by the government (Davis and Sinn, 2016). The property is not to be sublet without permission from the housing provider, and lastly, there is a maximum purchase price set for units available on the scheme.

Management of shared ownership projects: -

The scheme included a majority of flats in its housing stock and as such, requires the whole building to be managed by the housing provider for practical reasons. Shared-ownership housing tenure is leasehold in the UK and shared owners cannot collectively manage the building or buy the freehold, which is possible on regular leasehold tenures. Shared owners pay full rate service charges and are responsible for repairing the internal aspects of their flat/house. The management of the housing organisation consists of the money managers who ensure that eligible people purchase the property, collect rents and monthly service charge, and the property managers who are responsible for the maintenance and repairs of the property, and are usually construction professionals. The service charge is used for staff wages, maintaining the building communal areas, repairs and major investments. By law, the funds raised must be invested in a registered annual sinking fund and yearly account statements provided to all owners and renters (Adeokun and Isaac-Sodeye, 2014).

Main Benefits of the scheme are as follows: -

1. It allows gradual purchase of the property up to 100% ownership (Staircasing). This is definitely the most attractive feature particularly for those who intend to staircase to 100% but are unable to afford the full price at the point of purchase.
2. Historically, S-O units were offered at below market value, and this benefit was also one of the main attractions of the scheme.
3. The buyer can move in immediately, which is a distinct advantage over the self-build/incremental approach.
4. An average income earner is able to access a reasonable quality of housing as these units have to comply fully with the building regulations and are often part of developments where units are also offered on the open market, hence there cannot be a major difference in appearance and quality.
5. Those who work in key sectors are able to access this benefit in recognition of their role in local communities.
6. The rent paid on unowned shares of the unit is direct income for the housing provider.

7. At the inception of the scheme, the deposit required by some of the lenders was as low as 5% of the share being purchased by the buyer, and this was very helpful for people below the median income level.

The Main Shortcomings are discussed below, as they might relate to the African market: -

- Leasehold ownership of residential property is most uncommon in most African countries, and likely to be very contentious, because it goes against the grain of most traditional land/property owning rights in Africa which is usually in perpetuity. A culturally acceptable tenure model must be adopted in the African context.
- Shared owners may have difficulty selling the property if it is in negative equity, but this shortcoming is not peculiar to the scheme and is a generic problem in the property sector (Clarke and Heywood, 2012a).
- A major criticism of the scheme is that although the opportunity to staircase is a very attractive feature, only 25% of shared owners have gone on to 100% ownership according to Graham (2010). Clarke and Heywood (2012a), and Graham (2010) stated that for most, the initial share purchased had been the maximum they could afford, and had experienced insufficient growth in their incomes to buy any more. Also, while most housing providers strongly encourage existing shared owners to staircase, a minority (20%) do not (Clarke and Heywood, 2012b). Other factors that hamper staircasing include property values growing faster than incomes, reduced availability of mortgage finance products and staircasing valuation fees and legal costs borne by the shared owner.
- Peaker (2013) suggests that the scheme currently presents some significant legal flaws for the buyer. The housing association remains the owner of the property up to the point of the 100% buyout and the shared owner can be evicted for rent arrears without being recompensed for all the prior payments. This position has been upheld in a court case in the U.K., and its outcome was viewed as unduly harsh by many; with legal implications that needs to be reviewed by the government. However, as Graham (2010) noted, shared ownership repossession rates for 2008/09 was slightly lower than all homeownership and remains comparable at this time according to Davis and Sinn (2016).
- The shared owner is responsible for the full service charge despite only owning a part of the unit. The argument in support of this aspect is that the shared owner derives full benefit of the communal areas, hence should contribute fully to the service costs.
- One of the main advantages of the scheme- the fact that the units were made available at below market value- has been hugely eroded in recent times, exacerbating the ability to staircase as houses prices fast outstrips income raises (Davis and Sinn, 2016). SHELTER

(2013) stated that almost three quarters (1.8 million) of low to middle income families in England cannot afford the mortgage on a three-bedroom home, and house prices on the open market in the U.K., where many dwellings cost more than 5 times the median income, is severely unaffordable according to Demographia International Housing Affordability Survey (2017).

Clarke and Heywood (2012b) recommended an assessment of whether the typical deposit is big enough to afford shared owners some protection during a housing market downturn, and a major review of how staircasing protocols can better facilitate full ownership by reviewing the minimum percentage of initial shares. Many lenders have responded to this, with most now asking for a 10 percent deposit instead of 5 percent. Also, the fact that many S-O owners get stuck on the minimum shares, and income raises have not kept pace with house prices would suggest a need for prospective shared owners to aim for a lower full price, to be in a position to buy a bigger share at the onset according to Adeokun and Isaacs-Sodeye (2014), in order to reduce the number of 'steps' required to achieve 100% ownership. Davis and Sinn (2016) concluded that the S-O product will remain affordable as the sector is committed to improving the product and to developing a charter of common standards with the Chartered Institute of Housing, while the U.K. government has also recently shown strong support for the product. They state that despite some struggles with the product, the escalation of open market prices means the tenure remains a valid option into homeownership for many.

Introducing the African Housing Market (The case of Ghana, Nigeria and South Africa)

Housing needs

The huge need for affordable housing units in many African countries (for rental or ownership), especially for low income households is well documented in literature [Adeokun and Isaacs-Sodeye, 2014; Adedeji and Olotuah, 2012; UN-Habitat, 2011]. The UN:Habitat (2011) report states that Ghana needs at least 70,000 housing units annually whilst the national supply is currently about 35 per cent of this figure. South Africa has an estimated shortfall of 650,000 dwellings, although post-apartheid South Africa has shown some political will to deliver affordable government housing, delivering over 2.7 million affordable housing units to date, yet, there is a considerable backlog in the South African housing sector. Several sources refer to a shortfall of between 12 and 16 million housing units in Nigeria (Jambol et. al. 2013). There have been new initiatives in Nigeria, in the form of a National Affordable Housing Scheme announced recently by the President with an allocation of $235 million that will provide about 3% of the housing stock requirement according to CAHF (2016b), and other initiatives including land donation by 24 of the 36 Nigerian states [CAHF, 2016a], but it is too early to say how effective the programmes will be. In addition, the enabling period of the 1980s and 1990s whereby many African countries (such as Nigeria) embraced the global policy to step back from direct provision of affordable mass housing, left the private sector

(individual landlords, small-scale developers, and private companies (providing housing for a small segment of their staff) as the main provider.

According to UN:Habitat (2011), the proliferation of informal settlements in many African cities is a result of poorly functioning housing markets especially for lower income households in response to rapid urbanisation rates since 2000, and inadequacies in housing provision in these settlements are often due to a combination of low housing quality, tenure insecurity (illegal tenure forms), poverty, and a lack of political willpower to improve the provision of formal support and services. Housing provision in Nigeria according to CAHF (2016b) is affected by inadequate access to finance, high cost of land registration, titling, and allocation costs, high costs of funding and building materials; conditions that are also common in the other case study countries.

Home ownership affordability

Housing affordability data is not widely available for African countries, but regional figures for 2001 from UN:Habitat (2011) demonstrates that urban Africa had the highest house price-to-income ratio of all regions, at 12.5, indicating that it takes 12.5 median annual salaries to buy a median price house. These are similar to the Asia-Pacific region and Arab States (12.5 and 11.3 respectively) but more than double that of Latin American and Caribbean countries (5.4 and 5.8 respectively). In addition, the P.I.R in large cities is often higher than that of smaller cities and towns.

The formal housing finance market is very limited in most parts of Africa, with close to 85% of Africa's population have little or no access to housing loans (UN:Habitat, 2011) and where it is available, interest rates are high. The lowest recorded interest rate on a mortgage in Nigeria is 19 percent, as of September 2016, and requires at least a 25 percent down payment (CAHF, 2016b). Repayment periods are often shorter than the norm of 20 years in developed economies which makes repayment inaccessible to many households, even though CAHF (2016b) suggests that nearly half of the population in urban areas in Nigeria can afford a loan to buy the cheapest newly built house, and 16 percent of Africa's population could qualify for a prudent mortgage according to Badev, Beck, Vado and Walley (2014).

Despite a positive trend in recent times, the ratio of mortgage debt to GDP remains extremely low in Africa at around 3 percent, according to Nguena et. al. (2016), and in Nigeria, mortgage uptake constitutes less than 1 percent of the GDP (Adebamowo, Odewaye and Oduwaye (2012). Housing penetration (the percentage of the adult population with an outstanding loan to purchase a home) is also very low, with no African country achieving more than a 9 percent penetration rate. Housing finance in Nigeria and Ghana is predominantly via private sources (Adeokun, Adewale and Oloke 2014), although there are more formal lending options in South Africa. According to the UN: Habitat (2011) report, while microfinance and community based savings groups are providing alternative housing finance options, they remain constrained by unsupportive institutional and regulatory frameworks. In many African countries, cooperatives have

endeavoured to provide formal finance products to low-income households but with limited success until market liberalisation from the 1980s onwards (Adeokun et. al. 2014). Eastern and Southern Africa cooperatives have notably been relatively strong in recent decades, but have had limited success in producing housing in the quantities required. As such, the need to improve housing finance options and develop new housing delivery products remains an important task.

Housing tenure options

The two main forms of tenure in Africa are a) Ownership (inherited, self-build; often incremental and purchased; a tiny portion of the market) and b) Rental. Common housing types are traditional housing, single storey detached/semi-detached houses, and two or three-storey blocks of flats. Ownership of land and property ranges from full legal title to illegal buildings on invaded land (common in informal settlements). Many countries in Africa including all three case studies, still operate traditional land allocation systems, usually based on community rights and often cost little for locals to gain land use-rights, which in earlier times, ensured that most households could afford to own modest, durable accommodation. This system often overlaps with systems of individual titling derived from European law, and which often involve significant transaction costs, making individual land-holding unaffordable for many and rental tenure the only option for many in urban areas, though the opposite occurs in rural areas.

Fifty-one percent of Nigerians live in rented accommodation according to Kolawole (2014). In Ghana, 57 per cent of households claim ownership of their dwellings (40 per cent in Greater Accra), two percent of households live in public rental housing set aside for civil servants, and private employers provide housing for five per cent of formally employed households. Home ownership rates in many South African cities increased after 1994 and currently stand at 51 percent, with 36 percent renting and 12 percent classified as squatters. However, the reality is that in most urban areas, the majority of residents are informal lodgers (CAHF, 2016b). Nonetheless, according to CAHF (2016b), some African countries have developed innovative ways to secure cost-effective land tenure for the urban poor. In Mauritius, housing policy provides both leasehold and purchase opportunities of state land, housing permits are provided in francophone Sub-Saharan Africa countries, certificates of rights in Botswana, community land trusts and temporary occupation licenses in Kenya, communal ownership in South Africa, and starter, leasehold, and freehold titles in Namibia.

METHODOLOGY

The first stage was a review of existing literature about the Shared Ownership scheme in the United Kingdom. This was followed by the production of an executive summary report on the key features, benefits and shortcomings of the scheme as it stands in 2016/2017, which identified recent modifications to the scheme and incorporated some of the

recommendations of the authors' previous study of the scheme published in 2014.

The next stage involved the 'recruitment' of a small panel of construction industry practitioners and academics from Ghana, Nigeria and South Africa. The countries were selected based on the presence of significant housing needs, significant urban populations (each has over 30% of their total populations in urban areas) and the existence of growing political willingness to address these needs.

Two panellists each, from Nigeria and South Africa, and one panellist from Ghana were recruited, to provide their assessment of the scheme in relation to their respective countries. The main selection criteria were that each prospective panellist was a) a practising architect/developer/designer, or an academic with significant number of publications in housing studies, b) had at least 10-15 years post-qualification experience, and c) was based in the country being reviewed. In addition, one panellist with significant experience of the delivery of shared ownership housing projects in the U.K. was also recruited. The prospective panellists were initially selected from the authors' own professional network and a total of fifteen (15nos.) people/housing organisations were contacted. Each contact person was invited to send the questionnaire to other people in their network that met the criteria identified above; a process which yielded one member of the panel. A total of six panellists participated (inclusive of the U.K. based panellist), resulting in a 40% participation rate.

To conduct the assessment, a 2–stage questionnaire was administered to each panellist (see appendix). The exploratory questionnaire accompanied with the executive summary report was sent to each prospective panellist. Each of the five panellists was also sent a second stage questionnaire that asked them to assess the viability of the scheme in relation to their local context. The results of this two-stage assessment are presented in the discussion chapter.

RESULTS AND DISCUSSION

The participating panellists are Mr A. Akinlade (South Africa), a practising architect with a background in architecture and project management, Mr R. Gildenhuys (South Africa), an interior designer with experience in interior design and interior architecture, Mr G. Akinola (Nigeria), a chartered practising architect and experienced property developer, Professor D. Amole (Nigeria), a chartered architect and senior academic with a focus on housing research and Dr. D. Ahadzie (Ghana), also a senior academic focusing on housing studies. Mr Y. Bolaji, a U.K. based executive director in the social housing sector with a background in quantity surveying provided the overview about the scheme in the U.K. market. The exploratory and follow-up questionnaire results are presented below.

Exploratory questionnaire results

The questionnaire revealed some differences in the format of housing available in each country for the three categories of key workers identified

in the questionnaire- Teachers, Nurses and Junior Civil Servants. All categories of key workers had access to rent either shared accommodation or self-contained dwelling units in the three countries, with all the panellists providing typical rental rates for both options. The question on typical costs of purchasing property however, revealed that while all three categories of key workers had access to self-contained dwellings to buy in South Africa (and are unlikely to purchase shared/tenement accommodation), no data was provided by one of the panellists in Nigeria, and the second Nigerian panellist suggested that only shared tenements were available for purchase for these key workers. The panellist in Ghana also provided typical purchase costs for both shared and self-contained units for all three key worker categories.

The question on affordable housing typology revealed more options from the South African and Ghanaian panellists (Flats, Houses and Bungalows). Only flats were deemed affordable in the large city in Nigeria but the panellist based in the Nigerian town stated that key workers could afford to own bungalows, highlighting a real difference between housing markets in cities and towns in Nigeria (see Table 19). Small and medium scale developers and the government were the main providers in South Africa however the Ghanaian and Nigerian markets are dominated by individual landlords and private organisations (for their staff). This is consistent with existing literature which reports more public funding commitment in the South African market for this cadre, whilst most housing for purchase in Nigeria and Ghana targets middle and upper-middle income earners for safer investment returns.

All panellists, including the U.K. based panellist stated that the Overall Cost of the unit as a key consideration in the purchase of residential property out of fifteen possible criteria identified in the questionnaire. The top three criteria identified by all the panellists were consistent, with Overall Cost, and Proximity to the Workplace being the top two criteria identified. Interestingly, only the panellists in Nigeria mentioned security as one of the top three criteria influencing housing choice. In terms of funding strategies adopted by key workers - bank loans are the main source of home ownership funding in South Africa, with private funds being the key source in Nigeria and Ghana (see Item 4 in Table 19). Only Nigeria-based panellists referred to the role of loans from Co-operatives in funding home ownership.

The panellists were asked to provide a general assessment of the scheme in relation to their local context from the supply side (housing provider viewpoint) and also from the demand side (prospective S-O owner's viewpoint). Remarkably, despite differences in median income levels, funding strategies and typologies, there was a general cautiously optimistic view that the scheme has some lessons to offer (see Table 20). On the supply side, the responses ranged from Yes to Maybe, however, only the panellist commenting on the Ghanaian market took a markedly cautious approach (to both supply and demand sides) citing cultural differences between the S-O country of origin and their local context, and emphasising the dominant

informal approach to land and housing market in Ghana as a real drawback for this type of scheme. The main attraction for all panellists was that the product could lower the cost barrier to the buyer, and would critically be less onerous than trying to raise the 100% price at inception. One of the panellists from Nigeria (N1) emphasised that the current economic distress being experienced in the Nigerian economy might make this product attractive as it takes cognisance of dwindling purchasing power, and could perhaps 'pull' in customers if the supplier can accept what is in essence 'payment in instalments'.

Table 19: Some results from the Exploratory Questionnaire

Questions	South Africa (small City) Panellist SA1	South Africa (City) Panellist SA2	Nigeria (large City) Panellist N1	Nigeria (Town) Panellist N2	Ghana (City) Panellist G1
1) Housing available for Key workers	A) 2/3 Bed Flats C) Bungalows	A) 2/3 Bed Flats B) Houses C) Bungalows	A) 2/3 Bed Flats	C) Bungalows	A) 2/3 Bed Flats B) Houses C) Bungalows
2) Existing Infrastructure	A) Transport, B) Electricity, C) Pipe-borne Water, D) Drainage, F- Schools, G- Shops.	B- Electricity, C- Pipe-borne Water D- Drainage, G- Shops.	A- Transport, B- Electricity, D- Drainage, F- Schools, G- Shops.	N/A	B- Electricity
3) Main Providers of Affordable Housing	A) Small/Med. Scale Developers. D) Local/state/fed. Govt.	A) Small/Med. Scale Developers	D)Local/State/ Fed. Govt.	C) Private Organisations (for Staff)	B) Private Landlords
4) Main Funding Strategies for Housing Purchase	A) Bank Loans	A) Bank Loans	B) Loans from Co-ops. E) Private Funds	B) Loans from Co-ops. E) Private Funds	E) Private Funds

The most measured cautionary note was understandably from the U.K. based panellist in stressing a) the need for strong statutory backing (to reassure investors that downside risks are mitigated), and that the ability to repossess the unit is an important reassuring feature, and b) the need for a wide range of mortgage/finance products. The need for developers to support unsold equity and subsidise rent to make it truly affordable would necessitate some public subsidy in the form of government funding or developers with a comfortable cash flow. The last cautionary point made by the U.K. based panellist was the need for availability of land, which would

suggest that either medium-large scale developers are needed in the S-O scene or some government enablement with land acquisitions or subsidy would be a key factor in exploring this kind of scheme in African countries. It is unlikely that the scheme can be done by a small landlord.

With regards to the demand side, there was more agreement that the features and benefits of the S-O scheme would be viable for the prospective owner who would otherwise have to go down the incremental self-build route (typically taking upwards of 10 years or more to achieve). The fact that the scheme would allow the prospective owner to gain a foothold on the property ladder in a long-term way was deemed more sustainable by both panellists commenting on the South African market, due to assistance from the housing provider (and the ability to initially buy less than 100% shares). Panellist N1 (the architect/developer) also emphasised the attractiveness (on the demand side) of the fact that the purchase is done in stages, suggesting this product could be tied in with raising resources via cooperatives, and that support is provided by the joint owner (the developer).

Table 20: Results from the Questions on Viability of S-O scheme from Supply and Demand side

Questions	South Africa (small City) Panellist SA1	South Africa (City) Panellist SA2	Nigeria (large City) Panellist N1	Nigeria (Town) Panellist N2	Ghana (City) Panellist G1	U.K. Panelist.
1) Is the Scheme Viable? (Supply Side)	YES	MAYBE	YES	Not answered	MAYBE	MAYBE
2) Is the Scheme Viable? (Demand Side)	YES	YES	YES	YES	MAYBE	MAYBE

The panellist from Ghana (G1) however stated that unless there is government involvement he was unsure of the possible attraction of the scheme on the demand side, again due to cultural differences and informality of the land and housing market. The U.K. based panellist provided some salient caveats in suggesting that while the scheme may be attractive from the demand side, a real cost comparison of the purchase price and rent is required to understand the real opportunities and shortcomings of the product, and suggested that governments, co-operatives and large institutions could provide this product as a kind of benefit to members of their workforce. In summary, some of the key features of the scheme, with government backing and financial incentives, were considered by the panellists likely to assist low and middle income earners to achieve homeownership. The follow-up questionnaire strictly focussed on the assessment of the scheme's benefits and shortcomings and the results are presented below.

Follow-up questionnaire results

The follow up questionnaire focussed on the seven key benefits and five main shortcomings of the scheme identified in literature, but only four panellists responded despite reminders. Comments by the panellists about the key benefits are given below in Table 21, and the main benefit that resonated strongly with all panellists is that the units are available for immediate possession. The availability of good quality units on the scheme, the use of the scheme as a 'reward' for public servants and the fact that the initial cost of the unit was in principle made available below market value were all considered major benefits on the demand side, apart from Panellist N2 who felt that the scheme will not serve as an incentive to the shared-owner. For the housing provider, the main benefits were identified as the money made directly from the sales, as well as the ongoing income from the rents paid on the on-owned shares, which as we see from the low rate of 100% staircasing in the British S-O market, means that the rent revenue is available to most housing providers for a long time. It must also be stated that the fact that the units can be repossessed by the bank or the housing provider due to loan or rent default significantly reduces the direct risk borne by the bank and provider; a factor also emphasised by the U.K based panellist.

Whilst the opportunity to gradually increase ownership was seen as a strong advantage on the demand side because it would help key workers gain a foothold on the property ladder, and provides ongoing rental income for the supply side, the low minimum entry point rate of 25% was considered to be of less advantage, presumably on the demand side. This is intuitively what the authors had expected as full ownership is likely to be the driving inspiration for most in the African context hence a low entry rate is unlikely to engender a strong sense of ownership. As argued in the literature review, a low entry point in part, is more likely to make it difficult to achieve 100% ownership and as such, more people are likely to prefer a higher percentage initial share, for a strong sense of ownership, and to make full ownership more achievable.

Finally, the assessments of the shortcomings by the panellists revealed a number of concerns (See Table 4 overleaf). Where a number of panellists agreed on the likelihood of a given shortcoming also constituting a problem in the African context, the reasons and ameliorative measures suggested differed. The low rate of 100% ownership, identified as a failure of the scheme in the U.K. was considered likely to be a problem in the African context (Item 1, Table 22). The solutions proffered by Panellists SA1 and N1- equity release and amortisation- as a means of funding the purchase of additional shares are quite different in principle. Only one panellist (N2) seems to think this is unlikely to be a problem- presumably due to the fact that on sale of the unit, the S-O owner benefits from the increased equity, based on their share. As was expected, the option that the S-O owner could be evicted in the case of default on payments was generally not considered to be a problem as it provides significant protection for the housing provider. Even the panellist that highlighted it as a potential problem was not strictly

speaking contending the use of eviction, rather stated that on the event of a sale forced by repossession, any profit made from the increased equity in the property ought to be split between the housing provider and the S-O owner, arguably after the housing provider has recouped outstanding arrears. The decision by the U.K. court in the arrears recovery case reported in the literature review, that the tenant not be recompensed for past payments seems very harsh, and highlights the need to address the scenario clearly in legal regulations for the adaptation of the S-O product.

Table 21: Assessment of S-O benefits by the panellists

Assessment of BENEFITS From 1 = suited, to 3 = very well suited, OR From 1 = unsuited, to 3 = extremely unsuited.	South Africa (small City) Panellist SA1	South Africa (City) Panellist SA2	Nigeria (large City) Panellist N1	Nigeria (Town) Panellist N2
1) Initial Cost of the Unit is below market value.	Suited- 2	Unsuited- 3	Suited- 3	Suited- 3
2) Opportunity for Gradual increase in ownership.	Suited- 2	Suited (not rated)	Suited- 2	Suited- 2
3) Immediate possession of property.	Suited- 3	Suited- 1	Suited- 3	Suited- 3
4) Availability of good quality accommodation.	Suited- 3	Unsuited- 3	Suited- 2	Suited- 3
5) Provides rental income for landlord until 100% ownership of unit is achieved.	Suited- 2	Suited- 1	Suited- 1	Suited- 2
6) A form on incentive/ reward for workers in public sector.	Suited- 3	Suited- 1	Suited- 3	Unsuited - 2
7) A minimum share of 25% can be bought.	Suited- 1	Unsuited- 2	Suited- 2	

Finally, the assessments of the shortcomings by the panellists revealed a number of concerns (See Table 4 overleaf). Where a number of panellists agreed on the likelihood of a given shortcoming also constituting a problem in the African context, the reasons and ameliorative measures suggested differed. The low rate of 100% ownership, identified as a failure of the scheme in the U.K. was considered likely to be a problem in the African context (Item 1, Table 22). The solutions proffered by Panellists SA1 and N1- equity release and amortisation- as a means of funding the purchase of additional shares are quite different in principle. Only one panellist (N2) seems to think this is unlikely to be a problem- presumably due to the fact that on sale of the unit, the S-O owner benefits from the increased equity, based on their share. As was expected, the option that the S-O owner could be evicted in the case of default on payments was generally not considered to be a problem as it provides significant protection for the housing provider.

Table 22: Assessment of Shortcomings of the S-O scheme by the panellists

Assessment of SHORTCOMINGS	South Africa (Small City) Panellist SA1	South Africa (City) Panellist SA2	Nigeria (Large City) Panellist N1	Nigeria (Town) Panellist N2
1) Most shared owners have been unable to increase t 100% ownership.	Problem – 'Savings levels are very low and there are competing areas of household expenditure. Incentives to borrow against invested equity in the house may increase levels of "staircasing".'	Problem- 'Denser apartment blocks in less prime area would ensure more affordable units. Secure employment for numerous owners is not'.	Problem – Possible Alleviation (government subsidy amortisation)'	Not a Problem
2) The shared owne can be evicted for rent arrears withou being recompensed for past payments.	Problem – 'Property valuation must be market related. Any increase in valuation must be split between shared owner and landlord'.	Problem- 'Our country typically defends the tenant more than the owner. This (along with companies closing and staff retrenchments) often lends itself to tenants not being able to pay rent and "squatting" in the premises. If their rent starts going into arrears, the initial deposit of 25% could be divided to cover numerous months rental Thus, should the Shared Owner be retrenched an unable to pay his rent, h could have the option of "cashing" in his part ownership for a certain number of months' rent'.	Not a Problem	Not a Problem
3) The shared owne is responsible for th full Service Charge.	Not a Problem	Problem- 'This would ideally be shared pro-rata between the owner and Shared Owner, based on the percentage of ownership. If it is 50 / 50 owned, the responsibility should be 50/50'.	Not a Problem	Problem- 'Laws and regulations to protect the shared owner need to be strengthened'.
4) Scheme is only available as Leasehold.	Problem- 'Not sure why the model is restricted to leaseholds which is no particularly popular ir Africa. Guaranteed renewal of the leasehold may assist'	Problem- 'Shared owners would probably want to sell their portion, due to the increase in property value. This leasehold wouldn't allow for them to buy an sell easily, in order to climb the property ladder'.	Not a Problem- '(at least not until the spectre of title succession comes up after the expiry of the leasehold)'.	Problem – 'The supporting owners will never want to take risks or responsibilities for this because the uncertainties are high in Nigeria'.
5) Many houses ma be over-priced in th first place.	Not a Problem	Problem- 'Typically everyone is trying to make a profit; be it the government or banks. (Besides the corruption that would probably infect any kind of attempt at benefiting the typical man on the street)'.	Problem- 'Possible Alleviation (introduction of the scheme to many funding organisation to encourage competition and force prices down)'.	Problem (No proposals to ameliorate this)

Even the panellist that highlighted it as a potential problem was not strictly speaking contending the use of eviction, rather stated that on the event of a sale forced by repossession, any profit made from the increased equity in the property ought to be split between the housing provider and the S-O owner, arguably after the housing provider has recouped outstanding arrears. The decision by the U.K. court in the arrears recovery case reported in the literature review, that the tenant not be recompensed for past payments seems very harsh, and highlights the need to address the scenario clearly in legal regulations for the adaptation of the S-O product.

The fact that S-O schemes are only available as leaseholds was flagged up by the panellists as very likely to be a problem (for various reasons- Item 4, Table 4). Perhaps other forms of ownership such as the Share of the Freehold (SOF) whereby the freehold of the land is held jointly by all S-O owners in a specific development or the use of very long renewable leases which in effect becomes freehold, are possible solutions in an African environment. While the use of service charges was not considered a problem by several panellists, it is important as pointed out by Panellist N2, that laws and regulations to protect the S-O owner are strengthened to prevent exploitation by housing providers via exorbitant service charges, and ensure that charges are responsibly managed.

Finally, both Nigeria-based panellists were of the opinion that overpriced houses would be problematic, as this would constitute exploitation of the very people the scheme is meant to assist. The ameliorating strategy suggested is the introduction of such a scheme via several funding organisations at the same time to perhaps encourage competition and consequently keep prices down. However, this may not work as housing providers may collude to agree prices, but may be possible via regulatory guidelines.

Possible lessons about the viability of the S-O scheme in Africa

The general consensus of the panel is the viability of some of the benefits of the scheme in an African context, demonstrating awareness that the search for ways to assist people on or below the median income to achieve home ownership is evolving. The relative divergence of viewpoints in relation to the shortcomings especially where there are differences from one country to another would suggest that customisation of the product is necessary. The ability to operate the Shared Ownership scheme effectively requires a formal structure, regulations and incentives. Whilst it clearly offers some profit to the housing provider, it is also within the realm of social enterprise as it is subsidised to some degree. The relative success of the model in its original context is underpinned by financing institutions providing mortgages suited to this range of salaried workers and the incorporation of maintenance programmes into the legal documentation for the sale/rent of the units. Consequently, the model requires a measure of public support, political will and a fairly robust legal structure.

CONCLUSIONS

The shared ownership scheme leasehold format is alien to many African cultures - a point strongly emphasised by Panellist G1, and in Adeokun and Isaacs-Sodeye (2014). However, solutions to this difficulty include giving the buyer an option of the share of the freehold, providing longer leases, or giving the option of lease extensions without limitations on the number of extensions available. For African key workers to benefit significantly from the scheme, expanded access to formal loan/mortgage products at lower interest rates, or the use of a funding vehicle such as housing cooperatives is required, as suggested by Panellist N1 and Adeokun et. al. (2014). Loan products need to be affordable, yet not impinge on any cultural aversion to long periods of indebtedness prevalent in some African cultures, and governments also need to motivate finance institutions to provide smaller loans and less onerous collaterals. The need for clear legal framework, inclusive of maintenance programmes & service charges is essential for the protection of the S-O buyer in any adaptation of the scheme, as expressed in the literature review and by some panellists.

The low level of 100% staircasing is a serious concern, however a number of recommendations made in the U.K. could improve the 100% ownership rates. These include a) the reduction of the financial burden of staircasing on the S-O owner, by sharing the burden with the housing provider, b) making more S-O owners aware of the benefits of staircasing, c) clear consistent marketing of the scheme and d) placing more emphasis on staircasing goals right at inception. Similar improvements were also advocated by Cowan, Wallace and Carr (2015), including a strong request for legal clarity in the documentation of the sale of the units. As stated before, an initial 25% share is often too low to facilitate 100% ownership, therefore we advocate a higher entry point (above 30%) to engender 100% ownership, by potentially reducing the number of staircase 'steps' needed to achieve full ownership.

If a government chooses to subsidise the scheme, they can also ensure that the properties are built to good construction standards in order for the housing provider to qualify for the subsidy. The government can apply a penalty on the developer in the case of substandard construction, and the developer can also use their participation in such a scheme to shift their housing stock. Any adaptation of the scheme would also benefit from community engagement to ensure it is suited to the target population. A transition period prior to the purchase of a unit, as advocated by Crabtree (2016) could be a useful strategy, perhaps in form of a short rental period, which is then discounted off the purchase price. Finally, the expert panel, whilst highlighting a clear need for format modification, nonetheless recognises possible benefits of the model to enable key workers to own and occupy a completed house during their prime working life.

ACKNOWLEDGMENTS

The authors wish to thank the panellists for participating in the assessment of the shared ownership scheme in relation to the African context.

REFERENCES

Adebamowo, M. E., Oduwaye, L., and Oduwaye, O. S. (2012). Problems mitigating housing finance through primary mortgage institutions in Lagos. International Business and Management Journal: 4 (1), 126-134.

Adedeji, Y. D., & Olotuah, A. O. (2012). An Evaluation of Accessibility of Low-Income Earners to Housing Finance in Nigeria. *American-Eurasian Journal of Scientific Research*: 7 (1): 23-31. doi: 10.5829/idosi.aejsr.2012.7.1.1101

Adeokun, C.O.; Adewale, B.A. & Oloke, O.C. (2014) *Reworking traditional fund raising institutions for affordable housing provision: a review of Nigerian and Kenyan case-studies* In: Laryea, S. and Ibem, E. (Eds) Proceedings 8th Construction Industry Development Board (cidb) Postgraduate Conference, 10-11 February 2014, University of the Witwatersrand, Johannesburg, South Africa, 1-7.

Adeokun, C. O & Isaacs-Sodeye, F. (2014) *Delivering affordable dwellings for key workers: the shared-ownership option in sub-Saharan africa* In: Laryea, S. and Ibem, E. (Eds) Proceedings 8th Construction Industry Development Board (cidb) Postgraduate Conference, 10-11 February 2014, University of the Witwatersrand, Johannesburg, South Africa, 233-246.

African Union for Housing Finance Website (http://www.auhf.co.za/)

Badev, A., T. Beck, L. Vado & S. Walley (2014), *"Housing finance across countries: New data and analysis*," World Bank Working Paper Series.

Centre for Affordable Housing Finance in Africa (CAHF) 2016 Yearbook. (2016a). HOUSING FINANCE IN AFRICA *'A review of some of Africa's housing finance markets'*. Retrieved from http://housingfinanceafrica.org/app/uploads/CAHF_Housing-Finance-in-Africa-Yearbook-2016.09.pdf

Centre for Affordable Housing Finance in Africa (CAHF) (2016b) Nigeria Housing Finance Newsletter 2016, '*Understanding Nigeria's Housing Finance Market'*, October 2016.

Clarke, A. & Heywood, A. (2012a). *Understanding the second-hand market for shared ownership properties*. Report for Cambridge Centre for Housing and Planning Research. Department of Land economy, University of Cambridge. Cambridge.

Clarke, A. & Heywood, A. (2012b). *Understanding the second-hand market for shared ownership properties*. Executive Summary for Cambridge Centre for Housing and Planning Research. Department of Land economy, University of Cambridge. Cambridge.

Cowan, D., Wallace, A., & Carr, H. (2015). Policy Report. '*Exploring experiences of shared ownership housing: reconciling owning and renting'.* July 2015.

Crabtree, L. (2015). Exploring hybridity in housing: Lessons for appropriate tenure choices and policy.

Davis, S. C. & Sinn, (2016). *'Shared Ownership 2.1 Towards a fourth mainstream tenure - taking stock'* chartered Institute of Housing and ORBIT. 2016.

Demographia International Housing Affordability Survey (2017). 13th Annual Demographia International Housing Affordability Survey: 2017 '*Rating Middle-Income Housing Affordability'* 2016, 3rd Quarter.

Graham S. (2010). '*The role of shared ownership in the future housing market-Discussion paper summary'*. MOAT Housing Association.

Jambol, D. D., Molwus, J. J. & Daniel, M. M. (2013) *Re-thinking the approaches to mass housing delivery in Nigeria*, *In:* Smith, S. D. and Ahiaga-Dagbui, D. D. (Eds) Procs 29th Annual ARCOM Conference, 2-4 September 2013, Reading, UK, Association of Researchers in Construction Management, 285-295.

Kolawole, Y. (2014). 51% of adult Nigerians live in rented houses — NOI Polls Retrieved from: http://www.vanguardngr.com/2014/11/51-adult-nigerians-live-rented-houses-noi-polls//

Leasehold Advice from www.leaseadvice.org, 2013

Nguena, C. L.; F. T. Tchana and A. G. Zeuferk (2016). Policy Research Working Paper 7902 'Housing Finance and Inclusive Growth in Africa: Benchmarking, Determinants, and Effects'World Bank Group, Macroeconomics and Fiscal Management Global Practice Group and the Office of the Chief Economist, Africa Region. December 2016.

Peaker, G. (2013). The Hidden Dangers of Shared Ownership. Article in Guardian Professional.http://www.theguardian.com/housingnetwork/2013/sep/03/hiddendangers-shared-ownership?commentpage=2 Accessed 06/12/2013.

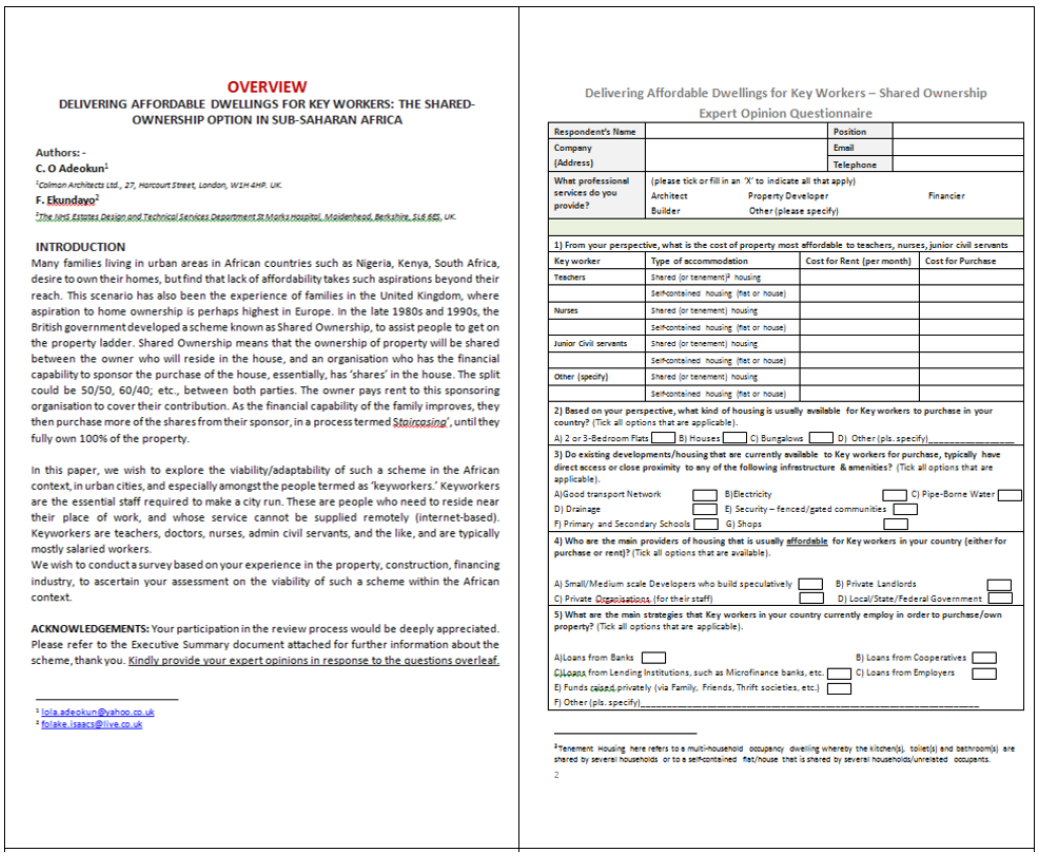
SHELTER (2013). Policy Report *'Homes for forgotten families; Towards a mainstream shared ownership market'* August 2013.

Shelter Afrique website (http://www.shelterafrique.org/)

U.K. Government Website (accessed 14/01/2014.) https://www.gov.uk/leasehold-property/extending-changing-or-ending-a-lease

United Nations Human Settlements Programme (UN-HABITAT), (2011). ADEQUATE HOUSING SERIES '*Affordable Land and Housing in Africa'* Volume 3.

APPENDIX A- EXPLORATORY QUESTIONNAIRE (PAGES 1-4)



OVERVIEW

DELIVERING AFFORDABLE DWELLINGS FOR KEY WORKERS: THE SHARED-OWNERSHIP OPTION IN SUB-SAHARAN AFRICA

Authors: -

C. O Adeokun[1]

[1]*Colman Architects Ltd., 27, Harcourt Street, London, W1H 4HP. UK.*

F. Ekundayo[2]

[2]*The NHS Estates Design and Technical Services Department St Marks Hospital, Maidenhead, Berkshire, SL6 6DB. UK.*

INTRODUCTION

Many families living in urban areas in African countries such as Nigeria, Kenya, South Africa, desire to own their homes, but find that lack of affordability takes such aspirations beyond their reach. This scenario has also been the experience of families in the United Kingdom, where aspiration to home ownership is perhaps highest in Europe. In the late 1980s and 1990s, the British government developed a scheme known as Shared Ownership, to assist people to get on the property ladder. Shared Ownership means that the ownership of property will be shared between the owner who will reside in the house, and an organisation who has the financial capability to sponsor the purchase of the house, essentially, has 'shares' in the house. The split could be 50/50, 60/40; etc., between both parties. The owner pays rent to this sponsoring organisation to cover their contribution. As the financial capability of the family improves, they then purchase more of the shares from their sponsor, in a process termed *Staircasing*', until they fully own 100% of the property.

In this paper, we wish to explore the viability/adaptability of such a scheme in the African context, in urban cities, and especially amongst the people termed as 'keyworkers.' Keyworkers are the essential staff required to make a city run. These are people who need to reside near their place of work, and whose service cannot be supplied remotely (internet-based). Keyworkers are teachers, doctors, nurses, admin civil servants, and the like, and are typically mostly salaried workers.

We wish to conduct a survey based on your experience in the property, construction, financing industry, to ascertain your assessment on the viability of such a scheme within the African context.

ACKNOWLEDGEMENTS: Your participation in the review process would be deeply appreciated. Please refer to the Executive Summary document attached for further information about the scheme, thank you. Kindly provide your expert opinions in response to the questions overleaf.

[1] lola.adeokun@yahoo.co.uk

[2] folake.isaacs@live.co.uk

Respondent's Name		Position	
Company (Address)		Email	
		Telephone	
What professional services do you provide?	(please tick or fill in an 'X' to indicate all that apply) Architect Property Developer Financier Builder Other (please specify)		

1) From your perspective, what is the cost of property most affordable to teachers, nurses, junior civil servants

Key worker	Type of accommodation	Cost for Rent (per month)	Cost for Purchase
Teachers	Shared (or tenement)[3] housing		
	Self-contained housing (flat or house)		
Nurses	Shared (or tenement) housing		
	Self-contained housing (flat or house)		
Junior Civil servants	Shared (or tenement) housing		
	Self-contained housing (flat or house)		
Other (specify)	Shared (or tenement) housing		
	Self-contained housing (flat or house)		

2) Based on your perspective, what kind of housing is usually available for Key workers to purchase in your country? (Tick all options that are applicable).

A) 2 or 3-Bedroom Flats ☐ B) Houses ☐ C) Bungalows ☐ D) Other (pls. specify)_____

3) Do existing developments/housing that are currently available to Key workers for purchase, typically have direct access or close proximity to any of the following infrastructure & amenities? (Tick all options that are applicable).

A) Good transport Network ☐ B) Electricity ☐ C) Pipe-Borne Water ☐
D) Drainage ☐ E) Security – fenced/gated communities ☐
F) Primary and Secondary Schools ☐ G) Shops ☐

4) Who are the main providers of housing that is usually affordable for Key workers in your country (either for purchase or rent)? (Tick all options that are available).

A) Small/Medium scale Developers who build speculatively ☐ B) Private Landlords ☐
C) Private Organisations (for their staff) ☐ D) Local/State/Federal Government ☐

5) What are the main strategies that Key workers in your country currently employ in order to purchase/own property? (Tick all options that are applicable).

A) Loans from Banks ☐ B) Loans from Cooperatives ☐
C) Loans from Lending Institutions, such as Microfinance banks, etc. ☐ C) Loans from Employers ☐
E) Funds raised privately (via Family, Friends, Thrift societies, etc.) ☐
F) Other (pls. specify)_____

[3]Tenement Housing here refers to a multi-household occupancy dwelling whereby the kitchen(s), toilet(s) and bathroom(s) are shared by several households or to a self-contained flat/house that is shared by several households/unrelated occupants.

6) From your perspective, out of the 14 criteria listed below, please identify the 3 most important criteria that you think people consider when choosing housing TO BUY. Please rank these 3 most important criteria from 1 (least important) to 3 (most important). If there is a variable that is not in the list below, but you think should be one of the top 3 variables, please identify below under 'Other' and rank accordingly.

Criterion	Grade (1 to 3)	Why?
a) Overall Cost of the unit		
b) Number of bedrooms		
c) Proximity to workplace		
d) Proximity to schools		
e) Proximity to healthcare		
f) Proximity to shops, markets		
g) Public transport network		
h) Roads (condition)		
i) Water (access to public utility)		
j) Electricity (access to public utility)		
k) Familiarity with neighbourhood		
l) Security – Gated community		
m) Additional land for expansion		
n) Perceived popularity of Estate		
o) Other (please specify)		

7) From the Supply side (as a Developer, Financier, Architect etc.), do you think Shared Ownership Schemes are a viable route to home ownership in your country? Yes ☐ No ☐ Maybe ☐

If Yes, or Maybe, (From the Supply side), why do you think the scheme may be viable? (pls. be specific)

If No, (From the Supply side), why do you think the scheme may NOT be viable? and How could it be adapted to better suit your own country? (pls. be specific)

8) From the Demand side (buyer), do you think Keyworkers will consider Shared Ownership Schemes as a viable route to home ownership in your country? Yes ☐ No ☐ Maybe ☐

If Yes, or Maybe, (From the Demand side), why do you think Keyworkers will consider the scheme viable? (pls. be specific)

If No, (From the Demand side), why do you think Keyworkers will NOT consider the scheme to be viable? And How could it be adapted to better suit your own country? (pls. be specific)

If you would like us to get in touch with you to discuss further about the potential for the adaptation of the Shared-Ownership scheme to suit the African context, kindly tick below, thank you.

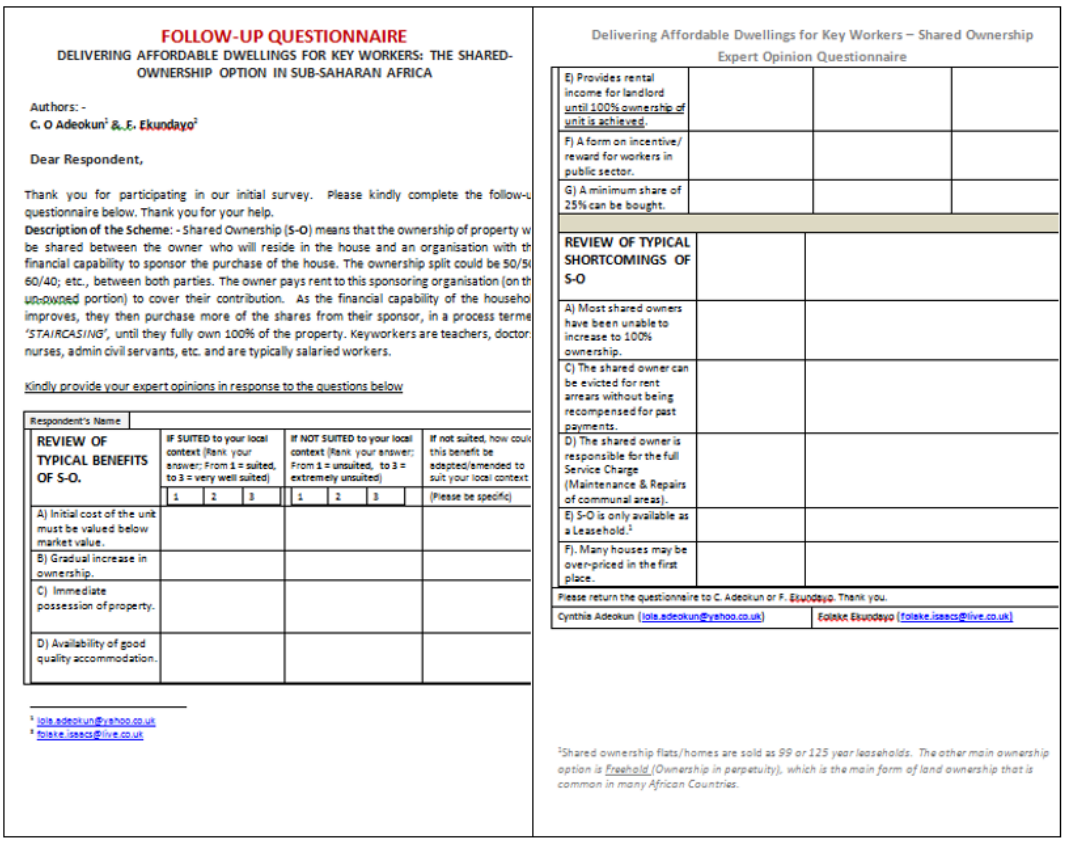
Please contact me for further discussion(s) by Phone/Email ☐

Thank you very much for taking time to respond to our questionnaire.

Please return to:

Cynthia Adeokun	Folake Ekundayo
Lola.adeokun@yahoo.co.uk	folake.isaacs@live.co.uk

APPENDIX A- FOLLOW UP QUESTIONNAIRE (PAGES 1-2)



FOLLOW-UP QUESTIONNAIRE

DELIVERING AFFORDABLE DWELLINGS FOR KEY WORKERS: THE SHARED-OWNERSHIP OPTION IN SUB-SAHARAN AFRICA

Authors: -
C. O Adeokun[2] & F. Ekundayo[2]

Dear Respondent,

Thank you for participating in our initial survey. Please kindly complete the follow-u questionnaire below. Thank you for your help.

Description of the Scheme: - Shared Ownership (S-O) means that the ownership of property w be shared between the owner who will reside in the house and an organisation with th financial capability to sponsor the purchase of the house. The ownership split could be 50/5 60/40; etc., between both parties. The owner pays rent to this sponsoring organisation (on th un-owned portion) to cover their contribution. As the financial capability of the household improves, they then purchase more of the shares from their sponsor, in a process terme *'STAIRCASING'*, until they fully own 100% of the property. Keyworkers are teachers, doctor nurses, admin civil servants, etc. and are typically salaried workers.

Kindly provide your expert opinions in response to the questions below

Respondent's Name								
REVIEW OF TYPICAL BENEFITS OF S-O.	**IF SUITED to your local context** (Rank your answer; From 1 = suited, to 3 = very well suited)			**If NOT SUITED to your local context** (Rank your answer; From 1 = unsuited, to 3 = extremely unsuited)			If not suited, how could this benefit be adapted/amended to suit your local context
	1	2	3	1	2	3	(Please be specific)
A) Initial cost of the unit must be valued below market value.							
B) Gradual increase in ownership.							
C) Immediate possession of property.							
D) Availability of good quality accommodation.							

[1] iole.adeokun@yahoo.co.uk
[2] folake.iseacs@live.co.uk

Delivering Affordable Dwellings for Key Workers – Shared Ownership Expert Opinion Questionnaire

E) Provides rental income for landlord until 100% ownership of unit is achieved.			
F) A form on incentive/ reward for workers in public sector.			
G) A minimum share of 25% can be bought.			
REVIEW OF TYPICAL SHORTCOMINGS OF S-O			
A) Most shared owners have been unable to increase to 100% ownership.			
C) The shared owner can be evicted for rent arrears without being recompensed for past payments.			
D) The shared owner is responsible for the full Service Charge (Maintenance & Repairs of communal areas).			
E) S-O is only available as a Leasehold.[1]			
F). Many houses may be over-priced in the first place.			

Please return the questionnaire to C. Adeokun or F. Ekundayo. Thank you.

Cynthia Adeokun (iole.adeokun@yahoo.co.uk) Folake Ekundayo (folake.iseacs@live.co.uk)

[1]Shared ownership flats/homes are sold as *99 or 125 year leaseholds. The other main ownership option is Freehold (Ownership in perpetuity), which is the main form of land ownership that is common in many African Countries.*

THE SIGNIFICANCE OF HEALTH AND SAFETY OF CONSTRUCTION INDUSTRY PERSONNEL IN LAGOS STATE: CCECC CASE STUDY

Adesanya Adekunbi[1], O.R.O. Amusu[2], K. A. Salvador[3]
[1,2,3]Department of Building Technology Lagos state polytechnic Ikorodu, Lagos, Nigeria

Assurance of health and safety of personnel in construction industries is a product of planning, co-ordination and commitment by the employers and the employee. The aim of this study is to access the significance of health and safety of construction industry personnel in Lagos State. It is of high importance to assess the factors that could facilitate health and safety hazards on construction site and the factors that could ameliorate the hazards on construction site. An exploratory survey was used in generating data within the Chinese civil engineering construction company(CCECC) Lagos. The population of the study consists of 75 workers of three categories vis a-vis supervisors, the foremen and the Artisans. The questionnaire was designed to obtain a fair representation of the three categories. Mean average statistics revealed that, site congestion, negligence, inadequate communication, and lack of safety equipment are highest factors that could facilitate health and safety hazards. While provision of site emergency facilities, site canteen, staff training and incentives could go a long way in ameliorating hazards. The study therefore recommended a cordial and passionate relationship between the employer and the employee by holistically providing site emergency facilities, safety equipment, staff training amongst other factors to give the workers a sense of belonging to the organization.

Keywords: construction industry, health and safety, , hazard, Lagos, survey

INTRODUCTION

Safety is about the protection of people, assets, absence of accidents and safe working practices. It is primarily concerned with finishing the working day in the same physical condition as when you started it. Accident therefore is a mishap resulting in damage of property and/or injury or death to persons. It is traceable to an act of omission on the part of somebody caused by human action through unsafe acts and conditions. The most common is poor

[1] adesanya.adekunbi@gmail.com
[2] olusholaamusu@gmail.com
[3] dammydunny@gmail.com

Adekunibi, A., Amusu, O.R. O. and Salvador, K. A. (2017) The significance of health and safety of construction industry personnel in Lagos State: CCECC case study *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1366-1373

management organization, failure to provide and follow safe system of work, inadequate training and instructions (Bokini 2001).

Every construction site is by its nature hazardous. There are many dangers, even to the very experienced workers. It is necessary for every construction workers to be wary of the possibility of suffering pains and injury by the actions. Safety is often difficult to predict out of common knowledge, and may have to be measured in terms of the frequency with which events occur (Banjo 2003). The only way to eliminate all possibility of hazard is to refuse to build. Building involves the greatest set of compromise with which man is regularly faced with. The response in term of reduced accident incidence has not been very encouraging. The construction site is a very different type of factory environment. It is in many cases a unique and a constantly changing industry. The monitoring of operations is therefore much more difficult and demand a more flexible and extensive control by site managers and foremen (John 2001).

Speaking the language of business requires knowledge of business and financial skills combined with an understanding of the stakeholders the business serves. The main stakeholders traditionally served are the shareholder or investor seeking a return on investment. The safety profession has recognized that to gain the attention of corporate decision makers, its practitioners must be able to justify expenditures and present safety in terms of its positive impact on bottom-line profits as a return on investment (Schneid 2008). However, the value safety brings to an organization goes beyond the financial statement. Construction companies in Nigeria owe ethical responsibilities to all stakeholders in the construction industry, not just investors or financial supporters. Safety professionals can promote the value of safety by demonstrating how effective safety management system serves all of an organization's stakeholders. Safety professionals must think in terms of creating and sustaining value for key stakeholders, no matter the business's overall purpose or direction (Freeman, Harrison & Wicks 2007).

STATEMENT OF THE PROBLEM

An accident can be defined as an unplanned and unexpected occurrence which upsets a planned sequence of work resulting in injury and or death to personnel, loss of production and or damage to plants and equipment (Dickson 1993). This seems to agree with (Marti 2005) who opined that hazard is any existing potentials condition in the work place that by itself or by interacting with other variables can result in death, injuries, property damages and other losses.

The organization is concerned principally with people, their knowledge, training and responsibility in ensuring that work is done safely and without risk to health. These responsibilities deal mainly with how they could be achieved.

Employers of labour are constrained by law to ensure as far as possible that the physical and mental wellbeing of workforce in an organization is

adequately catered for. The purpose is to look into everything that happens around us to arouse safety and clinical consciousness, so that the workforce will maintain a high degree of productivity (Socrates 1998).

The study therefore aims at appraising the significance of health and safety of construction industry personnel in Lagos State.

The objectives include

1. Assessing the factors that could facilitate health and safety hazards on construction sites.
2. Assessing the factors that could ameliorate health and safety hazards on construction sites.

LITERATURE REVIEW

Safety in respect of health is not so well developed, but neither is it critical, since accepted practices are generally well above the level of which there is concern for health today (Robert 1984).

Building codes are essentially sets of safety regulations in respect of situations, fire and health. They are originally developed in expenses to frequently demonstrated hazard, structural collapse, catastrophic fires and the spread of diseases. In doing their jobs, the workers are sensitive to the need to preserve and conserve the environment for healthy organization of adequately monitored jobs.

On the health of persons employed in industrial establishment, the factory Act 1958 considered such items as cleanliness, over-crowding, ventilation lighting, drainage of floors, sanitary convenience, dusts and fumes, meals in certain trades and protective clothing. The act provided that factory must not be allowed to become unnecessarily dirty, in particular, accumulation of dirt or refuse must be removed daily from floors and benches or every workroom must be washed at least once a week. The act stipulates that a factory must not be overcrowded so as to cause risk of injury to the health of the employees.

Project actualization goes beyond joining of all structural members. Like columns, beams etc. It goes beyond bricks and mortars, but extends to dealing with every possibility of meeting danger, suffering harm or loss as a result of some risk elements inherent in the industry. This could be due to evolving and conditions through project life cycle and project environmental circumstances which are generally caused by physical environmental, social and political circumstances interrelated with resources available and the project characteristics on hand (Akinloye, 1998).

Factors of site personnel injury should mean things or situation that cause or influence safety risk in the construction industry. During the pre-contract stage of a project, risk cannot be identified or quantified in order to manage

them. Though construction industry always allow sum to accommodate unforeseen contingencies, yet the contractor shall be liable for and shall indemnify the employee against any expenses, liabilities, loss, claims or processing, in respect of any injury or damage for any property, real or personal in so far as such injury or damage arises out of or in the course of works. It is quite good to know that the construction industry is not left out of this contractual agreement.

Safety professionals in the construction industry must recognize their corporate decision makers as well as their stakeholders. The range of stakeholders has expanded over the years from owner or shareholders to a broader group that now includes those who affect or are affected by a firm's goal (Freeman et al, 2007) or who have a stake in a firm's operations (Werther & Chandler, 2006). This group includes customers, suppliers, employees, financier, communities and managers. The effective construction safety management must promote benefits and values that address all construction industry stakeholders. This will ensure that safety professional are better recognized, understood and appreciated by decision makers within the construction industry. Hence, safety professionals must play a vital role in teaching and educating decision makers and stakeholders about the "importance and beneficial aspect of safety in their operation" (Schned, 2008). Beyond the effect on profits, construction safety professionals must design safety management programs that address the needs of stockholders and stakeholders.

Health and Safety of workers in CCECC, Lagos

Nigerians working for China Civil Engineering Construction Company, (CCECC), on the 22nd day of July, 2015 marched to the office of the Lagos State Governor in Alausa, Ikeja, Lagos State to protest the sack of over 500 workers. The protesters who stormed Alausa at mid-day, also, alleged several inhuman treatments, including high handedness, non-compliance to safety culture, and failure to compensate injured or deceased workers. These are all against their Chinese employers.

It would be recalled that, the Chinese construction is one of the major beneficiaries of construction contracts awarded by the Lagos State Government, Federal Government, and many other state governments. CCECC is also currently working in the Abuja-Lagos rail projects among others. The protesters, numbering over 300, appealed to the state government to come to their aid and save them from "foreigners enslaving us in our country". The protesters said they had worked for the company for at least five years, both casual workers and permanent staff under "dangerous conditions, without safety materials" which often lead to permanent disabilities and death of their colleagues.

Speaking on behalf of the workers, "Mark Eze Okila, who lost his full left arm while working for CCECC said some of the workers were paid as low as N550 per day, "while the Chinese supervisors who do nothing, but answer phone calls and smoke cigarette receive as much as N450,000 monthly.

Okila said they, however, got fed up with the company when their appointments were verbally terminated. The workers demanded that CCECC should pay them off at agreed rate of N600,000 per casual worker and N800,000 per staff. Another protester told the "The Guardian" that CCECC had a reputation of employing verbally and disengaging in the same manner too. Besides, he alleged that, the only occasion in which the company has compensated any worker was when one of them fell off from a slab and broke his waist. The victim got the sum of N1million for his permanent disability.

In their protest letter to Governor Akinwunmi Ambode, signed by Okila and Muyideen Ola, the workers said a labourer earns N550 per day while workers (skilled) earn N850 per day.We also have serious problems in safety and matters that always cause lots of accident on sites. They give appointment without any safety induction certification and at the same time, they give work without any safety gadgets, and that has been leading many workers to injuries of permanent disability and even death in the process of working and nothing serious will be done about it."Now, it has come to a point that the company is sacking workers without any explanation for such action. So we are seeking your opinion for justice to be done over this matter for citizen's right", the petition read in part.

While receiving the workers on behalf of the Lagos State Governor, Samuel Olukunle Ojo, told the workers that the governor had been holding meeting with the General Manager of the Lagos State Metropolitan Area Transport Authority (LAMATA), Dayo Mobereola and Management of CCECC over their issue. (Guardian Vol. 32, No, 13,355, Thursday July 23rd 2015. Pg. 2).

RESEARCH DESIGN AND METHODS

The scope of the research is limited to Chinese civil engineering construction company as a case study. CCECC is one of the major beneficiaries of construction contracts awarded by the Lagos State government, Federal government and many other state governments. For the purpose of carrying out a survey on the significance of health and safety of construction industry personnel in Lagos State, an exploratory survey was used in generating data within the Chinese civil engineering construction company (CCECC)for the required study. The population of the study consists of 75 workers of three categories (5 supervisors of civil engineering and building profession, 10 foremen of trades including carpentry, iron benders and masonry and 60 artisans consisting of mason iron benders and carpenters). The questionnaire was designed to obtain a fair representation of the opinion of the three categories in the company using a five-point likert type scale of (1) highest (2) high (3) averagely high (4) significant (5) not significant. Stratified random sampling method was used for purpose of questionnaire administration and the responses of the questionnaire by the sample respondents were analyzed using mean average statistics. A total of 120 copies of questionnaire were administered out of which 75 copies were retrieved and used for the analysis.

DATA PRESENTATION ANALYSIS AND RESULT

Table 1 shows the ranking of perception of respondents in the factors that could facilitate health and safety hazard.

Table 1: Factors that Could Facilitate Health and Safety Hazard

Variables	Mean	Ranking
Open excavation	8.00	1
Improper site layout	5.33	8
Site congestion	8.00	2
Inadequate supervision	5.33	9
Negligence	8.00	3
Inadequate tools	5.33	10
Substandard/obsolete tools	2.66	16
Improper stacking & storage	4.00	14
Lack of safety equipment	6.66	5
Fatigue	5.33	11
Inadequate communication	8.00	4
Unskilled personnel	2.66	17
Excessive alterations	6.66	6
Poor workmanship	5.33	12
Lack of safety awareness	4.00	15
Professional quackery	6.66	7
Excessive profit	1.33	18
Lack of adequate plants	1.33	19
Non-maintenance of plant/equipment	5.33	13

Source: Field Survey 2017

From Table 1 it is obvious that open excavation, site congestion, negligence, inadequate communication, all of which are having mean of 8.00 are ranked highest amongst the factors that facilitate health and safety hazard. Lack of safety equipment, excessive alterations, professional quackery, all having the mean of 6.66 are all ranked high as factors that could facilitate health and safety hazard. Inadequate tools, fatigue, poor workmanship, non-maintenance of plants and equipment all having a mean of 5.33 are also ranked high amongst the factors that could facilitate health and safety hazard. Improper stacking and storage, lack of safety awareness all having a mean of 4.00 are also ranked significant amongst the factors that could facilitate health and safety hazard. Substandard and obsolete tools, unskilled personnel both having a mean of 2.66 are also significant as perceived by the respondents. Excessive profit, lack of adequate plants both having a mean of 1.33 are also significant as perceived by the respondents.

Table 2 shows the ranking of the perception of the respondents on the factors that could ameliorate health and safety hazard.

Table 2: Factors That Could Ameliorate Health and Safety Hazard

Variables	Mean	Ranking
Provision of safety tools/wear	5.33	8
Adequate maintenance of tools	2.66	15
Replacement of obsolete tools/wears	5.33	9
Provision of first aid facilities	5.33	10
Provision of site emergency facilities	8.00	1
Provision of site canteen	8.00	2
Provision of site conveniences	5.33	11
Provision of good site layout	5.33	12
Proper materials handlings and storage	5.33	13
Adequate and compulsory break	6.66	5
Adequate communication	6.66	6
Staff training	8.00	3
Provision of incentives	8.00	4
Staff motivation	6.66	7
Proper job schedule	2.66	16
Reasonable work overload	2.66	17
Adequate supervision	4.00	14
Staff encouragement	1.33	19
Enforcement of safety rules	2.66	18

Source: Field Survey 2017

From Table 2 it can be seen that the provision of site emergency facilities, provision of site canteen, staff training, provision of incentives, all having a mean of 8.00 as perceived by the respondents are ranked highest amongst the factors that could ameliorate health and safety hazard. Adequate and compulsory break time, adequate communication, staff motivation, all having a mean of 6.66 as perceived by respondents are ranked high as factors that could ameliorate health and safety hazard. Provision of safety tools and wears, replacement of obsolete tools and wears, provision of first aid facilities, provision of site conveniences, provision of good site layout, proper material handling and storage, all having a mean of 5.33 are ranked high as factors that could ameliorate health and safety hazard. Adequate supervision having a mean of 4.00 is ranked high as perceived by the respondents. Adequate maintenance of tools, proper job schedule, reasonable work overload, enforcement of safety rules, all having a mean of 2.66 are ranked significant by the respondents as factors that could ameliorate health and safety hazard. Staff encouragement having a mean of 1.33 is ranked significant by the respondents as a factor that could ameliorate health and safety hazard.

CONCLUSION AND RECOMMENDATION

Accidents on construction sites should be avoided as if it does not claim lives could leave permanent disability. All the respondents in the course of interview interaction decry non-compliance with safety culture by the company. They explained encountering problems with safety matters,

company not giving safety equipment and wears, which make them prone to accidents.

In view of the findings of this paper, it is hereby recommended that there should be cordial and passionate relationship between the employer and the employee by:

1. Providing site emergency facilities in case of any accident
2. Providing adequate and quality safety tools and wears that could reduce the proneness of accidents.
3. Providing staff training and adequate communication to staff to boost their morale and give a sense of belonging to the company.

REFERENCES

Akinloye, A. (1998) Project Management in Construction Industry. Journal of the Nigerian Institute of Quantity Surveyor

Banjo, K. (2003) Risk and Insurance Fundamental. Dekinban Press. Lagos

Bokini, S. (2001) Health and safety on construction site. Annual general conference of the Nigerian Institute of Building

Dickson A. (1993) Risk and Insurance Management Redwood books company Trowbridge London.

Freeman, R. Harrison, J. & Wicks A. (2007) Managing for Stakeholders. New Haven, CT. Yale University Press

Guardian Volume 32. No 13,355. Thursday July 23rd, 2015 pg2.

John L. (2001) Examining the potentials, risk mitigation and benefits of diversification. Gregoire capital, Chicago

Marti, P. (2005) Risk Management for distressed and security portfolio. 2nd edition. Murray capital management incorporation. Haymarket House London.

Robert, A.D. (1984) Risk, define it, measure it, and manage it, University of Massachusetts, Yale, South Africa.

Schneid T. (2008) Corporate Safety Compliance Boca Raton FL.CRC Press

Socrates, G. (1998) Building Technology and Management. Accident Investigation. Brunel University.

Wenther, W & Chandler, D. (2006) Strategic Corporate Social Responsibility. Thousand Oaks, CA. SAGE Publications.

THERMAL CLIMATE AND RESIDENTS' PERCEPTIONS OF SULTRY CONDITIONS IN RURAL AND SEMI-URBAN SETTLEMENTS IN SOUTHWESTERN NIGERIA

Eludoyin, Oyenike Mary[1]
Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria

Thermal climate, the atmospheric conditions of an area based on temperature differences and changes, involves delimitations of regions into thermal zones to enhance policies on dividing an area into temperature zones. This study examined the variations in the thermal climate of the urbanized southwestern Nigeria using selected traditional indices. It also investigated the coping strategies of residents in selected settlements to extreme thermal conditions. Air temperature, dewpoint temperature (an index of absolute humidity) and selected indices; Effective Temperature (ETI) and Relative Strain indices (RSI) were evaluated for 1961 – 2013 at ten meteorological stations in the regions. Results showed that the study area is characterized by 21.1 - 22.9 ^{o}C, 30.9 - 32.2 ^{o}C and 26.2 - 28.1 ^{o}C minimum, maximum and mean temperature variables, respectively within the study period. Dewpoint temperature, RSI and ETI were 21.3 - 24.4 ^{o}C, 0.09 - 0.15 (no unit), and 24.6 - 26.7 ^{o}C, respectively. Variations in the average values of selected variables between 1960 – 1990 and 1991 – 2013 were not significant ($p > 0.05$) but spatial variations occurred from one location to the other; there is also a tendency for increase in the values of the thermal climate variables. The study also showed that dominant coping strategies were changing cloth/wears, opening windows for cross ventilation and installing fan at homes or offices in the urban settlements. The study concluded that response to potentially increasing thermal stress (sultry) in the region is rudimentary, and recommends awareness of vulnerability to extreme thermal conditions in the region.

Keywords: regional climate, sultry, temperature change, thermal climate

INTRODUCTION

Extreme thermal climate is associated with too high or too low temperature and humidity (Ayoade, 1978; Olaniran, 1982; Candido et al., 2010; Eludoyin et al, 2014). The concept of thermal climate emphasizes the effects of 'heat elements' (temperature, humidity, air movement and radiant energy) in the understanding of adaptation, strain and productivity of man and animals in

[1] baynick2003@yahoo.com

Eludoyin, O. M. (2017) Thermal climate and residents' perceptions of sultry conditions in rural and semi-urban settlements in southwestern Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1374-1396

the environment. Its scope includes a 'humanisation' of geographical climatology as a step towards research on interrelations of physio-climatic features, health, mortality, economy, social habits, military tactics, clothing and shelter needs (Kalkstein and Valimont, 1986; Comrie, 2007). Thermal climate is typically measured in terms of unitary (temperature, humidity and other heat related climatic elements) and integrative indices (De Freitas and Grigorieva, 2014; Abuloye, 2015). Abuloye (2015) modified a list of human thermal comfort indices by De Freitas and Grigorieva (2014) to include 82 integrative indices, out of which three; Effective temperature (ETI), Relative strain (RSI) and Temperature humidity (THI) indices, have been found applicable to the Nigerian heterogeneous climate. Other commonly used measures include indicators of absolute humidity, such as dewpoint temperature (Td), air saturation index and relative humidity (Lawrence, 2005). Relatively humidity is, however, largely known to be severely influenced by air temperature and has not been considered as a good indicator of the thermal climate; hence many studies have used this climatic element to complement the air temperature based on acceptable Fanger models (Fanger, 1972). Studies on the regional climate with respect to the indices and humidity in Nigeria are few, and the results from the traditional indices will provide a control for the understanding of the more state-of-the-art indices in the area.

Human thermal comfort is an expression of feeling of satisfaction with the prevailing weather condition (Lee, 1953; Terjung, 1967). Extreme climate conditions outside the comfort zone are conditions of heat and cold stresses. Heat or cold stress is known to decrease work productivity, and increase (heat-related) mortality or morbidity (Kalkstein and Smoyer, 1993; Havenith et al., 2002; Alcamo et al, 2007; Wolkoff and Kjaergsard, 2007). Studies on thermal climate and thermal comfort have generated interests across the world because they form the basis for planning for housing, healthcare and recreation facilities (De Freitas, 2003; World Health Organization, WHO, 2011). Knowledge of the thermal comfort also ensures adequate warning for future extreme climate scenarios and for adequate preparation of humans and their livelihood against extreme climate conditions (Kalkstein and Smoyer, 1993).

Literatures have indicated that the rate of mortality resulting from heat-related sicknesses such as cerebrospinal meningitis has increased in the sub-Saharan Africa (Mohammed et al., 2000; Greenwood, 2006). For instance, Sawa and Buhari (2011) showed that meningitis and measles would increase by 6 and 19 persons per thousand, respectively for every 1°C increase in temperature in Zaria, Nigeria, for example. More people in the tropics now prefer air conditioners in homes and offices to suppress the effect of increased heat (Chappells and Shove, 2004). Temperature related diseases also tend to increase as urbanisation increases (Matzarakis, 2001).

Despite the increased tendency of foreseeable severe effects of climate in the tropics, and particularly in developing countries; where adaptation and coping strategies of the people to climate stress have been an issue of international concerns, studies (e.g. Githeko and Woodward, 2003; Boko et

al., 2007) have shown that specific local and regional climate information is scarce. Cases of local and regional outbreaks of weather-related health concerns, such as malaria and meningitis in parts of Nigeria suggest the need for a regional investigation. In addition, the Fourth Assessment Report on Europe (Alcamo et al., 2007) and other studies (e.g. David-West and Cooke, 1974; Omonijo et al., 2011) have reported increased cases of both cold and heat-related infections in many parts of Nigeria. Subsequently, that study is set to provide information that can enhance regional policy on weather related diseases in the southwest part of Nigeria. Specific objectives are to: (a) describe the thermal climate of the southwest region of Nigeria (b) examine the changes in the climate overtime, and (c) assess the approaches by which the rural and semi-urban residents cope with extreme thermal weather or climatic occurrences in the region.

LITERATURE REVIEW

A number of recent studies have focused on the thermal comfort of Nigeria, probably because of the increased awareness on climate change and its effects on the people and their livelihoods (e.g. Ayanlade and Jegede, 2015; Ayanlade, 2016; Mirrahimi et al, 2016; Igbawua et al, 2016; Ilesanmi, 2016). Nigeria is a typical developing country where people have been noted to be vulnerable to the effects of extreme climatic conditions because of poor economic, political and technological responses (WHO, 2011; UNISDR Africa, 2012; Pezzoli et al, 2016). Studies have noted that many sub-Saharan countries are vulnerable to conditions of livelihoods (e.g. food insecurity, water scarcity and environmental degradation) due to the intensive effects of climate-related causes, including desertisation, desertification and temperature increase (Lawson, 2016).

In Nigeria, our previous studies (e.g. Eludoyin and Adelekan, 2013; Eludoyin et al, 2014), among others have indicated that human comfort in the southwest Nigeria may be under heat stress in the recent years, but only specific information about the southwest region is rarely reported. It is therefore difficult to determine the the stretch of the vulnerable area in the region, since the studies. The southwest region is made up of Benin, Abeokuta, Ikeja, Ondo and Ibadan, which are mainly traditional large cities in the southwest Nigeria, and have been found to be characterized by heat stress (e.g. Omogbai, 1985, Aina, 1989, Oniarah, 1990, Adebayo, 1991, Efe,2004, Adelekan, 2005, Akinbode *et al.*, 2008) as typical of many large cities in the world (e.g. Algeciras et al, 2016; Yang et al, 2016; Baklanov et al, 2016). Incidence of heat stress in the rural and semi-urban areas in the region has not been reported in literature, however. A major difference between the countries in developing and developed economies is the reaction to the increasing thermal discomfort. While in rural areas in many developing countries, common mitigating or coping strategies to heat stress are rudimentary personal adjustments (such as changing personal variables, such as clothing, moving to a different location, etc.), approaches in many developed countries have developed into policy issues, early warning system and speedy responses (e.g. Kalkstein and Smoyer, 1993).

Studies (e.g. Metcalf et al 2016) also noted development of urban greening in many parts of developed countries to combat temperature extremes, many rural and semi-urban areas are being degraded in the quest for urbanization. Heat stress has been linked with increase in violence, heat stroke, rashes and meningitis among people (e.g. Mohammed et al, 2000; Alcamo et al, 2007; Lin et al, 2011).

STUDY AREA

The southwest Nigeria lies between 2°3' - 6° E and 6°2' - 8°4' N (Figure 1). The climate of region is strongly influenced by the moisture-laden tropical maritime (mT) and dust-laden tropical continental (cT) air masses (Omogbai, 2010). The southern sub-region is characterized by a general low relief (0 – 200 m above sea level) which rises gently northwards (Ileoje, 2001).

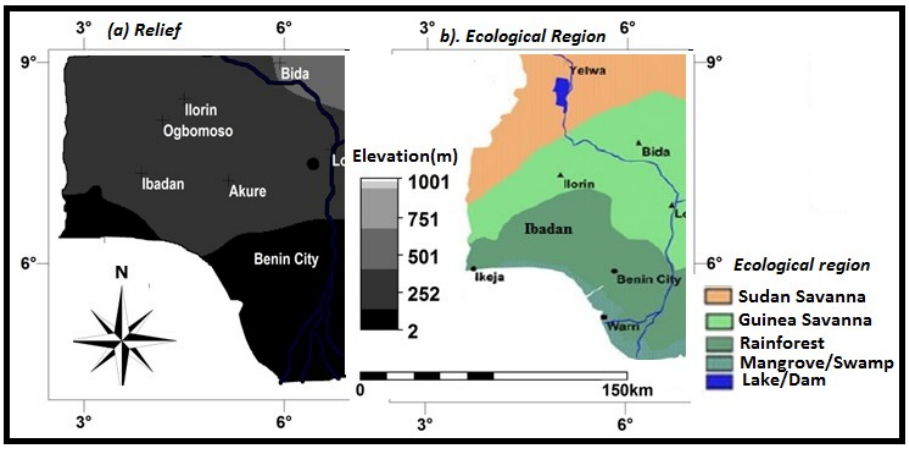


Figure 1. Relief and ecological variations in the southwest Nigeria

The southwestern part of Nigeria is known as the most populated and industrialized within the country, especially as it is the location for the second most populated (Lagos), and second and third largest city in Africa (Ibadan and Ogbomosho, respectively). Existing studies have explained the climate of the southwestern Nigeria as part of the entire country with high level of generalization (e.g. Olaniran, 1982; Omogbai, 1985; Adebayo, 1987; 1991; Aina, 1987; Akinbode et al, 2008) but existing studies with regional focus is scarce to find. The population of the region, as at 2006 was over 36 million, and was projected to be about 183 million in 2015, and about 433 million by 2050. The total land area is about 166,361 square kilometres (National Population Commission, 2006).

DATA

Monthly records of meteorological data (temperature and relative humidity) were used for this study, and although we sought to use heat related elements including wind and radiant energy from the Nigerian Meteorological Agency (NIMET), they were expensive (cost) to purchase for all the years. Also, the daily climate records were outrageously costly to obtain. Responses of residents from selected small and medium-size

settlements were sought and analysed. Figure 2 shows the location of the synoptic stations whose meteorological data, and the settlements from where responses were obtained.

Meteorological data

The monthly temperature and relative humidity records for all the 10 existing synoptic stations whose data started from 1960 in the region were used for the study. The data were obtained from the office of the NIMET's office at Oshodi, Lagos. Data were examined for spurious values and evidence of non-climatic heterogeneity and instrumental errors as advised by the World Meteorological Organisation (1989). The thermal comfort indices (ET, RSI and Td) were derived from the temperature and corresponding relative humidity data using equations i – iii (Gregorczuk and Cena 1967: Ayoade, 1978 (for ETI); Giles et al. 1990 (for RSI); Wolkoff and Kjaergaard, 2007 (for RSI))

$$ETI = T - 0.4(T - 10) * (1 - \frac{RH}{100}) \quad \text{(i)}$$

$$RSI = \left(\frac{T - 21}{58 - e}\right) \quad \text{(iia)}$$

$$e = \frac{(RH \times Vp)}{100} \quad \text{(iib)}$$

$$Vp = 6.11 \times 10^{7.5\frac{T}{237.3}+T} \quad \text{(iic)}$$

$$T_d = T - \left(\frac{100 - RH}{5}\right) \quad \text{(iii)}$$

Where ETI = effective temperature, H_{rh} = relative humidity, RSI = Relative strain Index,

Vp= Vapour Pressure (hPa), T_d = dewpoint temperature, T = air temperature

RH = relative humidity, e= actual vapour pressure

The mean and variations of the elements and indices were computed for 1961-1990, 1991-2013 and 1961-2013, and descriptive maps were produced with the moving average interpolation statistics in geographic information systems, for the periods. For the generation of comfort map for the study area, comfortable region for Td, RSI and ET were 17.5 – 23°C (Lawrence,

2005), 0.1 – 0.2 (Balafoutis and Macrogiannis, 2002) and 18.9 – 25.6 ^{o}C (Nieuwott, 1977; Ayoade, 1978; Kyle, 1994). Areas outside these thresholds were mapped as discomfort zone in the study.

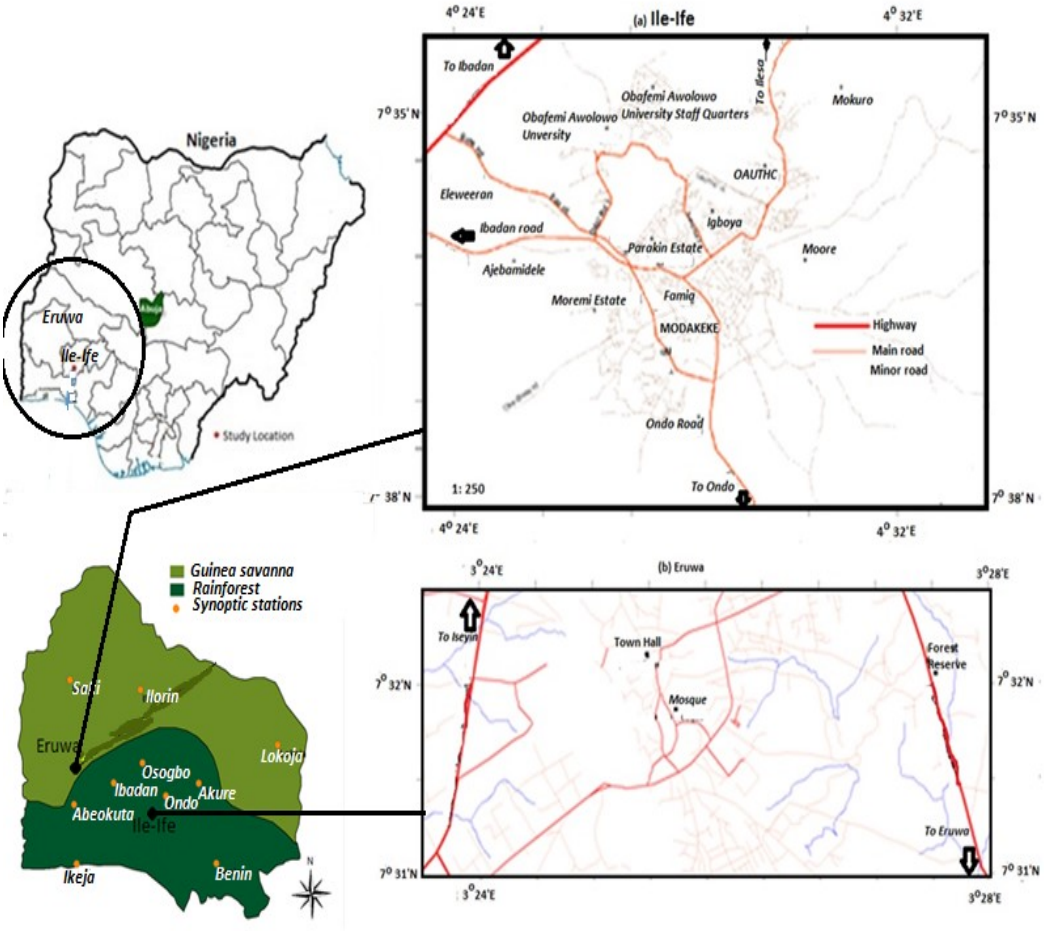


Figure 2: Selected meteorological stations and settlements for the perception study

Perception Study

In addition to the meteorological data, responses of residents of two settlements (Ile-Ife in Osun State, and Eruwa in Oyo State) were purposively to represent a semi-urban and rural settlement, respectively. A structured questionnaire (Appendix 1) was used to elicit information on the perceptions and experience of thermal comfort, and their means of coping with abnormally high heat events. In each settlement, occupants of every third building in a street) were sampled in identified residential, industrial (e.g. sawmills and a metal scrapping and smelting firm in Ile-Ife) and commercial (markets) areas in each settlement.

In all, 501 (321 and 180, in Ile-Ife and Eruwa, respectively) copies of questionnaire, which represents the responses of about 0.5% of the entire population of the two communities were returned after two weeks of administration by ten field personnel. Most of the copies of questionnaire for the residential areas were administered in the evening and weekends, because most respondents were not often in the house in the other periods.

RESULTS

Regional pattern of temperature and thermal variables

5.1.1. Mean variations, trends and change in 1960-1990 and 1991-2013 means

The summary statistics for the 53 (1961 – 2013) year mean monthly temperatures (minimum, average and maximum) and those of ETI, RSI and Td at all the selected stations are presented in Tables 2 and 3, respectively. Minimum temperature over the region varied between 21.1 and 22.9 ^{o}C while maximum temperature varied between 30.9 and 32.2 ^{o}C; mean temperature was from 26.2 to 28.1 ^{o}C. Dewpoint temperature values that varied from 21.3 to 24.4 ^{o}C while RSI values ranged from 0.09 to 0.15 (no unit).

The ETI values were between 24.6 and 26.7 ^{o}C. The temporal variations in the temperature variables were generally below 10%. Furthermore, while Akure (a medium-size administrative city in the region) exhibited decreasing trend in all the temperature variables, other stations exhibited increasing trends in minimum (except Ibadan and Ikeja) and maximum (except Ilorin and Lokoja) over the years. Correspondingly, relative humidity has increased in Akure, and Saki. Comparison of the 1961 – 1990 and 1991 – 2013 values of the temperature variables indicated significant ($p \leq 0.05$) increase (though with small 30-year average in most cases) at most stations (except Ilorin for mean and minimum temperature, Benin for maximum, Lokoja and Osogbo, for the mean temperature). Relative humidity also significantly reduced at most stations, except at Saki, Lokoja and Akure ($p \geq 0.05$).

The patterns of temporal change in RS, Td and ETI were different across the stations. Whereas the Td trend at most of the stations showed significant increase between the 1961 – 1990 and 1991 – 2013 values (except at Akure, Benin and Ilorin, where it significantly decreased, or Ondo and Saki, where changes in Td was not significant), RSI significantly reduced at most of the stations (except Saki, where it has significantly increased and other stations, where such variation was not significant). Significant 1960 – 1990 and 1991 – 2013 change occurred in the values of ETI at all but the Ibadan station, and such trend of change was negative for most stations (except Abeokuta, Ikeja and Saki) (Table 3).

Table 2: Mean, range, variation, trend (change of values over time) and temporal variations in temperature variables over selected station in southwest Nigeria (1961-2013)

	Station	Mean (Min—Max) (°C)	CV (%)	Trend ($a \pm b(x)$)	1961—199((mean) (°C)	1991—201((mean) (°C)	Variation ANOVA	
							P - value	F-value
Minimum temperature	Abeokuta	23.6 (15.7—26.5)	5.8	0.01x+21.3	23.2	23.9	0.002	609.8
	Akure	21.4 (13.2—23.8)	6.7	—0.001x+21.8	21.6	21.4	0.001	39.9
	Benin	22.9 (18.4—26.3)	4.3	0.003x+22.2	23.1	23.5	0.002	252.0
	Ibadan	22.3 (16.4—29.8)	5.2	—0.003x+21.5	22.6	22.8	0.001	14.7
	Ikeja	23.3 (20 —29)	5.7	0.005x+22	23.5	24.1	0.002	399.1
	Ilorin	21.3 (14.5—25)	7.8	0.002x+20.7	21.7	21.7	0.535	0.7
	Lokoja	22.8 (14.1—27.7)	9.0	0.001x+22.4	22.7	23.3	0.002	129.8
	Ondo	22.2 (18.5—25.1)	4.1	0.002x+21.8	22.3	22.5	0.001	57.9
	Osogbo	21.1 (13.5—24.3)	7.5	0.003x+21.1	21.5	21.0	0.001	122.9
	Saki	22.7 (19.5—25.4)	4.8	0.002x+21.7	22.6	22.8	0.003	44.8
	Average	*22.4 (13.5—29.8)*	*6.0*		*22.48*	*22.7*	*0.06*	*167.2*
Maximum temperature	Abeokuta	32.7 (28.0—38.1)	8.0	0.003x+31.7	32.7	32.9	0.002	9.44
	Akure	31.0 (26.5—36.5)	8.0	—0.01x+32.9	31.4	30.9	0.002	92.68
	Benin	31.4 (27.0—37.0)	6.0	0.002x+31	31.7	31.7	0.749	0.102
	Ibadan	31.3 (23.7—38.0)	8.0	0.002x+30.8	31.6	31.9	0.003	18.17
	Ikeja	30.9 (26.9—35.3)	6.0	0.002x+30.5	31.0	31.4	0.000	66.33
	Ilorin	32.2 (27.5—37.9)	8.0	—0.001x+32.6	32.2	32.0	0.031	4.666
	Lokoja	33.1 (28.0—39.1)	7.0	—0.001x+33.1	33.7	33.1	0.002	110.9
	Ondo	30.9 (26.1—34.2)	8.0	0.03x+30.0	30.9	31.4	0.003	57.87
	Osogbo	31.2 (25.0—37.2)	8.0	0.001x+30.9	31.3	31.5	0.001	11.26
	Saki	31.6 (25.0—37.2)	7.0	0.002x+30.8	31.5	31.7	0.013	6.165
	Average	*31.6 (25—38.1)*	*7.0*		*31.8*	*31.9*	*0.08*	*37.8*
Mean temperature	Abeokuta	28.1 (23.9—32.2)	5.9	0.004x+26.5	27.9	28.4	0.002	138.9
	Akure	26.2 (22.4—30.1)	5.3	—0.03x+27.3	26.5	26.1	0.001	128.6
	Benin	27.2 (24.3—31.3)	4.9	0.002x+26.5	27.4	27.6	0.003	28.6
	Ibadan	26.8 (23.4—31.4)	5.9	0.03x+26.1	27.1	27.3	0.003	21.46
	Ikeja	27.2 (21.6—31.3)	5.4	0.003x+26.2	27.2	27.7	0.000	205.2
	Ilorin	26.8 (22.3—30.7)	6.1	0.001x+26.2	26.9	26.8	0.041	4.185
	Lokoja	28.0 (23.9—32.9)	6.2	0.001x+26.2	28.2	28.2	0.571	0.32
	Ondo	26.5 (23.5—38.9)	5.2	0.002x+25.9	26.6	26.9	0.002	100.9
	Osogbo	26.2 (23.1—30.2)	5.5	0.001x+26.0	26.4	26.3	0.119	2.44
	Saki	27.1 (24.8—30.4)	5.2	0.002x+26.2	27.0	27.2	0.001	20.42
	Average	*27 (22.3—38.9)*	*5.5*		*27.1*	*27.3*	*0.07*	*65.1*

Table 3: Mean, range, variation, trend (change of values over time) and temporal variations in effective temperature, relative strain index and dewpoint temperature over selected station in southwest Nigeria (1961-2013)

	Station	Mean (Min—Max) (°C)	CV (%)	Trend (a±$b(x)$)	1961—1990 (mean) (°C)	1991—2013 (mean) (°C)	Variation ANOVA P - valu	F-valu
Effective temperature Index	Abeokuta	26.7 (20.1—29.9)	5.4	0.01x+25.4	26.6	26.9	0.002	94.2
	Akure	24.6 (17.6—28.0)	1.0	—0.01x+26.5	25.1	24.2	0.004	209.9
	Benin	26.0 (19.2—30.4)	0.8	—0.003x+25.3	26.2	26.5	0.001	33.8
	Ibadan	25.5 (22.0—29.8)	5.0	0.002x+24.9	25.8	25.8	0.252	1.32
	Ikeja	25.9 (21.2—29.5)	4.8	0.001x+25.2	25.8	26.4	0.003	392.5
	Ilorin	24.9 (16.1—28.8)	6.9	—0.001x+25.1	25.0	24.7	0.005	39.49
	Lokoja	25.6 (18.6—29.6)	12.0	—0.001x+26.0	26.1	25.3	0.004	99.79
	Ondo	25.3 (19.4—36.2)	4.4	—0.002x+24.9	25.5	25.7	0.002	54.50
	Osogbo	25.0 (21.1—28.5)	4.5	—0.001x+24.8	25.2	25.0	0.001	42.23
	Saki	25.3 (21.8—27.6)	4.1	0.002x+24.5	25.3	25.4	0.001	13.52
	Average	25.5 (16.1—36.2)	6.6		25.7	25.6	0.03	98.1
Relative Strain Index (no unit)	Abeokuta	0.12 (0.05—0.19)	23	1.0—0.03x	0.12	0.13	0.002	120.1
	Akure	0.09 (— 0.4—0.17)	53	0.1—0.01x	0.09	0.09	0.004	65.3
	Benin	0.15 (— 0.41—0.18)	37	0.09 +0.1x	0.11	0.11	0.2	25.1
	Ibadan	0.1 (0.04—0.18)	27	0.1+0.1x	0.11	0.11	0.3	21.5
	Ikeja	0.11 (0.01—0.18)	24	0.1—0.02x	0.11	0.12	0.001	205.2
	Ilorin	0.1 (—0.39—0.17)	25	0.1+0.08x	0.10	0.10	0.2	17.4
	Lokoja	0.09 (—0.39—0.20)	28	0.1 —0.03x	0.12	0.11	0.001	71.8
	Ondo	0.11 (0.04—0.31)	28	0.08+0.25x	0.10	0.10	0.4	89.7
	Osogbo	0.1 (0.04—0.16)	36	0.1+0.38x	0.09	0.09	0.119	2.43
	Saki	0.11 (0.07—0.16)	60	0.1+0.04x	0.10	0.11	0.01	20.5
	Average	0.1 (—0.39—0.31)	34		0.11	0.11	0.02	63.9
Dewpoint temperature (oC)	Abeokuta	24.4 (6.9—27.8)	8.0	0.003x+23.2	24.3	24.5	0.003	27.3
	Akure	21.3 (6.2—25.4)	19	—0.01x+25.	22.4	20.7	0.001	296.5
	Benin	23.8 (2.2—29.3)	10	—0.002x+23.2	23.9	24.3	0.002	35.9
	Ibadan	22.9 (15.7—27.6)	6.5	0.002x+22.5	23.2	23.1	0.006	22.9
	Ikeja	23.5 (14.6—27.4)	6.1	0.001x+23.1	23.1	23.9	0.004	559.9
	Ilorin	21.5 (3.2—26.6)	13	—0.002x+22.1	21.5	21.0	0.002	45.8
	Lokoja	22.0 (7.4—27.6)	19	0.003x+22.9	22.6	21.3	0.003	123.8
	Ondo	23.0 (5.7—34.3)	6.5	0.001x+22.7	23.2	23.2	0.965	0.326
	Osogbo	22.6 (14.7—26.6)	6.3	0.001x+22.4	22.9	22.5	0.001	135.7
	Saki	22.0 (11.5—25.6)	12	0.002x+21.1	22.0	22.1	0.721	0.396
	Average	22.7 (2.2—34.3)	11		22.6	22.5	0.189	135.7

Descriptive thermal maps for the region

The results of the moving average interpolation of the thermal climate variables investigated in this study are presented as Figures 3-6. Minimum temperature appears to decrease as one move away from the coastal areas, whereas maximum temperature was slightly higher around Lokoja than the other parts of the region. Except for the area around Abeokuta, where both minimum and maximum temperatures were higher than most part of the surroundings, maximum temperature tend to vary inversely with minimum temperature over the region (Figure 3). Both Td and ETI were also higher around Abeokuta – Ikeja axis and Benin in the south than the settlements in the other part of the southwestern Nigeria while the RSI interpolation showed lower values in the inner settlements (Osogbo – Ondo - Akure – Ilorin axis) of the region than the other parts (Figure 3d-f). Furthermore, whereas the values of minimum and mean temperature around the Ikeja and Lokoja axes have generally increased by 1°C, in 1991-2013 period, when compared to the 1961-1990 means, there was a decrease in the maximum temperature, also, by about 1°C around Lokoja in 1991-2013 period (Figure 4). In addition, Td and ETI interpolations over the study area exhibited an increase of at about 1°C, over the coastal region of the Atlantic Ocean, and a converse decrease by 1°N in the northern sub-region. The RSI unit was also lower around the northern part in the 1991-2013 period (Figure 5).

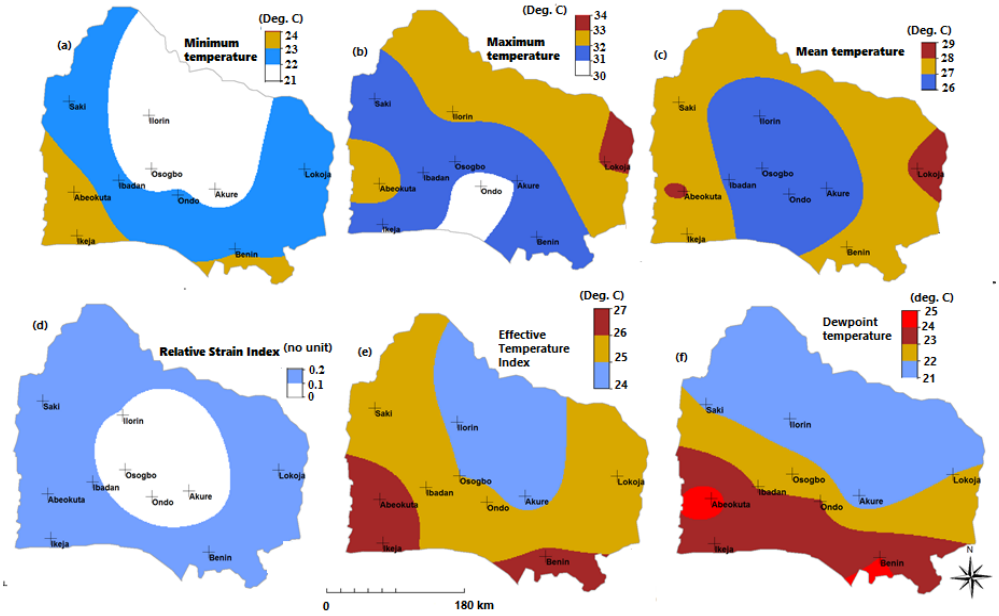


Figure 3a- f: 53 (1961 – 2013) years average temperature (minimum, maximum and mean), relative strain index, effective temperature and dewpoint temperature over the southwest Nigeria. *The cross indicates the location of the meteorological station whose data were interpolated*

Source: Author's analysis

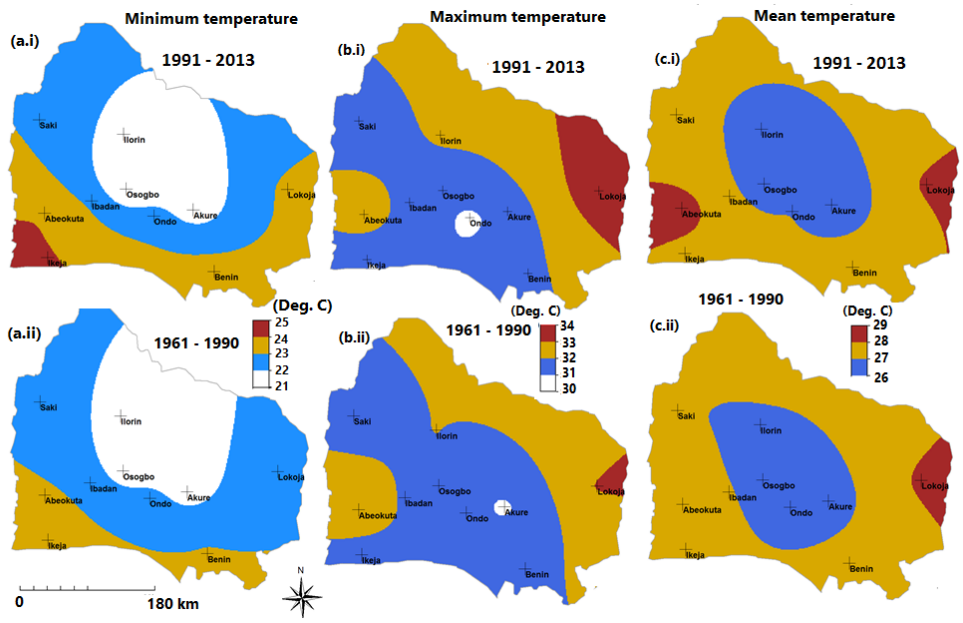


Figure 4a-c: Variation in the minimum, mean and maximum temperature over the southwest Nigeria in 1961-1990 and 1991 – 2013 years periods. *The cross indicates the location of the meteorological station whose data were interpolated*

Source: Author's analysis

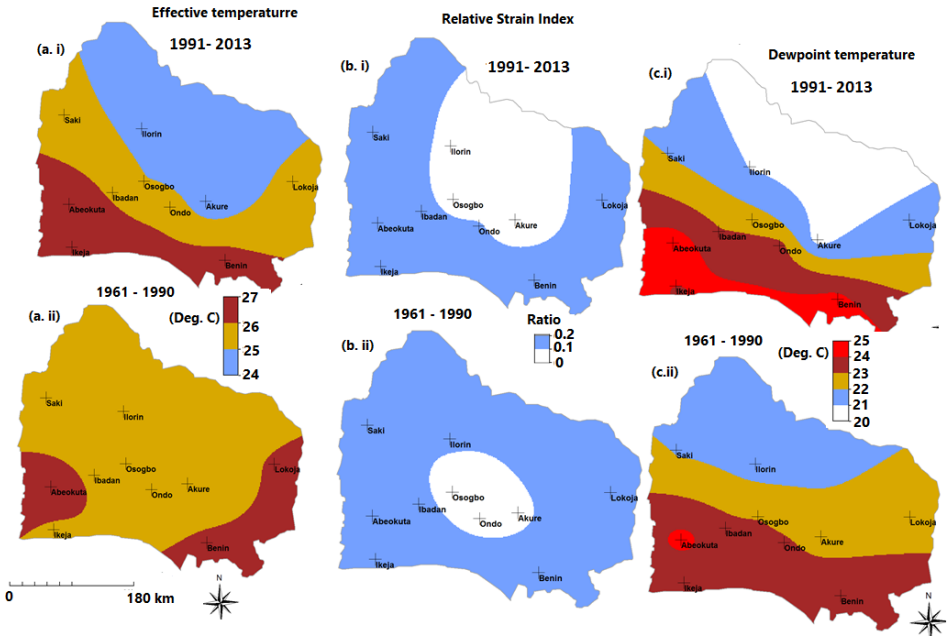


Figure 5a-c: Variation in the effective temperature index, relative strain index and dewpoint temperature over southwest Nigeria in 1961-1990 and 1991 – 2013 years periods. *The cross indicates the location of the meteorological station whose data were interpolated*

Source: Author's analysis

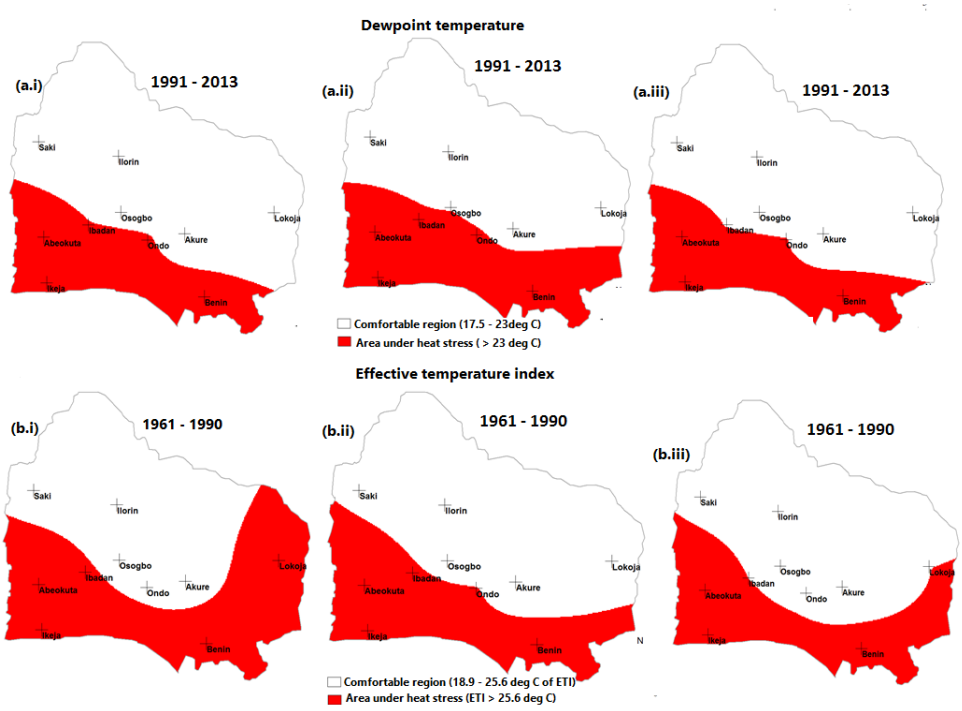


Figure 6a-c: Computed variations in dewpoint temperature and effective temperature index for 1961-1990, 1991 – 2013 and 1961 – 2013 means. The relative strain index is not presented because the entire region was homogenously classified as comfortable in the study period.

Source: Author's analysis

Assessment of the Td, RSI and ETI over the study area with the recommended thresholds of 17.5 – 23°C, 0.1 – 0.2 and 18.9 – 25.6 ^{o}C, respectively, showed that areas further into the interior of the region are more thermally comfortable than the coastal region, especially with respect to Td and ETI but RSI results describes the entire region as thermally comfortable, however (Figure 6a.iii and b.iii). When compared across the 1961-1990 and 1991-2013 periods, the results of the interpolation indicate that whereas thermal discomfort has aggravated in more areas in the western sub-region of the study area, the thermal condition in eastern region has improved in the 1991- 2013, than the preceding 30-year period (Figure 6ai-bii).

Perception of residents of selected settlements on comfortable weather condition

5.2.1. Characteristics of respondents

Over 94% of the respondents in both settlements have had at least primary education and were able to understand the content of the questionnaire and its purpose. The entire sampled population at Eruwa were aged above 30 years and majority of the respondents from Ile Ife were at least 18 years. About 81% of the respondents were employed and made at least ₦20, 000 ($100) monthly while more than 70% have dependants, and worked for a minimum of 5 hours daily. In addition, majority of the respondents work

indoor (55.3% and 76.1% respectively in Ile Ife and Eruwa) and under shade, if outdoor (35.4 and 18.9%, respectively) (Table 1).

Table 1: Demographic and socio-economic characteristics of the respondents

Variable	Option	Percentage (frequency)	
		Ile-Ife	Eruwa
Age (years)	< 18	1.9 (6)	—
	18—30	33.7 (106)	—
	31—60	51.1 (161)	76.1 (137)
	> 60	13.3 (42)	23.9 (43)
Gender	Male	49.8 (160)	48.9 (88)
	Female	50.2 (161)	51.1 (92)
Height (meter)	< 1.2	2.0 (6)	—
	1.2 — 1.79	46.4 (140)	15.9 (28)
	>1.8	51.7 (156)	84.1 (148)
Body type	Slim	13.1 (42)	8.9 (16)
	Moderate	60.4 (194)	52.2 (94)
	Fat	26.5 (85)	38.9 (70)
Marital status	Single	38.2 (120)	—
	Married	61.8 (194)	100 (180)
Minimum educational qualification	No formal education	1.9 (6)	—
	Primary	1.2 (4)	4.4 (8)
	Secondary/ technical	42.7 (137)	31.7 (57)
	Tertiary	54.2 (174)	63.9 (115)
Job category	Student	18.7 (60)	—
	Self Employed	28.7 (92)	21.1 (38)
	Government Employee	35.5 (114)	34.4 (62)
	Private Employee	17.1 (55)	44.4 (80)
No of dependant(s)	None	27.9 (88)	—
	< 5	62.9 (198)	97.2 (175)
	> 5	9.2 (29)	2.8 (5)
Monthly income (in Naira (₦))	< 20,000	21.6 (69)	—
	20,000 — 50,000	51.1 (164)	40.6 (73)
	> 50,000	27.4 (88)	59.4 (107)
Approximate No of work hour (Hours)	< 5	8.7 (28)	2.2 (94)
	5 — 8	65.4 (210)	92.8 (167)
	> 8	25.9 (83)	5.0 (9)
Category of occupants	Outdoor under shade	35.4 (107)	18.9 (34)
	Outdoor without shade	9.3 (28)	5.0 (9)
	Indoor	55.3 (167)	76.1 (137)

Coping strategies to extreme weather conditions

Concerns were raised over heat stress in the study area. Heat stress period were generally regarded as oppressive or sultry (similar to Lee, 1953's description) At least 80% of the respondents at both the settlements of Eruwa and Ile-Ife considered the time between 0800 and 1200 Nigerian Local Standard Time (LST) as comfortable, and the periods between 1200 and 1800 LST as thermally uncomfortable. The period between 1800 and 2100 LST was also considered as comfortable by about 70% of the respondents. There was no significant ($p \leq 0.05$) difference in the perceptions of the different categories of residents (those outdoor, undershade, outdoor without shade, and indoor) at the periods.

Coping strategies, however, varied among the different the majority of people in the two locations (Ile-Ife and Eruwa). Whilst the first three coping preferences at Ile-Ife were cloth/wear type, (ii) installation of fan and (iii) installation of air conditioners at home and offices, the most important preferences at Eruwa (in order of importance) were (ii) opening of ventilation for cross ventilation, (i) changing changing of cloth or wear type, and (iii) sleeping outside the house (outdoor) at certain times of the night or day (Figure 7).

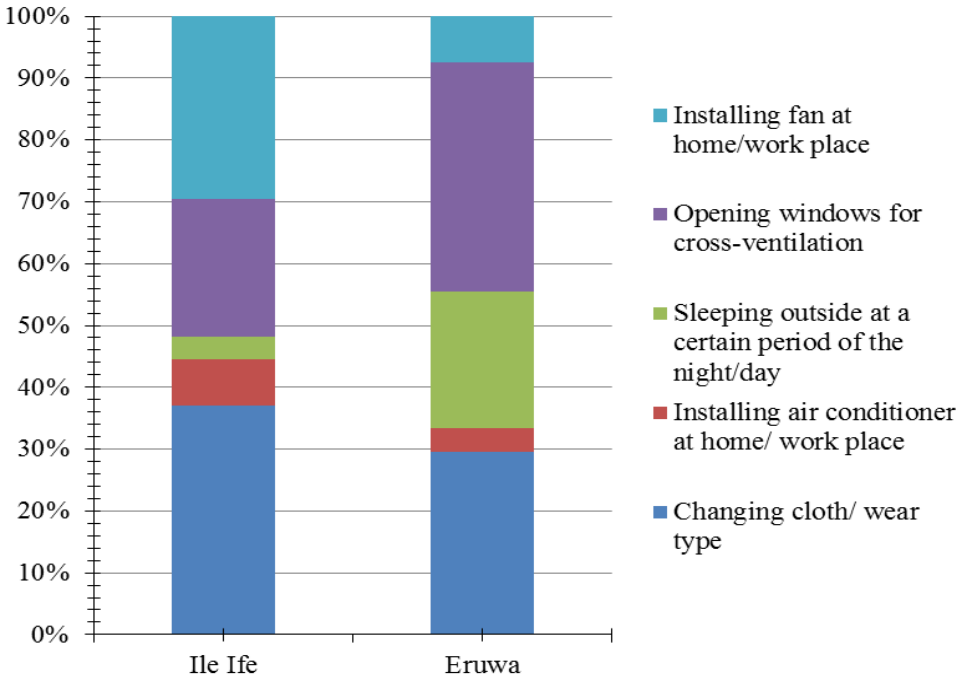


Figure 7: Distribution of prominent coping strategies to thermal stress in the selected settlements in Southwest Nigeria

DISCUSSION

This study investigated the variations in temperature and dewpoint temperature and selected traditional thermal comfort indices, as well as the responses of residents in two communities in the southwest Nigeria. The study showed that temperature and the indices showed that temperature

and relative humidity have varied differently (while it decreased in Akure, it has increased in other stations) over the region. The spatial differences in the pattern of changes in the climatic element across the region can be associated with different rate of urbanization across the region. Studies (including Oketola and Osibanjo, 2007; Ajayi, 2007) have reported rapid and haphazard industrialization in parts of the region. The effect of industrialization on the climate of the region may however have been suppressed by the fact that the synoptic stations in Nigeria are generally sited at the outskirt of urban areas, where vegetation may influence the absolute readings. Also, although the results might not have represented a daily occurrence, as monthly data were used, they present a generalized perspective of the changes in spatial distribution of temperatures, Td, ETI, RSI and THI in the area. Further studies using daily data will be required to determine daily pattern of variables across the area. Also, the study noted that that average temperature has increased by at least 1°C, between 1960 – 1990 and 1991 – 2013. Although this does not infer a magnitude increase, but can be important if considered with the observation of Sawa and Buhari (2011) that revealed that such a small increase in temperature correlated with 8 cases of meningitis in Zaria, northern Nigeria.

Furthermore, the results of Td revealed increase in absolute temperature over the region, especially in the coastal region. High absolute humidity has been linked with discomfort and sicknesses, including nausea, headache, among others (Lee, 1953; Kalkstein and Smoyer, 1993). The results of this study suggest that residents of the coastal communities in the present area may be vulnerable to the sicknesses that are associated with such level of humidity. In general, the Td showed a reasonable level of increase in absolute humidity in the coastal regions between in 1991 – 2013 when compared with that of 1961- 1990 periods. The difference in the report of discomfort by Td, THI, RSI and ETI in this study is expected, as previous studies, including Eludoyin et al (2014) have argued that THI, RSI and ETI are characterized by different assumptions. Further study on this region will explore recently developed comfort indices, and attempt to produce a model for the region. In general, studies on climate of the region, like other regions will benefit from the ability of the NIMET and other relevant data archiving government agencies in Nigeria to enhance data availability to researchers and students at minimal or no cost. Studies (including Hettige et al., 1994; Eludoyin, 2015) have also indicated that many developing countries lack the necessary information to set priorities, strategies, and action plans on environmental protection issues; a situation that can be ameliorated if data are available at low cost or freely for researchers.

In addition, this study has shown that capacity to cope with extreme heat conditions is rudimentary, and that there is no preparation for associated life-threatening effects by either the people or the government. In terms of an attendant risk, previous studies have raised questions on poor recovery systems that characterized major disasters in Nigeria (e.g. Omodanisi et al, 2014a and 2014b).

CONCLUSION

The study showed an increase in temperature and selected indices of thermal comfort at most studied stations in 1991-2013 over 1960-1990. It also showed that residents' coping strategies were mainly of rudimentary; one that involves personal adjustment, with few cases of environmental adjustments in urban settlements, which can be associated with different socio-economic status of the residents. Subsequently, there is need for awareness on climate extreme, and preparedness in the region.

REFERENCES

Abuloye A. P. (2015) Assessment of variations in thermal climate and response to thermal stress in some parts of the southwest Nigeria, Unpublished M.Sc. thesis, Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria, 105pp

Adebayo, Y. R. (1987) A note on the effect of urbanization on temperature in Ibadan. *Journal of Climatology.* 7: 185–192.

Adebayo, Y. R. (1991) Heat island in a humid tropical city and its relationship with potential evaporation, *Theoretical and applied Climatology* 43(3) 12-26

Adelekan I.O. (2005) Urban climate research in Nigeria. Country Report, *Newslett. Int. Assoc. Urban Clim.* **13**: 8–10.

Aina, S.A. (1989) *Aspects of the Urban Climate of Oshogbo*, Unpublished M.Sc Dissertation, University of Ibadan, Nigeria

Ajayi, D. D. (2007) Recent trends and patterns in Nigeria's industrial development. *Africa Development*, 32(2)

Akinbode, O. M., Eludoyin A. O., and Fasae O.A. (2008) Temperature and relative humidity distributions in a medium-size administrative town in Southwest Nigeria, *Journal of Environmental Management* 87:95-105.

Alcamo J., Moreno J. M., Nov´aky B., Bindi M., Corobov R., Devoy R. J. N., Giannakopoulos C., Martin E., Olesen J. E., and Shvidenko A., (2007) Europe, climate change 2007: impacts, adaptation and vulnerability. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

Algeciras, J. A. R., Consuegra, L. G., and Matzarakis, A. (2016) Spatial-temporal study on the effects of urban street configurations on human thermal comfort in the world heritage city of Camagüey-Cuba. *Building and Environment*, *101*, 85-101

Ayanlade, A. (2016) Seasonality in the daytime and night-time intensity of land surface temperature in a tropical city area. *Science of the Total Environment*, *557*, 415-424.

Ayanlade, A., and Jegede, O. O. (2015) Evaluation of the intensity of the daytime surface urban heat island: how can remote sensing help? *International Journal of Image and Data Fusion*, *6*(4), 348-365.

Ayoade, J. O. (1978) Spatial and seasonal patterns of physiologic comfort in Nigeria, *Archives for Meteorology*, *Geophysics and Bioclimatology*, 26: 319 – 337

Baklanov, A., Molina, L. T., and Gauss, M. (2016) Megacities, air quality and climate, *Atmospheric Environment*, *126*, 235-249

Balafoutis, C. J. and Makrogiannis, T. J. (2003) Hourly discomfort conditions in the city of Thessaloniki (North Greece) estimated by the relative strain index (RSI). In *Proceedings of the Fifth International Conference on Urban Climate, Todz Poland* (pp. 1-5)

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., ... and Yanda, P. Z. (2007) Africa. Cambridge University Press

Candido, C., de Dear R. J., Lamberts R., Bitterncourt L. 2010. Air movement acceptability limits and thermal comfort in Brazil's hot humid climate zone. *Build. Environ*. 45: 222–229.

Chappells, H., and Shove, E. (2004) Comfort: A review of philosophies and paradigms. *University of Lancaster*

Comrie, A. (2007) Climate change and human health. *Geography Compass*, *1*(3), 325-339

David-West, T. S., and Cooke, A. R. (1974) Laboratory and clinical investigation of the 1974 influenza epidemic in Nigeria. *Bulletin of the World Health Organization*, *51*(1), 103.

De Freitas, C. (2003). Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector. *International Journal of Biometeorology* 48: 45–54.

De Freitas, C. R., and Grigorieva, E. A. (2015) A comprehensive catalogue and classification of human thermal climate indices, *International Journal of Biometeorology*, *59*(1), 109-120

Efe, S.I. (2004) *Urban Effects on Precipitation Amount and Rainwater Quality in Warri Metropolis*, Unpublished PhD thesis, Delta University, Abraka, Nigeria

Eludoyin, O. M. (2015) Assessment of daytime physiologic comfort, its perception and coping strategies among people in tertiary institutions in Nigeria, *Weather and Climate Extremes*, *10*, 70-84.

Eludoyin, O. M. and Adelekan I. O. (2013) The physiological climate of Nigeria. *International Journal of Biometeorology* 57: 241–264

Eludoyin, O. M., Adelekan, I. O., Webster, R. and Eludoyin, A. O. (2014) Air temperature, relative humidity, climate regionalization and thermal comfort of Nigeria. *International Journal of Climatology*, *34*(6), 2000-2018.

Fanger, P. O. (1972) Thermal Comfort: Analysis and Applications in Environmental Engineering. *McGraw-Hill Book Company*: New York.

Giles, B. D., Balafoutis, C., and Maheras, P (1990) Too hot for comfort: the heatwaves in Greece in 1987 and 1988. *International Journal of Biometeorology*, *34*(2), 98-104.

Githeko, A. K., and Woodward, A. (2003) International consensus on the science of climate and health: the IPCC Third Assessment Report. *Climate change and human health: risks and responses*, 43-60.

Greenwood, B. (2006) Editorial: 100 years of epidemic meningitis in West Africa–has anything changed? *Trop. Med. Int. Health* 11:773–780

Gregorczuk, M., and Cena, K. (1967) Distribution of effective temperature over the surface of the earth, *International Journal of Biometeorology*, *11*(2), 145-149

Havenith, G., Holmer, I., and Parsons, K. C. (2002), Personal factors in thermal comfort assessment; clothing properties and metabolic heat production, *Energy building* 34(6):581-591

Hettige, H., Martin, P., Singh, M. and Wheeler, D. (1994) IPPS–The Industrial Pollution Projection System, World Bank, *Policy Research Working Paper*, 1431

Igbawua, T., Zhang, J., Chang, Q., and Yao, F. (2016) Vegetation dynamics in relation with climate over Nigeria from 1982 to 2011, *Environmental Earth Sciences*, *75*(6), 1-16

Ileoje, N. P. (2001) *A New Geography of Nigeria, New Revised Edition*. Longman Publishers: Ibadan, Nigeria

Ilesanmi, A. O. (2016). Doctoral research on architecture in Nigeria: Exploring domains, extending boundaries. *Frontiers of Architectural Research*, *5*(1), 134-142.

Kalkstein, L. S. and Smoyer, K. E. (1993) The impact of climate change on human health: some international implications. *Experientia*, 49(11), 969-979

Kalkstein L, and Valimont K. (1986) An evaluation of summer discomfort in the United States using a relative climatological index. *Bull. Am.Meteorol. Soc.* **67**: 842–848.

Kyle, W. J (1994) The human bioclimate of Hong Kong. In Brazdil R, Kolar M (eds.) Contemporary Climatology, Proc. of COC/IGU Meeting, 15–20 August 1994, Brno, Czech Republic, Masaryk University, Brno, Czech Republic, pp 345–350

Lawrence, M. G. (2005). The relationship between relative humidity and the dewpoint temperature in moist air: A simple conversion and applications. *Bulletin of the American Meteorological Society,* 86 (2)*,* 225-233.

Lawson, E. T. (2016). Negotiating stakeholder participation in the Ghana national climate change policy, *International Journal of Climate Change Strategies and Management*, *8*(3)

Lee, D. H. (1953) Physiological climatology as a field of study, *Annals of the Association of American Geographers*, *43*(2), 127-137

Lin T, Ho T, Wang Y (2011) Mortality risk associated with temperature and prolonged temperature extremes in elderly populations in Taiwan. *Environ Res* 111:1156–1163

Metcalf, S. S., Svendsen, E. S., Knigge, L., Wang, H., Palmer, H. D., and Northridge, M. E. (2016) Urban Greening as a Social Movement, In *Urban Sustainability: Policy and Praxis* (pp. 233-248). Springer International Publishing

Mirrahimi, S., Mohamed, M. F., Haw, L. C., Ibrahim, N. L. N., Yusoff, W. F. M. and Aflaki, A. (2016). The effect of building envelope on the thermal comfort and energy saving for high-rise buildings in hot–humid climate, *Renewable and Sustainable Energy Reviews*, *53*, 1508-1519.

Mohammed I, Nasidi A, Alkali A.S, Garbati M.A, Ajayi-Obe E.K, Audu K.A, Usman A and Abdullahi S. (2000) A severe epidemic of meningococcal meningitis in Nigeria. *Trans. Roy. Soc. Trop. Med.Hyg.* 94: 265–270

National Population commission (NPC) (2006), National population census, Abuja, Nigeria

Nieuwolt S (1977) Tropical climatology: an introduction to the climates of the low latitudes. Wiley

Oketola, A. A., and Osibanjo, O. (2009) Estimating sectoral pollution load in Lagos by Industrial Pollution Projection System (IPPS): Employment versus output. *Toxicological and Environ Chemistry*, *91*(5), 799-818.

Olaniran, O. J. (1982) The physiological climate of Ilorin, Nigeria, Archives for Meteorology, *Geophysics and Bioclimatology* 31 (3): 287 – 299

Omodanisi, E. O., Eludoyin, A. O., and Salami, A. T. (2014a) A multi-perspective view of the effects of a pipeline explosion in Nigeria. *International Journal of Disaster Risk Reduction*, *7*, 68-77.

Omodanisi, E. O., Eludoyin, A. O., and Salami, A. T. (2015b) Ecological effects and perceptions of victims of pipeline explosion in a developing country, *International Journal of Environment Science and Technology*, *12*(5), 1635-1646.

Omonijo, A. G., Oguntoke, O., Matzarakis, A., and Adeofun, C. O. (2011) A study of weather related respiratory diseases in Eco-climatic zones. *The African Review of Physics*, 5. 0003

Omogbai, B. E. (1985) *Aspects of Urban Climate of Benin City*, Unpublished M.Sc. Dissertation, University of Ibadan, Nigeria

Omogbai, B. E. (2010) Rain days and their predictability in southwestern region of Nigeria *Journal of Human Ecology,* 31(3): 185-195

Oniarah A. (1990) *Aspects of the Urban Climate of Kano*, Unpublished M.Sc Dissertation, University of Ibadan, Nigeria

Pezzoli, A., Santos Dávila, J. L., and d'Elia, E. (2016) Climate and Human Health: Relations, Projections, and Future Implementations. *Climate*, *4*(2), 18

Sawa, B. A. and Buhari, B. (2011) Temperature variability and outbreak of meningitis and measles in Zaria, northern Nigeria, *Research Journal of Applied Sciences, Engineering and Technology*, *3*(5), 399-402.

Terjung, W. (1967) The geographical application of some selected physio-climatic indices to Africa, *International Journal of Biometeorology* 11(1): 5-19

United Nations International Strategy for Disaster Reduction Regional Office for Africa, UNISDR (2012) *Disaster Reduction in Africa*, Special Issue on drought.

Wolkoff, P., and Kjærgaard, S. K. (2007) The dichotomy of relative humidity on indoor air quality. *Environment International*, *33*(6), 850-857.

World Health Organisation, WHO (2011) Regional consultation on health of the urban, *Proceedings of the 2010 Regional consultation of Mumbai*, *India*, *Regional Office for South East Asia*, UNFPA, p.82

World Meteorological Organisation, WMO (1989) Calculation of monthly and annual 30-year standard normal, World Climate Programme, Data, WMO-TD/N0 341, WMO, Washington DC.

Yang, Y. E., Wi, S., Ray, P. A., Brown, C. M., and Khalil, A. F. (2016). The future nexus of the Brahmaputra River Basin: Climate, water, energy and food trajectories. *Global Environmental Change*, *37*, 16-30.

APPENDIX 1

1. Address (zone): Commercial ( ) Residential ( ) Industrial ( )

2. Age group? (a) <18 ( ) (b)18 – 30( ) (c)31 – 60( ) (d)>60 years( )
3. Gender: (a) Male ( ) (b) Female ( )

4. Height: (a)<4 ft (1.2m) (b)4 – 5.9ft (1.2 – 1.79m) (c)≥ 6 ft (1.8m)

5. Description of body building (a) Very slim ( ) (b) Slim ( ) (d) Moderate ( ) (c) fat ( )

(d)Very fat ( )

6. Marital Status: (a) Single ( ) (b) Married ( )

7. Highest Education Achievement: (a) No Formal Education ( ) (b) Primary Education ( ) (c) Secondary/Technical Education ( ) (d) Tertiary Education ( )

8. Job category: (a) Student (b) Self Employed (c) Government Employee (d) Private Employee

(e) Others (specify) _____

9. Total numbers of dependants? (a) None( ) (b) Less than 5( ) (c) above 5
10. What is your approximate income in a month?
(a) Less than N20,000( )
(b) Between N20,000 and N50,000( )
(c) Above N50,000
11. How many hours (or approximate numbers of hours) do you work in a day?
(a) <5 hours (b) 5-8 hours (c) >8 hours/day

12. Please classify your work place in the category below; (a) Outdoor under shade( ) (b) Outdoor without shade (c) Indoor
Classify your work hours in the category below;

S/N	Time of the day	Very Comfortable	Comfortable	Uncomfortable	Very Uncomfortable
13.	8am - 12noon				
14.	12noon - 3pm				
15.	3pm - 6pm				
16.	6pm - 9pm				
17.	Later than 9pm				

How will you describe your house (or room) in terms of comfort from heat or cold at the following period?

S/N	Time of the day	Very Comfortable	Comfortable	Uncomfortable	Very Uncomfortable
18.	4pm - 6pm				
19.	6pm - 9pm				
20.	9pm - 12am				
21.	Later than 12am				

How will you describe the seasonal situation of comfort at home?

S/N	Season	Very Comfortable	Comfortable	Uncomfortable	Very Uncomfortable
22.	Dry Season (Feb-Apr)				
23.	Wet Season (Jun-Nov)				
24.	Harmattan (Dec-Jan)				

How will you describe the seasonal situation of comfort at your work place?

S/N	Season	Very Comfortable	Comfortable	Uncomfortable	Very Uncomfortable
25.	Dry Season (Feb-Apr)				
26.	Wet Season (Jun-Nov)				
27.	Harmattan (Dec-Jan)				

Rank the following methods in order of relevance for coping with an uncomfortable weather based on your practice

S/n		Very Important	Important	Unimportant	Very Unimportant
28.	Changing cloth/wear type				
29.	Installing air conditioner at home				

30.	Installing air conditional at place of work				
31.	Sleeping outside at certain period of the day/night				
32.	Opening windows while asleep for cross-ventilation.				
33.	Installing fans at home o place of work				

34. Have you ever been admitted for heat or cold related illness (including pneumonia, heat rash, and heat stroke) before? (a) Yes ( ) (b) No ( )
35. If yes, what seasons of the year were you admitted? (a) wet season ( ) (b) dry season ( ) (c) Harmattan season ( )
36. How will you describe the treatment at hospital? (a) very effective and punctual ( ) (b) Slow and ineffective ( ) (c) slow and effective ( )

UNETHICAL PROFESSIONAL PRACTICES IN TENDERING OF PUBLIC BUILDING PROCUREMENT IN BAUCHI METROPOLIS, NIGERIA

Ibrahim I. Inuwa[1], Shamsuddeen M. Maleka[2] and Sani U. Kunya[3]

[1]*Department of Quantity Surveying, Abubakar Tafawa Balewa University, Bauchi, Nigeria*

[2]*Physical Planning Unit, Federal Polytechnic, Bauchi, Nigeria*

[3]*Department of Building Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria*

Globally, Public construction procurement is acknowledged as instrument for promoting economic, social and environmental wellbeing of a nation, and as a strategic means for curtailing unethical practices in the use of public funds. Nonetheless, abuse of tendering procedure in public building procurement are evident in Nigeria. Hence, this study investigated unethical professional practices in tendering of public building procurement in Bauchi metropolis, Nigeria, with a view to improving on professional ethics that will ensure value for money (VfM) procurement. Stratified random sampling technique was used to administer 122 questionnaires to construction professionals in Bauchi metropolis, and records 85.73% (105) valid response rate. Data were analysed using descriptive and inferential statistics. Results show no statistical difference in respondents mean scores on what constitute, influences perpetuation and measures for curbing unethical professional practices respectively. Connivance, deceitful advertisement, deliberate disparity of documents to tenderers, divulging confidential tender information, favouritism, and non-adherence to prequalification criteria were ranked as severe causes of unethical professional practices. Discontinuity in government projects, glorifying corrupt leaders, greed, immorality in society, poor understanding of ethical standards, poor workers remuneration, job insecurity, and weak judicial systems were ranked severe factors that influences perpetuation of unethical professional practices. While credible leadership, enforcement of strict punitive measures by professional bodies, ensuring parity in tendering, introducing ethics as a course in academic institutions, organizing seminars on ethics, strict adherence to professional ethics and procurement requirements, sufficient time for preparation of tenders, and understanding ethical and professional values among professionals were ranked effective and highly effective measures for curbing unethical professional practices. The implication is that contractors, consultants, and clients are all culprit in exhibiting unethical professional practices, and this need to be addressed collectively. This study recommends: stakeholders in tendering adhere to ethical requirements, public procurement Act be reviewed, improvement on public workers remuneration, appointment of

[1] iiinuwa@atbu.edu.ng

[2] smmmaleka@gmail.com

[3] snkunya@gmail.com

Inuwa, I. I., Maleka, S. M. and Kunya, S. U. (2017) Unethical professional practices in tendering of public building procurement in Bauchi Metropolis, Nigeria *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1397-1416

credible leaders in public procurement agencies, and synergy between key public construction stakeholders for effective implementation of measures for curbing unethical professional practices.

Keywords: Nigeria, professionals, public building procurement, tendering, unethical practices

INTRODUCTION

Globally, public construction procurement is a relevant instrument of government policy and a lever for wider economic, social and environmental change, as well as a strategic profession that plays a central role in preventing mismanagement and minimizing the potential of corruption in the use of public funds (Kangogo & Kiptoo 2013). Yet, public procurement, a process used for the acquisition of public goods, works, and related services required in the execution of a project (Inuwa 2014), is still susceptible to unethical practices in most African countries (Sichombo, Muya, Shakantu, & Kaliba 2009; Jacob 2010; Kangogo & Kiptoo 2013). One of the stage in public procurement that is very vulnerable to unethical practice, according to Kangogo and Kiptoo (2013) is the tendering stage. Unethical professional practices are ways that professionals disrespect the interest of their clients which translate to the wider public interest not being recognized and respected (Owoyebi *et al.,* 2011). Studies conducted across the globe acknowledged that the consequencies of unethical profesional practices in the construction industry is very detrimental to the technological and socio-economic development of any nation (Harding *et al,* 2004; Bowen, Pearl, & Akintoye, 2007; Abdul-Rahman, Wang, & Yap, 2010; Inuwa, *et al.* 2014).

According to Sichombo *et al.* (2009) the fight against unethical professional practices in the construction industry has taken centre stage worldwide. This had informed many efforts taken to increase the ethical standards and integrity among construction professionals that will ensure the attaiment of VfM in their effort in delivering construction projects worldwide (Abdul-Rahman *et al.,* 2010). Consequently, most developed countries and some developing countries, had realized that adhering to professional ethics during tendering procedure, is an inevitable pre-requisite to attaining VfM in the procurement of building projects (Abdul-Rahman *et al.*, 2010; Ray *et al.,* 1999). Nonetheless, even with the enactment of public procurement Act in 2007 by the Nigerian government (Federal Government of Nigeria-FGN, 2007), to curtail unethical practices, consequences of unethical professional practices during tendering for public building projects in Nigeria still abound (Jacob, 2010; Alutu & Udhawuve, 2009). The public procurement Act 2007 is used in all Federal Government procurements only, thus all building projects procuments in higher public institutions, sponsored by FGN are subjected to the use of the Act. (State governments use separate procurement laws)

According to Mlinga (2006), the application of the highest ethical standards will help ensure the best achievable construction procurement outcome, as well as enhance the procuring entities reputation in the marketplace. Unfortunately, construction procurement outcome in Nigeria is very dismal due to fraudulent award of contracts to wrong contractors through the perpetuation of unethical professional practices (Alutu, 2007; Adebanjo, 2012). Consequences of such action to a country deny its construction industry of successful delivering of basic infrastructural projects that will support the country's economy (Harding *et al*., 2004; Abdul-Rahman *et al.,* 2010). Adebanjo (2012) revealed that almost 60% of funds budgeted for public construction procurement in Nigeria ends up partly on unnecessary administrative expenses and the rest in local and foreign accounts of individuals due to unethical professional practices. More alarming is a World Bank report in 2010 on Nigerias' procurement assessment, which revealed that about 50% of projects in Nigeria are dead even before they commence; projects are designed to fail because the objective is not to implement, but to use them as vehicles for looting of public treasury. Instead of adding value, they become economic drain pipes (Jacob, 2010).

Consequently, Nigeria posts the highest building construction cost in Africa; an average building project costs over 50% more in Nigeria than in Ghana and 77% more in Nigeria than in Senegal, all countries within the same ECOWAS sub-region (Langdon, 2011 in Anago, 2012). This act results in the country's poor VfM building projects procurement (Ameh & Odusami, 2010; Oyewobi *et al*., 2011; Usman *et al*., 2012; Inuwa *et al.,* 2014). Even with the successes recorded in procurement requirements awareness and cost savings as a result of the enactment of the procurement Act in 2007 by the Nigerian government, evidences had shown that the tendering procedures of some public construction procurement projects amounting to over ₦ 20 billion were dented with blatant abuse of the procurement Act (see Jacob, 2010; Anago, 2012).

A review of studies on ethics in the Nigerian construction industry failed to reveal a study that centered on the identification of unethical professional practices during tendering for public building projects, as well as the causes of its perpetuation and measures to curb it (Alutu, 2007; Ameh *et al*., 2007; Ameh & Odusami, 2010a; Ameh & Odusami, 2010b; Ayodele *et al*., 2011; Oyewobi *et al*., 2011; Usman *et al*., 2013; Inuwa *et al*., 2014). Hence, the aim of this study is to investigate unethical professional practices during tendering for public building procurement in Bauchi metropolis, Nigeria, with a view to improving professional ethics that will ensure VfM procurement of public buildings. The study outlined the following objectives:

i. To identify and evaluate factors that constitutes unethical professional practices during tendering for public building procurement in Nigeria.

ii. To identify and evaluate factors that encourage the perpetuation of unethical professional practices during tendering for public building procurement in Nigeria.

iii. To identify and evaluate measures for curbing unethical practices during tendering for public building procurement in Nigeria.

This study is delimited to higher public institutions in Bauchi Metropolis, Nigeria. Academic staff (construction professionals) are central for creating awareness on ethics to the public and in the training of professionals, and are most at times engaged as consultants during tendering. While non-academic staff (public construction professionals) working in these institutions are the clients' representative during tendering for public building procurements. Thus, the following null ($\mathbf{H_o}$) hypotheses were postulated in order to test the relationship of the variables in the above mentioned objectives:

i. $\mathbf{H_o}$: There is no difference in means between academic and nonacademic staff on the factors that constitute unethical professional practices during tendering for public building procurement in Nigeria.

ii. $\mathbf{H_o}$**:** There is no difference in means between academic and nonacademic staff on the factors that encourage the perpetuation of unethical professional practices during tendering for public building procurement in Nigeria.

iii. **Ho:** There is no difference in means between academic and nonacademic staff on the measures for curbing unethical Professional practices during tendering for public building procurement in Nigeria.

LITERATURE REVIEW

Concept of professional ethics and VFM procurement

Historical evidence drawn from different philosophical traditions (Egypt & Mesopotamia, Judeo-Christian, Middle East, and Asia) revealed that ethics evolved as a set of moral standards that govern the conduct of an individual or a group of persons in an organizational or societal setting (see McNabb, 2009). Ethics is the set of principles that govern the conduct of an individual or a group of persons, and briefly as the study of morality or moral behaviour (McNabb, 2009). According to Guthrie (2010), ethics is a standard of professional behavior. Thus professionals involved in project procurement are expected to exhibit behaviour that ensures clients' get full value for what they paid for; VfM (Anago, 2012). Though it sounds simple, it is very complex in public procurement domain (Anago, 2012). VfM mean services at lower cost, of better quality or a combination of these outcomes (Regan, 2014). For procurement to satisfy VfM, it has to assess quantitative (or whole-life costs) and the qualitative attributes (or fitness for purpose) of a particular procurement decision (HM Treasury, 2006 in Regan, 2014). VfM assists professionals to guide client decision on which procurement method

will deliver the best outcome, as well as on the most effective and efficient bidding method and process that will result in selecting the best bidder proposal that maximises public benefit. To achieve VfM procurement, construction professionals' must render services that will result in better outcome through an economic, effective, and efficient way. Thus, they are expected to provide procurement services that will: incur lowest reasonable cost, yield better productivity, and achieve an impact that could either be quantitative or qualitative or both. VfM is said to be attained when there is an optimum balance between cost, effectiveness and efficiency; when costs are relatively low, productivity is high and successful outcomes have been achieved (Adebanjo, 2012).

The emergence of a procurement law in Nigeria

Prior to 2007, there was no statutory provision that directly regulate the award of public contracts in Nigeria, hence the public procurement system had been grossly abused leading to high losses of resources (Ayangade, Wahab, & Alake, 2009; Jacob, 2010). Thus, contract award in Nigeria is used as an avenue by which the government functionaries reward their friends and cronies and by which they too amass wealth, consequently negating the economic growth of the Nation (World Bank, 2000; Olatunji, 2008; Jacob, 2010). More worrisome is that construction professionals who are trained and expected to exhibit high level of professionalism are not exempted from this moral decadence (Usman *et al*., 2012; World Bank, 2000). Studies had shown that public construction procurement performance in Nigeria, spanning decades after its independence in 1960, is marred with fraudulent practices perpetuated through unethical professional practices (Oladapo, 2000; Adebanjo 2012; Usman *et al*., 2012).

Disturbed with the devastating effects of unethical professional practices on the reputation and economy of the country, the Nigerian government commissioned a diagnostic study in 2001 to investigate the stage of affairs of public procurement in the country. In a bid to nib the menace in the bud, the government set up a Due Process Unit under the presidency to undertake the exercise (Ayangade *et al*., 2009; Jacob, 2010). Furtherance to its effort to sanitize and improve the public procurement performance, the government found it necessary to enact a procurement Law; thus enacted into Law the public procurement Act in 2007 (Jacob, 2010; Adebanjo, 2012).Though the introduction of the procurement Act in 2007 created awareness in the public domain on the essentials of procurement process and practice, and saved the nation over ₦300 billion ($790 million) in contracts over-pricing within the threshold of ₦ I billion ($2.63 million) by Ministries, Departments and Agencies. Nonetheless, its successes could not deter the perpetuation of unethical professional practices in the award of public construction contracts (Jacob, 2010; Anago, 2012).

One of the flaws in the Public Procurement Act is that it failed to acknowledged the complexity of construction procurement process, as well as it different routes and as such, rules in the Act covering procurement are uniformly applicable to procurement of goods, services and infrastructure. This should not be the case; experts in construction procurement had for

long acknowledged that it is a 'complex system', which may help to offer insights from the procurement of other types of complex systems (Hughes, 2012). Its complexity is as a result of: its organizational structure; large size, expensive and risky; takes longer duration to accomplish, and different systems (see Hughes, 2012; Inuwa, 2014). Moreover core construction procurement professionals roles are not spelt out and as such, consequences of their professional misconduct are not explicitly captured in the Act, hence making it difficult to convict erring professionals. The Act also failed to include the peculiarity of construction procurement process vis-à-vis its administration as required in the Joint Contract Tribunal (JCT, 2005); a standard document which form the basis of construction contract administration, stipulating rights and limitations of all stakeholders involved in construction procurement process.

Unethical professional practices in tendering procedures in public building procurement

According to Australian Oxford Dictionary (2004), unethical means not ethical; especially unscrupulous in business or professional conduct. The word unethical from another perspective is a synonym to the word corruption. Corruption is an exhibition of a dishonest, illegal or immoral behaviour especially from someone or a professional entrusted with the authority to manage or oversee the execution of an assignment (Ayodele, Ogunbode, Ariyo & Alabi, 2011). Hence the exhibition of a professional behaviour in the accomplishment of a duty which negates the proper moral professional standards guiding the conduct of such a profession constitutes unethical professional practice. Furtherance to understanding what constitute unethical professional practice, one has to know what demarcate between ethical professional practice and unethical professional practice.

According to Ramus *et al.* (2006), tendering is a very important matter that requires careful thought and execution if success is to be attained in the procurement of construction projects. Hence construction professionals engaged in accomplishing the task of procurement are expected to exhibit appropriate ethical requirements without fear or favour. Thus the task of construction professionals are to find a contracting company that: is financially stable and has a good business record; the size of the project is neither too small nor too large; has a reputation for good-quality workmanship and efficient organization; and has a good record of industrial relations (Ramus *et al.*, 2006). To achieve this end, tendering must be open, competitive and transparent. By so doing the client limited resource will be efficiently and effectively utilize to achieve VfM (Moneke, 2000). To demarcate what are unethical professional practices during tendering, one must be conversant with what constitute ethical professional practices during tendering for construction procurement. Ramus *et al.* (2006) identified the followings as the ethically recognized procedure for tendering: preliminary enquiry; period for preparation of tenders; parity of tendering; opening tenders and; notifying tenderers. Other tendering procedure stipulated by the Nigerian Public Procurement Act (FRN, 2007) includes: advertisement, prequalification of tenders, and tender evaluation.

Preliminary enquiry

To ascertain whether a contractor is interested in tendering for a project, and to avoid a situation where a contractor who is over loaded with work, to tender for a job at a price far above the lowest tender (cover price), a preliminary enquiry is sought from prospective tenderers (for detail see Ramus *et al*., 2006). Though preliminary enquiry according to Ramus *et al*. (2006), is a recommended practice but not always followed. It has the advantage of ensuring that bona-fide tenders are submitted, as well as reduces the length and cost of tendering management. However, where this procedure is not considered and applied by professionals engaged in the management of tendering procedure, it could be construed as an unethical professional practice.

Advertisement

One important facet of transparency according to Arrosmith (2010), is to ensure adequate publicity for contract opportunities. This helps to ensure wider competition and hence better VfM, and to provide for more effective monitoring and accountability of procurement activity. This procedure is to be initiated by the client's project manager, architect or quantity surveyor advertising and inviting contractors to tender in competition for carrying out work. Acknowledging the importance of advertisement in ensuring that public procurement is competitive, accountable, transparent, and ultimately attains better VfM, the Nigerian Procurement Act, stipulated in Part V subsection 19 (a) that all public procuring entities shall, in implementing its procurement plans advertise and solicit for bids in adherence to the Act and guidelines as may be issued by the Bureau from time to time (for detail see FRN, 2007). However, in Nigeria, public contract awarding entities most at times connive to award the contract to a specific contractor not minding his disposition, competence and business reputation; the advertisement they placed on dailies, journals and notice boards are merely to satisfy statutory requirements (Alutu, 2007; Jacob, 2010; Ottuh, 2012). Hence, the act of conniving to award a contract to a contractor prior to tendering, and placing deceitful advertisements or not advertising in the dailies to invite tenders for public procurement projects are violation of the ethically recognized requirements, and as such constitute unethical professional practices during tendering.

Period for preparation of tenders

Construction professionals tasked with the responsibility of managing tendering are expected to give tendering contractors ample time that will be sufficient for them to put up a bona-fide tender. From experience, the professionals are to take cognizance of the nature, size and complexity of a project in deciding the appropriate time for the contractors to prepare their tenders, as well as the date in which tenders are to be submitted; the time should be sufficient to allow all necessary enquiries from suppliers, sub-traders, and make possible any other task related to the tender preparation to be attended to (Omole, 2000; Ramus *et al*., 2006). Though, there is no universally accepted minimum duration for the preparation of tenders but

professionals are at all times required to evaluate the size, nature and complexities of a project using experience to come up with a duration sufficient to prepare tender for the project in question. Unrealistic period for the preparation of tenders could lead to flaws, and this could be construed as an unethical professional practice.

Parity of tendering

Parity of tendering is about creating an avenue where all tendering contractors are given equal basis to compete using uniform conditions and information. Consequently, all the tender documents, requirements and instructions relating to the tendering procedures must be identical. Any information resulting in variations emanating from: amendment on the initial tender documents, enquiry posed by any tenderer on materials and specifications, and method of construction which might eventually varies the initial envisaged nature and scope of the project in question should be communicated to all tenderers; tenderers should be asked to confirm in writing the receipt of every written communication of additional or varied information immediately (Ramus *et al*., 2006; FRN, 2007). However, any violation of the parity of tendering constitutes unethical professional practice (Ramus *et al*., 2006; Alutu, 2007; Ottuh, 2012).

Opening tenders

Ethically, tenderers are normally required to return their tenders in a specially marked envelope called return envelope (see Ramus *et al*., 2006). It essence is to ensure that tenders are recognized as such when received and to ascertain that the bids have not been tampered (Ramus *et al*., 2006; FRN, 2007). According to the Public Procurement Act (FRN, 2007), all bids shall be submitted before the deadline or date specified in the tender documents or any extension of the deadline for submission. All Tenders are to be opened in public and the same time immediately after the time given for submission had elapsed; opened within 24 hours of receipt (Omole, 2000; Ramus *et al*., 2006; FRN, 2007). Hence where opening of tenders do not follow formal laid down procedures in the submission and opening of tenders, such act constitutes unethical professional practice.

Notifying tenderers

It is a standard requirement to prepare and submit to all tenderers an alphabetical list of names of tendering entities when tenders are opened, as well as list of tenderers tender sums in descending order; from the lowest to the highest tender, without disclosing which tenderer submits what amount. Looking at the tender list, tenderers will be able to ascertain their position relative to the lowest tender (see Ramus *et al*., 2006; FRN, 2007). However, where tenderers are not notified when tenders are to be opened, such act construed unethical professional practice.

Pre-qualification of tenderers

The Pre-qualification scrutiny is aimed at determining the technical, managerial and financial capacity as well as confirm their previous experiences in performing similar projects and ultimately their suitability

as prospective bidders for the project (Omole, 2000). In addition, the pre-qualification of tenders seek to confirm a company's status in meeting statutory requirements for eligibility to participate in public and private procurements (FRN, 2007). However, there are instances where procuring entities conspire to violate pre-qualification criteria in favour of a contractor, thus constituting an unethical professional practice (Alutu, 2007; Ottuh 2013).

Tender evaluation

The evaluation of tenders is the stage in the procurement process during which a procuring entity identified which one of the tenders meets the set requirements on the basis of the pre-announced award criteria, either the lowest-priced or the most economically advantageous tender. The qualified tenderer whose tender has been determined to be either the lowest-priced or the most economically advantageous, as the case may be, is awarded the contract (FRN, 2007). This include Examination of the bids (both Technical and financial) to determine the bid that substantially responded to the bid solicitation. Regardless of how well the other steps in the procurement process are conducted, if bids are not evaluated correctly and fairly, the process will fail. During the bid evaluation, substantially responsive concept is used. It is a requirement of the guidelines for the procuring entity to expressly state all the criteria they intend to use in the evaluation of Bids, and that criteria set out shall be the one to be used (see FRN, 2007). However, in Nigeria, evidences had shown that public procurement entities conspire with professionals to unduly favour a contractor at the expense of others during tender evaluation for the award of government projects (Alutu, 2007; Jacob, 2010; Ottuh, 2013).

Factors influencing perpetuation of unethical professional practices in Nigeria

Consequences of perpetuating unethical professional practices could lead to over shooting cost of public contracting by 25%, generates waste of public resources, underdevelopment, and unfavorable business environment (Hassim, Kajewski, & Stephen, 2010). In spite of these consequences, unethical professional practices are still perpetuated in Nigeria, and many factors are said to encourage it (Inuwa, Usman & Dantong, 2014). Usman *et al.* (2012) identified factors that cause the perpetuation of unethical professional practice in the management of construction projects in Nigerian. Some of these factors could be experienced during tendering for public building procurement, and their perpetuation are reported to be influenced by: job Insecurity, fear of status relegation after retirement, relatively low income compared to needs, lack of loyalty to government, absence of punishment for corruption, loss of contract money due to change in government, lack of continuity in government programmes, and collusion between procurement officials and contractors.

According to Agbiboa (2012), poor workers remuneration in the public sector, lack of social security and the facilities needed to guarantee decent living after retirements, and the existence of defective cultural norms are

some of the factors that could influence the perpetuation of unethical professional practices during tendering in Nigeria. He added that, in Nigeria, loyalty to one's ethnic group is celebrated and is often far more important than legal rules in shaping behaviours. Consequently, the obligation to an ethnic group often overrides obligations of public office, causing civil servants and private actors to deviate from established rules proscribing corruption. In the same light Ayodele, *et al.* (2011) revealed that poverty level, excessive love for money/greed, politics in award of contract/God-fatherism, professional indiscipline, fall-out of endemic societal corruption and favouritism also encourage perpetuation of unethical professional practices in the procurement of public buildings in Nigeria. Moreover, unethical professional practices thrive in Nigeria due to poor judicial systems; most at times those convicted of embezzlement of public funds through fraudulent procurement practices are not meted appropriate punishment (Agbiboa, 2012; Ottuh, 2013)

Measures for curbing unethical professional practices during tendering

According to Inuwa et al. (2014), the need to curb unethical professional practices has been a major concern to many authors. Vee and Skitmore (2003), affirmed that curbing unethical professional practice depends on the implementation and policing of the ethical guidelines and policies of both professional bodies and private organizations' together with the leadership of public sector procurement agencies. Ameh and Odusami (2010) discovered that majority of Nigerian building professionals' ethical ideology are situationists, as such factors that will encourage unethical practices should be avoided. Situationists reason that people's situations, rather than their characters, are the explanatory powerful factors in determining why different people behave differently. Thus, massive enlightenment on ethical codes should be promoted. Ameh and Odusami (2010) advocated for professional institutes organising periodic training sessions on professional ethics as part of Continuous Professional Development (CPD). Issues to be discussed at such meetings should include: content(s) analysis of professional codes of conduct; case studies and scenarios on ethical improprieties; and emerging ethical issues of global and national significance. To other authors, credible leadership of public procurement agencies is a prerequisite for attaining a VfM procurement; devoid of unethical professional practices (Ameh & Odusami, 2010; Adebanjo, 2012; Agbiboa, 2012). Ottuh (2013) accusses the leadership of public procurement agencies in Nigeria of lacking the kind of philosophical and ideological vision and orientation that is committed to developing a dream society. In Alutu's (2007) view, seminars and workshops, and the introduction of a course on professional ethics in tertiary institutions will aid in curbing unethical professional practices in Nigeria. Ameh et al. (2007) advocated for the inclusion of professional ethics in postgraduate curriculum of construction disciplines in Nigeria.

In another study, Ameh et al. (2010) recommends professional institutions in Nigeria to give more priority consideration to ethical discourse at

technical sessions, public lectures and seminars. Oyewobi et al. (2011) proffers viable legislation mechanism in Nigeria to deal with unethical practices by strengthening professional institutions to punish erring members, and the introduction of enforcement and monitoring measures. Usman et al. (2012b) advocates for more government commitment in fighting corruption in Nigeria, and advised that professionals, contractors and civil servants exhibits hallmark of excellence through adherence to ethics, values, competence and integrity. Inuwa et al. (2014) advocated for: adherence to professional ethics, pre-emptive measures by regulatory bodies to supervise professionals, legislate laws that spell out punishment for any type of unethical practice, transparency and accountability in contract administration, and strong policy framework and enforcement. These measures if adhered could contribute to curbing unethical professional practices during tendering for public building procurement in Nigeria.

RESEARCH METHODOLOGY

This study focused on unethical professional practices during competitive tendering for public building procurement. The study adopted exploratory design and descriptive survey through literature review and the used of questionnaire respectively. The questionnaire captured questions on respondents' demographic profile and the study objectives. This study used an accessible population of 180 experienced and certified building procurement professionals (architects, builders, engineers, and quantity surveyors), due to the absence of an authoritative source for ascertaining the size of the target population (Oso & Onen, 2011). The professionals are academic and non-academic staff in the three tertiary institutions in Bauchi metropolis, Nigeria. The three institutions are Abubakar Tatari Ali Polytechnic (ATAP), Abubakar Tafawa Balewa University (ATBU), and Federal Polytechnic Bauchi (FPTB). A Sample size of 122 respondents was determined for the study using Krejcie and Morgan (1970) table for determining sample size.

Cronbach's alpha (α) reliability test used to test the internal consistency of the questionnaire constructs record α values of 0.79, 0.70, and 0.87 for unethical, perpetuation and measures for curbing unethical professional practices respectively. These results depict that the questionnaire reliability status is good, since it is ≥ 0.70; hence the questionnaire is said to be consistent, reliable and free from random error (Sekaran, 2003; Pallant, 2001). In addition, experts in the academia who specialized in construction and project management, verified and validated the study concept to be well represented by the items in the questionnaire, hence confirmed the content validity of the questionnaire (Sekaran, 2003). Subsequently, the questionnaires were distributed through disproportionate sampling technique in the study area: ATAP, ATBU, & FPTB. The survey records 85.73% valid response rate. Respondents were instructed to use 5-point likert scale to rank factors in the questionnaire. The scale interpretation for ranking unethical professional practices are: 1-not severe, 2-least severe, 3-moderately severe, 4-severe, and 5-highly severe. For influencing

perpetuation: 1-not-influential, 2-least influential, 3-moderately influential, 4-influential, and 5-highly influential. For measures: 1-ineffective, 2-least effective, 3-moderately effective, 4-effective, and 5-highly effective. Afterwards, statistical package for social sciences (SPSS) version 21 was used to analyze the data obtained for descriptive (frequencies, percentages-%, & mean) and inferential statistics (independent sample *t*-test and Spearman's rank correlation).

RESULTS AND DISCUSSIONS

Respondents demographic information

Table 1: Respondents demographic profile

Sections in institution	No.	%	cumulative	
Academic staff	88	83.8	83.8	
Non-academic staff	17	16.2	100	
Total	105	100		
Educational qualifications	No.	%	cumulative %	
PhD	10	9.5	9.5	
MSc	50	47.6	57.1	
BSc	36	34.3	91.4	
HND	5	4.8	96.2	
Others	4	3.8	100	
Total	105	100		
Educational specialization	No.	%	cumulative %	
Architecture	19	18.1	18.1	
Building	12	11.4	29.5	
Engineering	60	57.1	86.7	
Quantity surveying	14	13.3	100	
Total	105	100		
Professional registration	No.	%	cumulative %	
NIA	12	11.4	11.7	
NIOB	12	11.4	23.3	
NSE	55	52.4	76.7	
NIQS	14	13.3	90.3	
Others	10	9.5	100	
Total	103	98.1		
Years of experience	Mid value (X)	Frequency (F)	% of F	FX
5-10years	7.5	6	5.7	135.0
11-16years	13.5	32	30.5	432
16-21years	18.5	49	46.7	906.5
Over 21years	21	18	17.1	378.0
Total		105	100	1851.5
Mean years of experience = $\sum FX/\sum F$ = 1851.5/105= 17.63 ≈ 18 years				

Table 1 depicts the respondents' demographic profiles. Eighty percent of the respondents are academic staff while 16% are non-academic staff. This result shows that majority of the respondents are responsible for the training of professionals and as such are well informed on the professional ethical requirements in practice. BSc, MSc and PhD degrees holders

constitute 34.3%, 47.6%, and 9.5% respectively of the educational qualifications of the respondents, while 8.6% of the remaining respondents hold HND and others educational qualifications. This result shows that majority of the respondents are educationally qualified to respond to a research of this nature, and as such, enhanced the validity of the research data.

Table 1 also revealed that all the respondents (100%) specialize in core building procurement professions: Architecture, Building, Engineering and Quantity Surveying. This implied that they are core professionals engaged in public building procurement, and as such knowlegeable and experienced to supply valid data for the study. Table 1 shows that 90.3% of the respondents are professionally certified by their various professional bodies to practice. This shows that the respondents are qualified and statutorily recognized to render their services in building procurement transaction, and as such are familiar with the ethical requirement during tendering. In addition, Table 1 revealed that the study respondents have average of 18 years' experience working in the construction industry. These results confirmed that the data collected for this study is very valid because the respondents used are the most knowledgeable, experienced and appropriate to respond to the study area of enquiry.

Factors that constitute unethical professional practices during tendering

Table 2 shows factors identified from literature to constitute unethical professional practices during tendering for public building procurement, and the responses of the two groups of respondents on the severity of the identified unethical professional practices. The significant level (probability) in Table 2 under independent sample t-test are all above the required cut off value of 0.05, this according to Pallant (2001) shows that there is *no* statistically significant difference in the mean scores of academic and non-academic staff on their ranking of the severity of unethical professional practice. This shows that both academic and non-academic staff agree that all the factors identified constitute unethical professional practices in tendering. Hence, the null hypothesis that there is no difference in means between academic and non-academic staff on the factors that constitute unethical professional practices in tendering for public building procurement in Nigeria was accepted. Both academic and non-academic staff ranked scores for the severity of the unethical professional practices to be moderately severe(3) and severe (4); favouritism during evaluation of tenders (4.2614 & 4.0588), connivance to award the contract to a party prior to tendering (4.1136 & 3.7059), deceitful advertisement (3.9886 & 3.5882), divulging confidential and vital tender information (3.8750 & 3.7059), and non-adherence to pre-qualification criteria (3.4886 & 3.5294) were ranked by both academic and non-academic staff to be a severe unethical professional practices. While informal procedure in opening tenders (3.2386 & 3.1765), non-conduction of preliminary enquiry (3.3295 & 2.9412), unrealistic duration given for preparation of tenders (3.2500 & 3.2529), deliberate disparity of documents to tenderers (3.3864 & 3.4118), and not

notifying tenderers when tenders are to be opened (2.8636 & 2.6471) were ranked to be moderately severe.

Conduction of preliminary enquiry though not always practiced according to Ramus *et al.* (2006), is a recommended practice. However, no empirical study was conducted in Nigeria to investigate the extent of its application and abuse in tendering procedure. Moreover, the severity of non-conduction of preliminary enquiry in relation to other unethical professional practice during tendering procedure was never assessed prior to this study. The implication is that there is high likelihood that a contractor who is fully committed with other projects may be awarded the contract at a tender price far above the lowest tender, and could result in the project being delivered in a poor state that will not attain VfM (Ramus *et al.,* 2006). Deceitful advertisement is also acknowledged by Alutu (2007), Jacob (2010) and Attuh (2012) as an unethical professional practice during tendering for public building projects in Nigeria. They all agree that most advertisement for inviting tenders for a prospective project in Nigeria is deceitful. However, no study focused on it empirically to ascertain its severity as an unethical professional practice during tendering for public building procurement in Nigeria. This implied that there is no transparency and fairness in selecting contractors for public building procurement, thus resulting in selecting an incompetent contractor who could end up delivering a project that has no VfM. Hence denying the public from benefiting from the needs the project is intended to address. Though this study and Ramus *et al.* (2006) acknowledged conduction of preliminary enquiry as a tendering procedure, and as such, its violation is regarded as an unethical practice, however the Nigerian public procurement Act was silent about it.

Table 2: Factors that constitute unethical professional practices during tendering

				Independent samples t- test	
S/N	Unethical professional practices	Acad. mean	Non-acad. Mean	t Stat.	Sign. Level
1	Connivance to award the contract to a party prior to tendering	4.1136	3.7059	1.15	0.27
2	Deceitful advertisement	3.9886	3.5882	1.19	0.25
3	Deliberate disparity of documents to tenderers	3.3864	3.4118	(0.09)	0.93
4	Divulging confidential and vital tender information	3.8750	3.7059	0.46	0.65
5	Favouritism during evaluation of tenders	4.2614	4.0588	0.81	0.42
6	Informal procedure in opening tenders	3.2386	3.1765	0.22	0.83
7	Non-adherence to pre-qualification criteria	3.4886	3.5294	(0.14)	0.89
8	Non-conduction of preliminary enquiry	3.3295	2.9412	1.39	0.17
9	Not notifying tenderers when tenders are to be opened	2.8636	2.6471	0.64	0.53
10	Unrealistic duration given for preparation of tenders	3.2500	3.3529	(0.31)	0.76

Unrealistic duration given for preparation of tenders is also an unethical professional practice during tendering in Nigeria, that concurs with Omole (2000) and Ramus *et al.* (2006) assertion that an unrealistic duration given for preparation of tenders is unethical. The implication of this result is that where tenderers are not given adequate time to prepare, and tenders prepared in a hurry might contain mistakes and flaws that could affect project success and as such deficient in given VfM. Not notifying tenderers when tenders are to be opened is also discovered as an unethical professional practice. It should be noted that notifying tenderers when tenders are to be open is an ethical professional requirement in tendering as recommended by Ramus *et al.* (2006) and other statutory organs of government (FRN, 2007). However, were it is not adhered to, it constitutes unethical professional practice. Consequently, this study was able to reveal through empirical study the severity of not notifying tenderers when tenders are to be opened vis-à-vis other unethical professional practice.

Factors that influence perpetuation of unethical professional practices

Table 3 portrays factors that influence perpetuation of unethical professional practices as identified from literature as well as their level of ranking by respondents. The scores of the significant level shows that all the scores of the six factors range from 0.05 and above, hence according to Pallant (2001), this implies that there is no statistically significant difference in the means of the respondents'. Thus, the study second null hypothesis was accepted. Both academic and non-academic staff ranked greed for money/get rich syndrome (4.5114 & 4.0588), glorifying corrupt leaders (4.4545 & 4.1765), weak judicial system (4.0795 & 3.9412), immorality in the society (3.7614 & 3.8235), poor understanding of ethical standards (3.5682 & 3.5882), and discontinuity in government projects (3.9091 & 3.4706) to be influential in the perpetuation of unethical professional practices. While poor workers remuneration were ranked by academic staff to be influential (3.6705), however non-academic staff ranked it to be moderately influential (3.1765). Public sector job insecurity was both ranked by academic and non-academic staff to be moderately influential (3.4545 and 2.7647) in perpetuation of unethical professional practices.

Table 3: Factors that influence perpetuation of unethical professional practices

S/N	Factors influencing perpetuation of unethical practices	Acad. mean	Non- Acad Mean	Independent Samples *t*-test *t* Stat.	Sign. Level
1	Discontinuity in government projects	3.9091	3.4706	1.51	0.13
2	Glorifying corrupt leaders	4.4545	4.1765	1.02	0.20
3	Greed for money/Get rich syndrome	4.5114	4.0588	1.35	0.19
4	Immorality in the society	3.7614	3.8235	0.23	0.82
5	Poor understanding of ethical standards	3.5682	3.5882	0.64	0.95
6	Poor workers remuneration	3.6705	3.1765	1.65	0.10
7	Public sector job insecurity	3.4545	2.7647	2.02	0.05
8	Weak judicial system	4.0795	3.9412	0.48	0.63

Greed for money/get rich syndrome was reported to be the most influential factors that causes perpetuation of unethical professional practice in tendering procedure. The result agrees with the previous researches on the factors causing perpetuation of unethical practices in tendering (Alutu & Udhawuve, 2009; Oyewobi, *et al.* 2011; Usman, *et al.* 2012b; Inuwa, *et al.* 2014). However, this research contrast with other studies in the sense that it investigated the order of influence of the factors that encourage the perpetuation of unethical professional practices in tendering procedure of public building projects in Bauchi metropolis, Nigeria.

Measures for curbing unethical professional practices in tendering

Table 4 depicts measures identified from literature for curbing unethical professional practices during tendering for public building procurement, as well as their ranked order. All the factors significant levels are greater than 0.05. The result implied that there is no statistical difference in the means of respondents, thus the null hypothesis was accepted. Though there is a difference in means between academic (4.1705) and non-academic staff (4.7059) on credible leadership of public sector procurement agencies, even at that their mean scores are on the high side showing that it is an effective (academic staff) and highly effective (non-academic staff) measures in curbing unethical professional practices in tendering.

Enforcement of strict punitive measures by professional regulatory bodies (4.0455 & 4.3529), strict adherence to professional ethics (4.2500 & 4.1765), strict adherence to public procurement requirements (4.1136 & 4.2353), organizing lectures, workshops and seminars on professional ethics by relevant professional bodies (3.6136 & 3.8235), and understanding ethical and professional values among the professionals (3.7045 & 3.8824) were all ranked by both respondents as effective measures in curbing unethical professional practices in tendering.

Academic staff ranked ensuring parity in tendering (3.5568) as a highly effective measure for curbing unethical professional practices (3.3529), while non-academic staff ranked it to be an effective measure for curbing unethical professional practices. Academic staff ranked introduction of a course on professional ethics in academic institutions to be an effective (3.5000) measure in curbing unethical professional practices in tendering, however non-academic staff were of a contrary view that it is a measure that is least effective (2.4118).

The opinion of the two group of respondents also differ on the effectives of sufficient time given to tenderers for preparation as a measure for curbing unethical practices. While academic staff were of the opinion that introduction of a course on professional ethics in academic institutions is an effective measure (3.5114), non-academic staff view it as a moderately effective measure (3.2941).

Table 4: Measures for curbing unethical professional practices in tendering for public building Procurement

S/N	Measures for curbing unethical practices in tendering procedures.	Acad. Mean	Non-acad. mean	Independent Samples *t*- test *t* Stat.	Sign. Level
1	Credible leadership of public sector procurement agencies	4.1705	4.7059	2.80	0.10
2	Enforcement of strict punitive measures by professional regulatory bodies.	4.0455	4.3529	0.98	0.33
3	Ensuring Parity in tendering.	3.5568	3.3529	0.74	0.46
4	Introduction of a course on professional ethics in academic institutions	3.5000	3.4118	0.29	0.77
5	Organizing lectures, workshops and seminars on professional ethics by relevant professional bodies	3.6136	3.8235	0.98	0.33
6	Strict adherence to professional ethics	4.2500	4.1765	0.28	0.78
7	Strict adherence to public procurement requirements	4.1136	4.2353	0.42	0.68
8	Sufficient time for preparation of tenders	3.5114	3.2941	0.71	0.48
9	Understanding ethical and professional values among the professionals	3.7045	3.8824	0.61	0.54

Though there is a difference in opinions between academic and non-academic staff on credible leadership of public sector procurement agencies as a measure; even at that they are considered to be effective and highly effective measures in curbing unethical professional practices in tendering by academic and non-academic staff respectively. Other factors were considered to be effective measures in curbing unethical professional practices in tendering procedure. These findings are in concurrence with other studies: Alutu (2007), Ameh *et al.* (2007), Ameh *et al.* (2010), Oyewobi *et al.* (2011), Usman *et al.* (2012), and Inuwa *et al.* (2014). However, this research contrast with other studies in the sense that it was conducted in Bauchi metropolis, and investigated empirically the order of effectiveness of the measures proffers for curtailing unethical professional practices in tendering for public building projects in Bauchi metropolis, Nigeria.

CONCLUSION AND RECOMMENDATION

This study investigated unethical professional practices during tendering for public building procurement in Bauchi metropolis, Nigeria, with a view to improving on construction professionals' ethics that will ensure VfM procurement. The study objectives identified and assessed: unethical professional practices, causes of perpetuating of unethical professional practices, and measures for curbing unethical professional practices during tendering for public building procurement in Bauchi metropolis, Nigeria. The study adopted exploratory and descriptive survey design. Independent sample *t*-test used to test the study hypotheses revealed that respondents are in agreement on factors that: constitute unethical professional practices, influence perpetuation of unethical practices, and measures for curbing unethical practices during tendering for public building procurement in

Bauchi metropolis, Nigeria respectively. In addition, findings revealed that all the identified unethical professional practices were found to be moderately severe and severe. The implication is that contractors, consultants, and clients are all culprit in exhibiting unethical professional practices, and this need to be addressed collectively by the contractor, consultant, and the client. There is need for stakeholders in tendering for public building procurement to strictly adhere to ethical requirement during tendering.

Factors influencing the perpetuation of unethical professional practices identified were also discovered to be influential and highly influential (greed for money/get rich syndrome). By implication, measures need to be taken that will improve the living standards of Nigerians. These would go a long way in curtailing the causes of perpetuation of unethical professional practices in Nigeria. Measures identified for curbing unethical professional practices were discovered to be effective. However, credible leadership of public sector procurement agencies is revealed to be a highly effective measure. The study recommends: stakeholders in tendering procedure adheres strictly to ethical requirements, Nigeria's public procurement act be reviewed, improvement on public workers remuneration, appointment of credible leaders in public procurement agencies, and synergy between key public construction stakeholders for effective implementation of measures for curbing unethical professional practices.

REFERENCES

Abdul-Rahman, H., Wang, C., & Yap, X. W. (2010). How professional ethics impact construction quality: perception and evidence in a fast developing economy. Scientific Research and Essays, 5 (23): 3742-3749.

Adebanjo, A. (2012). Institutional Framework for Achieving Value for Money in Construction Projects in Nigeria. 1st National Project Cost Reduction Summit. Abuja: Quantity Surveyors Registration Board of Nigeria (QSRBN).

Agbiboa, D. E. (2012). Between Corruption and Development: The Political Economy of State Robbery in Nigeria. Journal of Bussiness Ethics, 108:325–345.

Alutu, O. (2007). Unethical Practices in Nigerian Construction Industry: Prospective Engineers' Viewpoint. Journal of Professional Issues in Engineering Education & Practice, (2)84-88.

Alutu, O. E., & Udhawuve, M. L. (2009). Unethical Practices in Nigerian Engineering Industries: Complications for Project Management. Journal of Management in Engineering, 25 (1): 40-43.

Ameh, J. O., & Odusami, K. T. (2010). Nigerian Building Professionals' Ethical Ideology and Perceived Ethical Judgement. Australian Journal of Construction Economics and Building, 10(3):1-13.

Ameh, O. J., Odusami, K. T., & Achi, F. O. (2007). An Assessment of Professional Ethics Content in the Academic Curriculum of Construction Disciplines in Nigerian Universities. Built Environment Education Conference. CEBE.

Anago, I. T. (2012). Value-for-Money as a Pre-requisite for Sustainable Economic Development in Nigeria. The 1st National Project Cost Reduction Summit (pp. 13-17). Abuja: Quantity Surveyors Registration Board of Nigeria (QSRBN).

Australian Oxford Dictionary. (2004). Australian Oxford Dictionary. Oxford: Oxford University Press.

Ayangade, J. A., Wahab, A. B., & Alake, O. (2009). Performance of Due Process Mechanism. Civil Engineering Dimension, 11 (1): 1-7.

Ayodele, E. O., Ogunbode, A. B., Ariyo, I. E., & Alabi, O. M. (2011). Corruption in the Construction Industry of Nigeria: Causes and Solutions. Journal of Emerging Trends in Economics and Management Sciences (JETEMS), 2 (3): 156-159.

Bowen, P., Pearl, R., & Akintoye, A. (2007). Professional Ethics in the South African Construction Industry. Building Research & Information, 35 (2): 189-205.

Dawson, C. (2002). Practical Research Methods: A user-friendly guide to mastering Research Techiques & Projects. Oxford: howtobooks.

FRN. (2007). Public Procurement Act. Abuja: Federal Republic of Nigeria.

Guthrie, G. (2010). Basic Research Methods: An Entry to Social Science Research. New Delhi: SAGE Publications India Pvt Ltd.

Harding, T. S., Carpenter, D. D., Finelli, C. J., & Passow, H. J. (2004). Does Academic Dishonesty Relate to Unethical Behavior in Professional Practice? An Exploratory Study. Science and Engineering Ethics, 10 (2): 1-14.

Hughes, W. (2012). The Business of Construction Procurement: Selecting, Defining and Managing Procurement. Proceedings of the 4th WABER Conference (pp. 24-26). Abuja-Nigeria: Laryea, S., Agyepon, S., Leiringer, R. & Hughes, W. (Eds).

Inuwa, I. I. (2014). Project Planning in Construction Procurement: The Case of Nigerian Indigenous Contractors. Nairobi-Kenya: PhD Thesis: Jomo Kenyatta University of Agriculture and Technology.

Inuwa, I. I., Usman, N. D., & Dantong, J. S. (2014). The Effects of Unethical Professional Practice on Construction Project Performance in Nigeria. African Journal of Applied Research (AJAR), 1 (1): 72-.79

Jacob, O. A. (2010). Procurement Law in Nigeria: Challenges for Attainments of its Objectives. University of Botswana Law Journal, 131-150.

Kangogo, K., & Kiptoo, E. J. (2013). Factors Affecting Ethical Standards in Public Procurement in Kenya. International Journal of Management Sciences, 1 (3): 90-99.

Krejcie, R., & Morgan, D. W. (1970). Determining of Sample Size for Research Activities. Educational & Psychological Measurement, 30: 607-610.

Moneke, G. O. (2000). Workshop Synopsis. In G. O. Moneke, Open and Competitive Tendering in the Procurement of public and Private Projects (pp. vi-vii). Lagos: NIQS.

Oladapo, M. A. (2000). Open and Competitive Tendering- A Vehicle for Transparency and Accountability in Governance. In G. O. Moneke, Open and Competitive Tendering in the Procurement of Public and Private Sector Projects (pp. 1-12). Lagos: The Nigerian Institute of Quantity Surveyors.

Omole, A. O. (2000). Framework for a Code of Procedure for Open and Competitive Tendering. In G. O. Moneke, Open and Competitive Tendering in the Procurement of Public and Private Sector Projects (pp. 20-36). Lagos: NIQS.

Oso, W. Y., & Onen, D. (2011). A General Guide to Writing Research Proposal and Report. Nairobi-Kenya: JKF.

Ottuh, J. A. (2013). Fighting Corruption in Nigeria (Titus 2:7-13): A Hemeneutico-Theological Approach. Journal of Arts and Contemporary Society, 5 (1): 1-21.

Owoyebi, L. O., Ganiyu, B. O., Oke, A. A., Ola-Awo, A. W., & Shittu, A. A. (2011). Determinants of Unethical Performance in Nigerian Construction. Journal of Sustainable Development, Vol. 4(4): 175-182.

Pallant, J. (2001). SPSS Survival Manual: A Step by Step to Data Analysis Using SPSS. New South Wales: Allen & Unwin.

Ramus, J., Birchall, S., & Griffiths, P. (2006). Contract Practice for Surveyors. Oxford: Butterworth-Heinemann.

Ray, R. S., Hornibrook, J., Skitmore, M., & Zarkada-Fraser, A. (1999). Ethics in Tendering: A Survey of Australian Opinion and Practice. Construction Management and Economics, 17: 139-153.

Regan, M. (2014). Value for Money in Project Procurement: Research Report for the Asian Development Bank 2013. Gold Coast-Australia: Bond University.

Sekaran, U. (2011). Research Methods for Business: A skill Building Approach, 4th Edn. New York: John Wiley & Sons, Inc.

Sichombo, B., Muya, M., Shakantu, W., & Kaliba, C. (2009). The Need for Technical Auditing in the Zambian Construction Industry. International Journal of Project Management, 27: 821-832.

Usman, N. D., Inuwa, I. I., & Iro, A. I. (2012). The Influence of Unethical Professional Practices on the Management of Construction Projects in North Eastern Sates of Nigeria. International Journal of Economics Development Research and Investment, Vol 3 (2): 124-129.

USING ANALYTIC HIERARCHY PROCESS (AHP) TO ASSESS EFFECTIVENESS OF COMPETITIVE TENDERING PROCESS

Sazoulang Douh[1]
[1]*Building Department, Ecole Nationale Supérieure des Travaux Publics (ENSTP), University of N'Djamena, Chad*

Despite reforms of public works procurement undertaken in Chad from 2000s, Competitive Tendering does not fully benefit developing countries as expected due to the ineffectiveness of the process. To improve the performance, one of appropriate ways is the assessment of the overall effectiveness. So, the paper aims at applying Analytic Hierarchy Process (AHP) in assessing the overall effectiveness of Competitive Tendering Process for works procurement at pre-contract stage. The effectiveness assessment uses seven criteria and thirteen related quantifiable indicators along five phases of the process. Based on these variables, two combined AHP hierarchies were constructed and used for data collection via a questionnaire from a sample of 60 procurement entities in Chad. 38 valid completed questionnaires were returned representing 63.32%. The main finding is an AHP adapted methodology involving nine steps which were fully described in the paper. Data were analyzed following this adapted methodology. A practical example is provided for illustration in appendix 2. The study concludes that AHP is an emerging and suitable method to evaluate performance of tendering process in works procurement with many other advantages.

Key words: AHP, overall effectiveness assessment, competitive tendering, developing countries

INTRODUCTION

US National Performance Review (2007), found that effectiveness assessment of tendering process impacts directly on the value for money. More specifically, assessing effectiveness of tendering process has been identified as one of the means to improve public procurement management performance (Patrice, 2008). In addition, there is an insisting request for improvement of public procurement performance from both donors and beneficiaries in developing countries (OECD/ACD, 2005). However, according to Oladapo (2000), an effective tendering process has to be open,

[1]sazoumata@gmail.com

Douh, S. (2017) Using analytic hierarchy process (AHP) to assess effectiveness of competitive tendering process *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1417-1432

transparent, fair, timely and cost effective and comply with rules, regulations and procedures set for. So, if these effectiveness attributes are adequately assessed and managed prior to the award of contract, it will surely mitigate the risks associated like delays, fraud, corruption, violation of rules, overprices, lack of transparency, lack of fairness and equity, poor productivity, etc. From the foregoing, any improvement in the effectiveness of Competitive Tendering Process (CTP) will undoubtedly increase the savings and gain other indirect benefits. In an attempt to develop a framework for assessing the effectiveness of competitive tendering process, seven relevant criteria and thirteen related key measurable indicators were established as well as a baseline of standard practices. Now, the problem is how to assess the overall effectiveness using these findings. That is why the present paper aims at describing a methodology that is employed in resolving this problem using an Analytic Hierarchy Process (AHP) approach.

Apart from this introduction, the paper is structured into five sections. The first presents the literature review including the background of the study followed by the method used. The third section is devoted to the presentation of developed methodology while the fourth section is consecrated to results discussion. Lastly, a conclusion ends the paper.

LITERATURE REVIEW

Effectiveness assessment process

Similar to performance measurement, a Measure of Effectiveness (MOE) indicates how well a system tracks against its purpose or normative behaviour (Richard, 2006). Hamilton and Chervany (1981) cited by Mouzas (2006) opined that effectiveness could be measured in two different ways: goal-centred view and system-resource view. The goal-centred view is concerned with assessing the organisation with respect to its task objectives by finding the difference between performance and objectives. In system-resource view, effectiveness is concerned with resource viability. For the assessment of a process' effectiveness, these considerations should converge as suggested by Mouzas (2006). Therefore, Effectiveness measures can be defined in a binary manner (e.g. goal achieved or not achieved) or by specifying a percentage by which the goal has been achieved (e.g. 82% in an assessment).

According to Bourne et al. (2003), effectiveness assessment cannot be done in isolation for it is only relevant within a reference plan against which the efficiency and effectiveness of action can be judged. Watermeyer (2013) added that in the effectiveness assessment process, the starting point is to clearly define objectives and expected outputs/outcomes as well as time lines, cost and levels of quality; then, perform activities and collect data; the end point is to compare the projected outputs/outcomes against the actual ones. In other words, effectiveness is achieved through setting specific goals and objectives, prescribing the expectations through formalisation of rules and roles, and monitoring conformance to these expectations (Baker and

Branch, 2002; Van-Weele, 2006). More explicit is the position of Watermeyer (2011a), who asserted that assessing a procurement process begins with the identification of project milestones to be reached, activities to be undertaken, products to be delivered, and/or projected costs likely to be incurred in the course of attaining a project's final goals. Then, the degree of difference from the expected process is used to evaluate success or failure (Teelken and Smeenk, 2003).

From the foregoing, effectiveness assessment process consists of defining a baseline (reference plan), identifying relevant criteria, determining related key indicators and setting corresponding target values, performing activities, collecting data, assessing the performance and finally comparing the actual results to the expected, judging the level of achievement that is the effectiveness.

Effectiveness quantification

According to Berrah et al. (2004) and Clivillé (2004), the quantification of an overall performance can be viewed as a procedure which, in a first step, quantifies the elementary performances; the second step then consists in their synthesis in an overall performance expression, generally thanks to an aggregation operator. Hence, the performance aggregation (Ag) can be formalized by the following mapping:

$Ag: E1 \times E2 \times ...Ei \times ...En \times \rightarrow E$ (1) and

$p1, p2..., pi ..., pn \rightarrow pAg = Ag\ p1, p2..., pi ..., pn$ (2) where

Ei's are the universes of discourse of the elementary performance expressions p1, p2, p3,.., pn and E is the universe of discourse of the overall performance expression pAg.

As the universes Ei's and E can be different, the determination of the aggregation mapping Ag is generally not straightforward. So, the transformation of physical measures into performance expressions can be given by the following relation (Berrah et al., 2004):

$P: O \times M \rightarrow E; (o,m) \rightarrow P(o,m) = p$

where O, M and E are respectively the universes of discourse of the set of objectives o, of the set of measures m and of the performance expression p.

To achieve that, there are several methods but the most popular in industrial performance measurement systems are MACBETH (Measuring Attractiveness by a Categorical Based Evaluation TecHnique), Fuzzy Logic (FL), and AHP (Clivillé, 2004; Berrah et al., 2006; Saaty, 2008; Tavakkoli-Moghaddam, 2012). Since the present research aims at assessing the overall effectiveness of CTP using multiple criteria and indicators, AHP emerges as a suitable method.

AHP Approach

Analytic Hierarchy Process (AHP) is a structured technique for dealing with complex decisions based on Mathematics and Psychology developed by Thomas L. Saaty since 1970 (Haas and Meixner (ND)). According to Kunz (2010), the AHP approach provides a comprehensive and rational

framework for structuring a decision problem, for representing and quantifying its elements, and for relating those elements to overall goal. According to Saaty & Vargas (2001), AHP uses a scale of nine numbers (1, 2, 3, 4, 5, 6, 7, 8, 9) that indicates how many times more important or dominant one element is over another. However, these nine numbers can be reduced to five numbers (1, 3, 5, 7, 9) as adopted by Saaty & Vargas (2001), Kunz, (2010) and Haas & Meixner (ND). Then, AHP uses hierarchy with many levels and permits to calculate mathematically 'Priority Vectors' or 'Weights' at different levels of the hierarchy; that fits perfectly the nature of the problem under study (criteria and related indicators). Instead of qualitative judgments like MACBETH and FL, AHP uses scales of figures that are directly computed without transformation; this can reduce subjectivity at the same time increase objectivity. In addition, AHP uses the weighted mean as aggregation operator at the top level of the hierarchy and calculations can be done by Excel without a specific software package. Therefore, AHP approach is selected for development of the methodology for assessing the overall effectiveness of CTP.

METHOD

The study adopted a quantitative approach with questionnaire as data collection instrument using Analytic Hierarchy Process (AHP) approach. Respondents are asked to pair-wise compare the identified 7 criteria and 13 indicators using a simplified AHP scale of 5 points: 1 = Equal Importance, 3 = Moderate importance, 5 = Strong importance, 7 = Very strong, and 9 = Extreme Importance (Saaty, 2000). The targeted population comprises 60 structures including public procurement entities, consulting firms, contractors and sponsors, and was considered as sample. Data analysis is done by an adapted AHP methodology involving five steps: (1) Identification of criteria and related measurable indicators, (2) Construction of AHP Hierarchy, (3) Collection of pair-wise comparisons from respondents and Verification of the Consistency of respondents, (3) Computation of Geometric Means of the consistent ratings and construction of a single pair-wise comparison matrix (Saaty, 2008), (4) Computation of relative weights of Criteria and Indicators with Consistency Ratio (CR) verification, (5) Computation of Composite Weights and ranking of Key Indicators (Kunz, 2010). Out of the 60 questionnaires administered, 38 valid completed questionnaires were returned representing 63.32%. The global rate of consistency test is 42.11%. The majority of respondents (60.52 %) are construction professionals, highly qualified and very experienced. The Consistency Ratios (CR), varying from 0.00 to 0.055 (< to 0.10), are indicating that respondents were very consistent. Besides, after the computation of the relative weights of criteria and indicators, a validation process was performed using Experts Approach. More than 70% of participants strongly agree on the relevance of these findings. Therefore, it can be concluded that results represent the point of view of qualified and experienced construction professionals and are considered valid.

DEVELOPED METHODLOGY

The main result of the study is the AHP adapted developed methodology of assessing the overall effectiveness involves nine steps as displayed graphically in the Figure 1 below.

Step 1: Establish goals and objectives with target values

Every country has its own goals and objectives for Public Procurement systems and operations. Besides the pursuit of development goals, countries usually have beyond the primary objective of procuring physical constructions, other objectives of generating jobs and employments for women and youth for instance through the use of High Labor Intensity programs. Naturally, some measurable indicators and target values are attached to these goals and objectives.

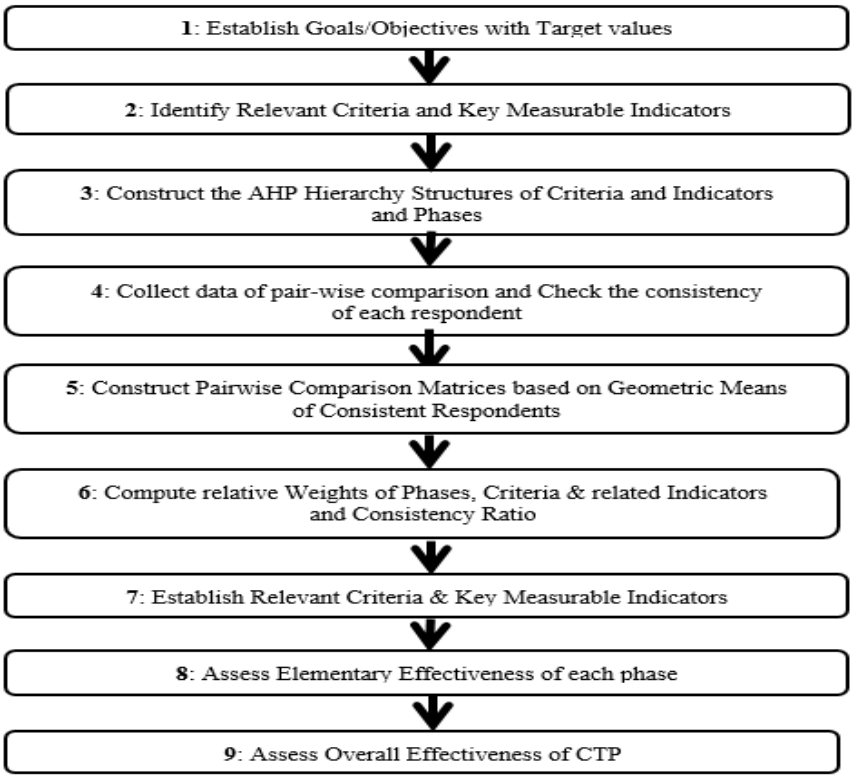


Figure 1: Adapted A.H.P. Methodology for assessing the overall Effectiveness of CTP
Source: Author's construction

Step 2: Identify relevant criteria and key measurable indicators

At this step, seven (7) following criteria were identified: Fairness and Equity, Competitiveness, Compliance and Conformity, Transparency and public Accountability, Ethics, Time Effectiveness, and Cost Effectiveness. Thirteen (13) following key measurable indicators were also considered in order of importance: Time for tender preparation, Applied Rate of Margin of Preference, Number and Nationalities of Bidders, Degree of Competitiveness, Advertisement total duration, Publicity frequency, Publicity extent, Time Performance Index, Cost Estimate Accuracy, Approvals Compliance Rate, Documentation Compliance Rate, Capacity Qualification Ratio, and Number of complaints or requests generated. All

these key measurable indicators are fully described as well as corresponding target values in Table 1 the next page. The next step is the construction of Saaty Hierarchies as shown in Figures 2 and 3 below.

Step 3: Construct hierarchies

Before constructing hierarchies, five (5) following critical phases of the CTP were established: tender Planning, tender Documentation, tender Solicitation, tender Evaluation and tender Pre-Award on one hand, and a baseline of 38 standard practices along the competitive tendering process were defined on the other hand. Based on the five (5) main phases of the process, the seven relevant criteria and the thirteen key measurable indicators presented above, two Saaty Hierarchies were constructed as shown in Figures 2 and 3.

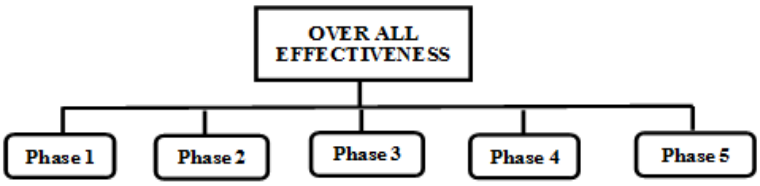


Figure 2: AHP Hierarchy for Phases – Source: Author's construction

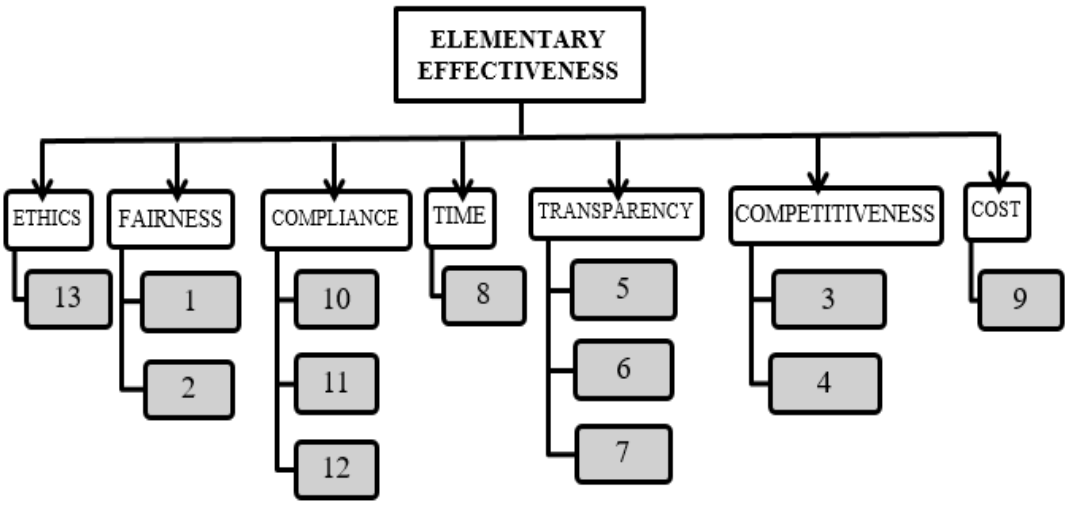


Figure 3: AHP combined hierarchy for Criteria & related Indicators
Source: Author's construction

Numbers 1 to 13 in Figure 3 represent respectively the indicators as listed above in Table 1.

Table 1: Identified Key Measurable Indicators with corresponding Target values

Rank	Indicator's designation	Brief description of Indicator	Formula / Expression Unit	Target values
1	Time for tender preparation	Is the actual time the last tenderer get for bid preparation	(Date of bids submission – Date of last tender documents sold); In days	≥ **45 days**
2	Advertisement total duration	Actual duration of the tender announcements	(Date of last announcement –Date of first announcement); In days	≥ **15 days**
3	Number and Nationalities of Bidders	Combined Number of national bidders and Foreign bidders	(National Bidders + Foreign Bidders) / 2; Numerical number	≥ **5**
4	Publicity frequency	Frequency of advert diffusions/publication in a week	How many times the advert was published in a week; Numerical number	≥ **2 times**
5	Time Performance Index	Is the actual ratio of the time performance and time allocated for the phase	(Time performed / Time allocated); Numerical number	≤ **1**
6	Number of complaints or requests generated	Expresses a sort of bidders' satisfaction	Number of formal complaints or requests for clarification registered; Numerical number	= **0**
7	Cost Estimate Accuracy	Is the actual variations of estimates as compared to initial budget	[(Initial Budget – Actual Estimate)/Initial budget]x100; In percentage	> **0 and** < **15%**
8	Publicity extent	Number of different media used for advertisement	Number of News-paper, radio, TV, Internet, Numerical number	≥ **3 media**
9	Approvals Compliance Rate	Is the actual ratio of required approvals and performed approvals along the process	(Approvals performed / Approvals required) x 100; In percentage	= **100%**
10	Degree of Competitiveness	Expresses variations among of bids' prices	[(High bid - Low bid) / Winner Bid] x 100); In Percentage	≤ **10%**
11	Documentation Compliance Rate	Is the actual ratio of the total number of documents required & recorded and provided	(Recorded Proceedings provided / proceedings required) x 100; In Percentage	= **100%**
12	Applied Rate of Margin of Preference	Actual rate used for that particular project as compared to the prescribed	Applied fraction of the prescribed Margin of Preference; In Percentage	≤ **10 %**
13	Capacity Qualification Ratio	The level of Capacity qualification (appropriate profiles via CVs)	(Qualified members / Non- qualified members); Numerical number	≥ **1**

Source: Author's construct

Step 4: Collect data of pair-wise comparison and check the consistency of each respondent

Using the above constructed hierarchies, pair-wise comparisons data are collected through questionnaire. Then, come successively the verification of the consistency of respondents, the computation of geometric means, the construction of the single pair-wise comparison matrix, the computation of relative weights of all the variables (phases, criteria and indicators) and the calculation of composite weights of key indicators (see demonstrative example in Appendix 1 for details and better understanding of the full procedure).

Step 5: Construct Pairwise Comparison Matrices based on Geometric Means of Consistent Respondents

A sample of pair-wise comparison matrix is presented below in Table 2 for illustration and is fully explained in Appendix 1.

Table 2: A sample of a single Pair-wise comparison matrix

Criteria	A	B	C
A	1	3	6
B	*1/3*	1	2
C	*1/6*	½	2

Step 6: Compute relative weights of phases, criteria and related indicators and consistency ratio

The computation of weights and relative weights is also fully described in the Appendix 1. However, in Tables 3 and 4 in the next page are presented computed Relative Weights of critical phases and those of relevant criteria as well as of key measurable indicators when using the actual collected data.

Step 7: Establish Relevant Criteria & Key Measurable Indicators
From Table 4, the high ranked criterion is Transparency with 0.292 of weight followed by Fairness and Competitiveness with 0.203 and 0.190 respectively. These three criteria put together do weight about 0.685 being almost 70% of the performance. Compliance has gained 0.101 and occupies the fourth rank. The scores of Time and Ethics are 0.077 and 0.073 respectively whereas Cost is the last with only 0.065 indicating probably that cost factor is of less relevance at pre-contract stage. However, assuming that all criteria were of equal weight, that means each would have 1/7 = 0.1428. The above scores as compared to the assumed average weight, it can be concluded that the most relevant criteria are in order of importance transparency, fairness and competitiveness. Applying the same rule to indicators, the established key measurable indicators are listed in Table 1 above.

Table 3: Relative Weights of Critical Phases of CTP

Phases	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Nth Root	Weights	Rank
Tender Planning	1.000	2.020	2.118	2.925	3.051	*2.072*	0.363	1
Tender Documentation	0.495	1.000	2.700	2.233	2.470	*1.491*	0.261	2
Tender Solicitation	0.472	0.370	1.000	1.817	2.053	*0.918*	0.161	3
Tender Evaluation	0.342	0.448	0.550	1.000	3.483	*0.783*	0.137	4
Tender Pre-Award	0.328	0.405	0.487	0.287	1.000	*0.451*	0.079	5
Sum =	2.637	4.243	6.855	8.262	12.057	5.714	1.000	
Sum*Weights =	0.956	1.107	1.101	1.131	0.951			
λ max = 5.247								
C.I. = 0.062								
RI = 1.12								
CR = 0.055								

Source: Author's construction

Table 4: Composite weights of relevant Criteria with key measurable Indicators

Criteria / Indicators	Trans. 0.292	Compt. 0.190	Fairn. 0.203	Compl. 0.101	Time 0.077	Cost 0.065	Ethics 0.073	λ max 7.190	CR 0.024	Comp. Weights
Transparency	(0.292)							*3.031*	0.027	
Indicator 1	0.507									0.148
Indicator 2	0.292									0.085
Indicator 3	0.201									0.059
Competitiveness		(0.190)						*2.000*	0.000	
Indicator 1		0.766								0.145
Indicator 2		0.234								0.044
Fairness			(0.203)					*2.000*	0.000	
Indicator 1			0.834							0.169
Indicator 2			0.166							0.034
Compliance				(0.101)				*3.024*	0.021	
Indicator 1				0.504						0.051
Indicator 2				0.363						0.037
Indicator 3				0.133						0.013
Time					0.077			*1.000*	0.000	0.077
Cos						0.065		*1.000*	0.000	0.065
Ethics							0.073	*1.000*	0.000	0.073
Total =										1.000

Source: Author's construction

Step 8: Assess Elementary Effectiveness of each phase
The assessment of Elementary Effectiveness involves three following steps: (i) compare collected data to target value and score the actual measure (X) of the Indicator accordingly; (ii) the actual measure of an indicator is multiplied by its weight (Ki) to get a weighted value of considered indicator (X*Ki); (iii) the sum of weighted values is divided by the sum of indicator's weights to obtain the score of the elementary effectiveness. Before continuing to the next step, the Table 5 below presents the adopted scoring system which is a scale of 0 to 9 corresponding to their respective qualitative appreciations.

Table 5: Indication of scoring or marking system

Qualitative appreciation	Marks
Perfect	8.0 – 9.0
Excellent	7.0 – 7.9
Very good	6.0 – 6.9
Good or acceptable	5.0 – 5.9
Fair	4.5 – 4.9
Not acceptable	2.5 – 4.4
Nil or worthless	0.0 – 2.4

When elementary effectiveness (ei) is < 6, the corresponding phase of the process has to be re-done. If ei is ≥ 6, the process continues to the next phase. The results of the full demonstrative application are presented in Appendix 2.

Step 9: Assessment of the Overall Effectiveness
Finally, the assessment of the Overall Effectiveness is as follows: the actual measure of elementary effectiveness (ei) is multiply by the weight of the phase (Kp) to get a weighted value of the considered phase (ei*Kp) and the weighted ei values are summed up to give the Overall Effectiveness (E). When E is < 6, the whole process is to be cancelled. When E is ≥ 6 the contract is awarded to the winner. The results of the full demonstrative application are presented in Appendix 2 where, it is worth to note that target values are extracted from Chadian context.

RESULTS DISCUSSIONS

From what precedes, it can be inferred that AHP approach is the most suitable as compared to MACBETH (Measuring Attractiveness by a Categorical Based Evaluation TecHnique) or Fuzzy Logic (FL). Though MACBETH approach allows the evaluation of options against multiple criteria, it needs only qualitative judgments (i.e. No, Very Weak, Weak, Moderate, Strong, Very strong and Extreme) about differences of attractiveness between 2 elements at a time, in order to generate numerical scores for each criterion and to weight them. Whereas Fuzzy Logic (FL) is

basically a multivalued logic that allows linguistic evaluations like true/false, yes/no, high/low, etc. to be formulated mathematically and processed by computers (Amrahov and Askerzade, 2010). In other words, it translates subjective judgment given in linguistic expressions (i.e., "low," "high," etc.) into mathematical measures. In addition, Fuzzy approach requires sufficient expert knowledge for the formulation of the rule base, the combination of the sets and the defuzzification. According to Amrahov and Askerzade (2010), the employment of FL is helpful when there is no simple mathematical model, specifically for highly nonlinear processes or when the processing of linguistically formulated expert knowledge is to be performed.

In short, AHP is an emerging method to evaluate performance because an earlier survey provided over 200 known applications in the evaluation of the overall performance (Forman and Gass, 2003; Yang and Shi, 2002; Zahedi, 1986). Not only that, AHP offers many other following advantages. First, AHP uses hierarchy with many levels and permits to calculate mathematically 'Priority Vectors' or 'Weights' at different levels of the hierarchy; that fits perfectly the nature of the problem studied (phases, criteria and related indicators). Second, it uses scales of figures that are directly computed without transformation; that can reduce subjectivity at the same time increase objectivity. Third, it uses the weighted mean as aggregation operator at the top level of the hierarchy. Fourth, calculations and analysis can be done by Excel without a specific software package. Fifth, it is open for adaptation and has many modified versions, and still gives reliable results. Sixth, it is very popular and commonly adopted in industrial sector. Furthermore, it has been subjected to many criticisms, but it still gives absolute satisfaction in many areas of multi-criteria decision making.

Of course, some concerns have been raised regarding AHP for the arbitrary ranking occurred when two or more alternatives have similar or quasi-similar characteristics (Triantaphyllou & Mann, 1995), or the rank reversal caused by the addition or deletion of alternatives (Dyer, 1990; Perez, 1995; and Tversky & Simonson, 1993). These undesirable effects however do not invalidate the AHP method, argued Harker & Vargas (1987) and Saaty & Vargas (1993) and Triantaphyllou and Mann (1995). In fact, ordinal aggregation methods exhibit rank reversal and it has been shown that the rank reversal will not be a problem in real world applications because it is very rare to encounter two alternatives with very similar or same characteristics. In such case, special precautions (e.g., grouping similar alternatives) can easily be taken to avoid any rank reversal (Saaty, 1990).

CONCLUSION

Assessing Competitive Tendering Process' overall effectiveness for awarding contract is obviously a complex multi-criteria problem. There are many ways to solve such problem but AHP has emerged as the suitable method among others in assessing the effectiveness. Not only that, AHP approach has been acknowledged as a structured technique for dealing with multi-criteria performance assessment procedure. In effect, the main

finding of the study is an AHP adapted methodology involving nine steps that were fully described in the paper in a specific section. Besides the successful application of the developed methodology, the study demonstrated that AHP offers many other advantages in assessing the overall effectiveness of Competitive Tendering Process. A full demonstrative example of weights computation through pair-wise comparison matrix is provided in appendix 1 for better understanding the procedure. In addition, a practical implementation of the methodology is attached in appendix 2 as proof. As a matter of fact, the successful application of AHP approach in the overall effectiveness assessment of competitive tendering process has generated undoubtedly a new approach which will promote its frequent usage in construction industry in general and in Construction Project Management in particular. In brief, the study concludes that AHP is an emerging and suitable method to evaluate performance of tendering process in works procurement.

REFERENCES

Berrah, L. and Clivillé, V. (2004). Towards a Quantitative Performance Measurement Model in a Buyer-Supplier Relationship Context. (LISTIC), Université de Savoie, France.

Berrah, L., Foulloy, L. and Clivillé, V. (2013). Towards an unified methodological framework for both Industrial Objectives break-down and performance expression. IESM' 2013 Conference proceedings, Rabat, Marroco, Oct. 28 – 30, 2013.Clivillé, V. (2004). Approche Systémique et Méthode Multicritère pour la définition d'un Système d'Indicateurs de Performance, Thèse de Doctorat, Université de SAVOIE, France.

Dyer, J. S. (1990). Remarks on the Analytic Hierarchy Process. In: Management Science, 36(3), 249-258.

Forman, H. E. and Gass, I. S. (2003). The Analytical Hierarchy Process – An Exposition

Haas, R. and Meixner, O. (ND). An illustrated Guide to the Analytical Hierarchy Process, Unpublished paper, University of Natural Resources and Applied Life Sciences, Vienna, retrieved from www.boku.ac.at/mi/.

Kunz, J. (2010). The Analytical Hierarchy Process, an Unpublished paper presented to the Eagle City Hall Location Options Task Force, February/March 2010.

OECD-DAC. (2005). The Paris Declaration on Aid Effectiveness. Adopted at the first High-Level Forum on Aid Effectiveness, Paris March 2nd, 2005

Oladepo, M. A. (2000). Open and Competitive Tendering – A vehicle for Transparency and Accountability in Governance. In: Open and Competitive Tendering in the Procurement of Public and Private Sector Projects. Nigeria Institute of Quantity Surveyors (NIQS), Lagos, Nigeria

Patrice E. M. (2008). Etude pour l'amélioration de l'efficacité de la Passation des Marchés Publics au Tchad: Rapport Diagnostic (R1), N'Djaména, Tchad.

Perez, J. (1995). Some Comments on Saaty's Analytic Hierarchy Process, In Management Science, 41(6), pp. 1091-1095.

Saaty, T. L. (1990a). An Exposition of the AHP in reply to the Paper: Remarks on the Analytic Hierarchy Process, In Management Science, 36(3), 259-268.

Saaty, T. L. (1990b). How to Make a Decision: The Analytic Decision Process, In European Journal of Operations Research, Vol.48, pp. 9-26.

Saaty, T. L. (2008). Decision Making with the Analytic Network Process. In International Journal Services Sciences, Vol. 1, No 1.

Saaty, T. L. and Vargas, L. G. (1993). Experiments on Rank Preservation and Reversal in Relative Measurement: Mathematical and Computer Modeling, Vol. 17(4/5), pp. 13-18.

Saaty, T. L. and Vargas, L. G. (2001). Models, Methods, Concepts and Applications of the Analytic Hierarchy Process, Boston: Kluwer Academic Publishers.

Tavakkoli-Moghaddam, R., Mousavi S. M. and Hashemi, H. (2012). A Fuzzy comprehensive approach for risk identification and prioritization simultaneously in EPC Projects, retrieved from www.interchopen.com pp.123-145.

Triantaphyllou, E. and Mann, H. S. (1995). Using the AHP for Decision Making in Engineering applications: Some challenges, In: International Journal of Industrial Engineering: Applications and Practice, Vol. 2, No. 1, pp. 35-44.

Tversky, A. and Simonson, I. (1993). Context-Dependent Preferences. Management Science, 39(10), 1179-1189.

US/GAO, (2009). Framework for Assessing the Acquisition Function at Federal Agencies. In: K.T. Thai, ed. International Handbook for Public Procurement. New York: CRS Press, pp. 27-65.

Yang, J. and Shi, P. (2002). Applying Analytic Hierarchy Process in Firm's Overall Performance Evaluation: A Case Study in China. In: International Journal of Business 7(1), 2002. ISSN: 1083-4346

Zahedi, F. (1986). The Analytic Hierarchy Process - A Survey of the Method and Its Applications. Interfaces 16(4), 96-108.

APPENDIX 1: DEMONSTRATIVE EXAMPLE OF WEIGHTS COMPUTATION

Let us have three criteria A, B and C that are pair-wise compared using the Saaty 9 points scale. In comparing them a particular expert gave the following ratings.

A = 3 as compared to B ➔ B = 1/3 as compared to A (i.e. reciprocity);

A = 6 as compared to C ➔ C = 1/6 as compared to A (i.e. reciprocity);

To be logic or consistent, B = 6/3 = 2 as compared to C ➔ C = 1/2 as compared to B and A = 1 as compared to itself.

a) Developing a single pair-wise comparison matrix

The resulting matrix below is 3 x 3 because the criteria to be compared are 3 (A, B, & C). Table 2 presents the results. The values in Italic *(1/3, 1/6, 1/2)* in the table represent the reciprocals as explained above.

Table 2: A single Pair-wise comparison matrix

Criteria	A	B	C
A	1	3	6
B	1/3	1	2
C	1/6	½	2

b) Calculation of Relative Weights

The calculation of weights involves the computation of "nth-root-of-product" and the "priority vector" or weights. The column labelled "nth-root-of-product" is the nth root of the product of all the values in the row. Each of the aforementioned third-root-of-product values are then added together to equal the Sum in the last row. Then, the nth-root-of-product values from the previous step will be normalized to get the appropriate weight for each criterion. The weight is the ratio of nth-root-of-product over the Sum as shown in the Table 3 below. Note that when calculated correctly, the total sum of weights of all criteria must equal to one.

Table 3: Calculation of the Weights or Priority Vectors

Items	A	B	C	Nth Root of the Product	Weights
A	1	3	6	(1*3*6)^(1/3) = 2.621	2.621/3.455 = 0.759
B	1/3	1	2	(1/3*1*2)^(1/3) = 0.667	0.667/3.455 = 0.193
C	1/6	½	2	(1/6*1/2*2)^(1/3) = 0.16′	0.167/3.455 = 0.048
Sum =	1+1/3+1/6 = 1.50	3+1+1/2 = 4.50	6+2+2 = 10.00	2.621+0.667+0.167 = 3.455	0.759+0.193+0.048 = 1

c). Verification of the Consistency Ratio (CR)

Calculating the CR is a four-step process. First, the pair-wise comparison values in each column are added together (as the "Sum" values) and each sum is then multiplied by the respective weight (from weights column) for that criterion. Note that the row labeled "Sum*PV" shown in the matrix below is the result of multiplying the respective sum (shown in the row

immediately above) by the respective weight for that criterion (shown in the column labeled "Weights"). Second, the aforementioned values (shown in the row labeled "Sum*PV") are added together to yield a total that is the Lambda-max. Unlike the weights which must sum up to one, Lambda-max will not necessarily equal one. Third, the Consistency Index (CI) equals to (Lambda-max –n) / (n–1) where <n> is the number of criteria being compared. Lastly, the Consistency Ratio (CR) is calculated by dividing the Consistency Index (CI) (from the previous step) by a Random Index (RI), which is determined from a lookup Table 4 below. Note that Random Index (RI) is a direct function of the number of criteria or factor being considered.

Table 4: Random Indices (RI)

N (number of items)	1	2	3	4	5	6	7	8	9
Random Index (RI)	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

The Consistency Ratio (CR) tells the decision-maker how consistent he/she has been when making the pair-wise comparisons. A higher number means the decision-maker has been less consistent, whereas a lower number means the decision-maker has been more consistent. If the Consistency Ratio (CR) <0.10, the decision-maker's pair-wise comparisons are relatively consistent and no corrective action is necessary. If the Consistency Ratio (CR) > 0.10, the decision-maker should seriously consider re-evaluating his/her pair-wise comparisons (e.g. the source(s) of inconsistency must be identified and resolved and the analysis re-done). The final results are presented below in Table 5. The ranking of criteria gives A first with a weight of 0.759, B second with 0.193 and C last with 0.048.

Table 5: Synthesis of Weights

Criteria	A	B	C	Nth R of Pr	Weights
A	1	3	6	2.621	0.759
B	1/3	1	2	0.667	0.193
C	1/6	½	2	0.167	0.048
Sum of columns =	1.50	4.50	10.00	3.455	1
Sum*Weights =	1.1385	0.8685	0.4800		
Lambda Max =	2.487				
Consistency Index (CI) =	-0.513				
Random Index (RI) =	0.58				
Consistency Ratio (CR) =	-0.088				

4). Calculation of Composite Weights

To get the composite weight of an indicator, the relative weight of indicator under a specific criterion is multiplied by the corresponding criterion's weight to give. For example, assuming that the weights of two sub-criteria of criterion A (with a weight of 0.759 in table 6 above) are a1 = 0.6 and a2 = 0.4 (the sum of weights must always equal to 1); the composite weight of a1 is 0.60*0.759 = 0.455 and that of a2 is 0.40*0.759 = 0.303.

APPENDIX 2. A PRACTICAL IMPLEMENTATION OF THE METHODOLOGIE

Table 1: Elementary Effectiveness of Tender Planning

Measurable Indicators	Target Values	Actual measures	Assess. Score(X)	Weights (Ki)	Actual Values (X*Ki)
1.Time Performance Index	≤ 100%	120%	5	0.077	0.385
2. Cost Estimate Accuracy	≤ 100%	90%	8	0.065	0.520
3. Publicity extent	≥ 3	2	7	0.059	0.413
4. Number of approvals and controls performed	= 100%	100%	9	0.051	0.459
5. Documentation Rate	= 100%	50%	4	0.037	0.148
6.Capacity Qualification ratio (Project team)	= 100%	30%	3	0.013	0.039
Sum =				0.302	1.964
Elementary Effectiveness at phase 1 (e1) = 1.964 / 0.302 =					6.503

Table 2: Elementary Effectiveness of Tender Documents

Measurable Indicators	Target Values	Actual measures	Assess. Score(X)	Weights (Ki)	Actual Values (X*Ki)
1.Time Performance Index	≤ 100%	90%	9	0.077	0.693
2.Cost Estimate Accuracy	≤ 100%	80%	6	0.065	0.390
3.Number of approvals and controls performed	= 100%	100%	9	0.051	0.459
4.Documentation Rate	= 100%	80%	7	0.037	0.259
5. Capacity Qualification ratio (Tender commit.)	= 100%	25%	3	0.013	0.039
Sum =				0.243	1.840
Elementary Effectiveness at phase 2 (e2) = 1.840 / 0.243 =					7.572

Table 3: Elementary Effectiveness of Tender Solicitation

Measurable Indicators	Target Values	Actual measures	Assess. Score (X)	Weights (Ki)	Actual Values (X*Ki)
1.Time Performance Index	≤ 100%	115%	6	0.077	0.462
2. Advertisement total duration	≥ 21 days	22 days	9	0.148	1.332
3.Publicity Extent	≥ 3	4	9	0.059	0.531
4.Publicity frequency	≥ 3	2	7	0.085	0.595
5.Number of requests of clarifications	= 0	2	7.5	0.073	0.548
6.Time allocated for tender preparation	≥ 60 days	75 days	9	0.169	1.521
Sum =				0.611	3.468
Elementary Effectiveness at phase 3 (e3) = 3.468 / 0.611 =					8.165

Table 4: Elementary Effectiveness of Tender Evaluation

Measurable Indicators	Target Values	Actual measures	Assess. Score (X)	Weights (Ki)	Actual Values (X*Ki)
1.Number and Nationalities of Bidders	≥ 5	4	8	0.145	1.160
2.Time Performance Index	≤ 100%	75%	9	0.077	0.693
3.Cost Estimate Accuracy	≤ 100%	95%	8.5	0.065	0.552
4.Degree of Competitiveness	= 100%	96%	8	0.044	0.352
5.Applied Rate of Margin of Preference	≤ 10%	0%	9	0.034	0.306
6.Capacity Qualification Ratio	= 100%	15%	2	0.013	0.026
7. Documentation Rate	= 100%	100%	9	0.037	0.333
Sum =				0.415	3.422
Elementary Effectiveness at phase 4 (e4) = 3.422 / 0.415 =					8.246

Table 5: Elementary Effectiveness of Tender Pre-Award

Measurable Indicators	Target Values	Actual measures	Assess. Score (X)	Weights (Ki)	Actual Values (X*Ki)
1.Time Performance Index	≤ 100%	98%	7.5	0.077	0.578
2.Number of complaints or litigations generated	= 0	2	7.5	0.073	0.548
3.Cost Estimate Accuracy	≤ 100%	90%	8	0.065	0.520
4. Publicity extent	≥ 3	2	7.5	0.059	0.442
5. Approvals Compliance Rate	= 100%	75%	7	0.051	0.357
6. Documentation Compliance Rate	= 100%	75%	6	0.037	0.222
7. Capacity Qualification Ratio (Award commi.)	≥ 100%	50%	6	0.013	0.078
Sum =				0.316	2.745
Elementary Effectiveness at phase 5 (e5) = 2.745 / 0.316 =					8.687

Table 6: Overall Effectiveness Assessment

Main Phases	Elementary Effectivenesses (X)	Weights (Kp)	Actual Values (X*Kp)
1. Tender Planning	6.503	0.363	2.360
2. Tender Documentation	7.572	0.261	1.976
3. Tender Solicitation	8.165	0.161	1.314
4. Tender Evaluation	8.246	0.137	1.130
5. Tender Pre-Award	8.687	0.079	0.686
Sum =		1.000	7.466
Overall Effectiveness E = 7.466 / 1.000 =			7.466

VALUATIONS FOR COMPENSATION PURPOSE: THE NEED FOR GLOBAL UNIFORMITY

Rosli Said[1], Anuar Alias[2], Olusegun Olaopin Olanrele[3] and Nurudeen Akinsola Bello[4]

[1,2]*Department of Estate Management, Faculty of Built Environment, University of Malaya, Kuala Lumpur, Malaysia.*

[3]*Department of Estate Management and Valuation, School of Environmental Studies, Moshood Abiola Polytechnic, Abeokuta, Ogun State, Nigeria*

[4]*Department of Estate Management, Faculty of Environmental Sciences, University of Ilorin, Ilorin, Nigeria*

Compulsory land purchase is a tool for the control of land uses as well as land acquisition for developmental projects by the public authorities, deriving such power in the relevant laws of different countries which usually provide for monetary compensation to the land/property owners whose land were confiscated. This study examined the compensation process of some countries across the continents in a search for a global standard for uniformity. The research adopted a content analysis of the provisions of compulsory land purchase laws of selected countries and literature review of some papers on compensation for compulsory land acquisition from different countries. There is no definition of 'adequate compensation' in the public land acquisition law of any of the countries under focus. The study found a provision for compensation in the various public land acquisition laws examined, with use of different nomenclature (Just, Fair, Equity, Equivalent) to qualify the compensation value. There is also no uniformity on the basis of valuations for compensation purpose across countries. In the spirit of globalisation and the various international standard being established like the financial reporting (IFRS) and valuation practise (IVSC-RICS Red Book), it will be germane to have a global standard for compensation to be adopted and incorporated in the various laws on compulsory land purchase and compensation. The study concludes that there is a need for global uniformity in valuation basis and methodology for global standard that should be adopted in compulsory land acquisition laws and implementation.

Keywords: compensation, compulsory acquisition, global, uniformity, valuation

[1] rosli_alambina@um.edu.my

[2] annuar_a@um.edu.my

[3] olanrelesegun@yahoo.com

[4] bello4all007@yahoo.com

Said, R., Alias A., Olanrele, O. O. and Bello, N. A. K. (2017) Valuations for compensation purpose: the need for global uniformity *In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference,* 16-18 August 2017, Accra, Ghana, 1433-1447

INTRODUCTION

Compensation for compulsorily land acquisition has continue to attract debates globally in the area of the adequacy of claim payment whether or not it is in the spirit of the definition of compensation (Alias & Daud, 2006; Bailey & Clough, 2009; Bello & Olanrele, 2016; Dundas & Evans, 2009; Famuyiwa & Omirin, 2011 and Rowan-Robinson & Hutvhison, 1995). The increasing rapid growth of countries coupled with high demand for land and the pressure on government to provide public amenities to meet the increasing population has inevitably led to government exercise of its power of eminent domain. Debates have identified inefficient process of compulsory acquisition with its resultant effect on economic growth (Bello and Olanrele, 2016, FAO, 2008). Though compulsory acquisition for development purpose is expected to be beneficial to the people, it is usually a disruptive exercise with its attendant displacement of original land owners, occupants and businesses (with loss of patronage and loss of goodwill). It often results in homelessness to some people leaving the affected persons with a wound of grave injustice.

It is understandable that the present era of sustainability in every aspect of human endeavour depends on adequate provision of infrastructures in terms of public utilities such as housing, schools, health institutions, transport and power/energy, drainages and other welfare goods from the government. Vital to the provision of the public good is the acquisition of land. Where suitable land is not available to purchase through land market, the government exercise its power of compulsory purchase by compelling the land owners to sell their interest in their properties to government for the actualization of a specific purpose of development of public infrastructure (FAO, 2008). Thus, public land acquisition is an inherent power of government to acquire land rights compulsorily for a beneficial purpose to the entire society. This power is possessed by the governments of every country through different laws or statutes. Some states have their land acquisition statutes embedded in the constitution (United States, Rwanda, Ghana, Chile) while others enacted specific Acts on compulsory land purchase (United Kingdom, Australia, Malaysia, Nigeria) and the various declaration for the protection of land rights.

Resettlement is another way of making compensation for acquired land especially with agricultural land. This is considered as an alternative to monetary payment of compensation provided for in some statutes. In Ghana, alternative land can be provided for any land taken, and also in Australia; Canada provides a “Home for Home” resettlement in lieu of monetary compensation. Nigerian Land Use Act provided for resettlement of displaced home owners in a new accommodation but without the principle of equivalence and equity. The law stated that claimant will be deemed fully satisfied if the value of resettlement is lower than the value of property acquired but treated excess value of the resettlement over acquired property as loan to be repaid by the resettled owners- a situation of double standard that put the claimants on a receiving end. Denmark uses land consolidation

techniques in compensation for farmlands through resettlement as full compensation when value of the resettlement is lower than the value of land acquired (FAO, 2008). In case of financial compensation, the basis should be the principle of equity and equivalent where the money paid should be able to fully replace the lost and put back the claimants on their immediate position before the acquisition. Under the principle of equity and equivalence of compensation, is the requirement of a flexible law that guides and allows assessment of adequate and equivalent amount of compensation.

A cross sectional look on the various public land acquisition and compensation process and practice reveals differences in what could be termed 'adequate compensation' as provided in different statutes in respect of the method of assessment and the list of item/objects that can be compensated for. This study is conceived to set the tone for the need for global standardisation of compensation value assessment in public land acquisition exercise and the for the concerned built environment professionals awareness and action. The issues of the impacts of appeal in case of unacceptable compensation value are outside the scope of this paper. The following sections examine the process of exercising the power of eminent domain in some countries of the world across the whole continents in a literature search. The methodology of the study is followed with analysis and results while discussion of findings and conclusion are presented in the last sections.

LITERATURE REVIEW

This review of literatures searches different land compensation statutes but focused more on articles that have appraised the compensation valuation practice through the implementation of the relevant laws.

Compulsory land purchase is the implementation of the power of government to acquire private interest in land (land rights of individuals) through the exercise of the power of eminent domain for the purpose of public good. However, these cannot be undertaken without the backing of a law or statute. Therefore, public land acquisition by government in any society (country) is usually legally backed by provisions of an enabling law. Such laws make provision for an acquiring agency that undertakes the acquisition for the government (usually a department of the government), lay down the specific process and procedure, and make monetary compensation (or resettlement) to affected owners. Most Acts also define the meaning of compensation and expected the value is fair to the affected land owners. The law could also specify the method of assessment of compensation sum for the acquired land. Compensation is a term that was adopted by a number of statutes, and used in different context. According to Alias and Daud (2006) it has a meaning for worker's compensation, a different meaning under the law of contract and tort and when used with respect to land right acquisition, it means the sum payable to a disposed land owner for the land taken plus other losses suffered as a result of the compulsory land purchase.

Valuation for compensation purpose is a statutory valuation that relies solely on the provisions of the enabling Act which will determine what qualified for compensation and how compensation will be estimated. In the United States, the power to compulsorily acquired land is contained in Article V of the Constitution and there is provision for just compensation (FAO 2008). The Rwanda's constitution provided that public purchase of land can only be the reason for the provision of public utilities in line with established laws (where details and court interpretation were stated) and a fair compensation must be paid before the effective possession of the acquired land, this was stated in Table II, Article 23. (FAO 2008). The Constitution of Ghana listed the projects and purposes for which there can be compulsory land purchase (Chapter 5, Article 20). The displaced persons can be resettled in an alternative land especially agricultural land. The Chilean Constitution through Chapter III, Article 19&24, in addition to purposes of acquisition, identifies the owner's right to court action, specifies the method of assessment for compensation purpose and the timing and sequence of taking possession. All land in Hong Kong is practically a leasehold or licence land with the exception of St John Cathedral Church which has a freehold title. Compulsory land acquisition is governed by the Basic Law of the Hong Kong Administrative Region of the Peoples Republic of China 1990 (a main constitution of Hong Kong). It was stated in Article 105 that compensation shall be equal to the real value of the property.

Compensation in Australia is regarded as a matter of statutory entitlement and it is based on the principle is of **"Just Term"** as provided in section 51 (xxx) of the Australia constitution which is also enforced in the NSW under the Land Acquisition (just terms compensation) Act of 1991. 'Just Term' is not defined in the constitution but assumed to be 'value to the owner' principle which acknowledged that compensation is more that the market value of the land taken (Chan, 2008). This principle does not only retain the concept of market value but also take into account any disturbance to the claimant as a result of the compulsory purchase of their interest in land, bringing the compensation sum to be more the ordinary sale price of the acquired land obtainable from a waiting buyer.

Compulsory land acquisition in other countries is backed with extensive laws in addition to the constitution provision. The Acts/laws specify the purpose of land acquisition, agencies to exercise the power of eminent domain, method of valuation for compensation and handling of claims and appeals that may result (mostly in reference to a tribunal or court). In the UK (in the 19th century) early legislations identified situation for compensation in an event of compulsory acquisition but left the amount of compensation for the courts to decide. United Kingdom court view compensation as the value loss to an owner of acquired land with no consideration for deprivation of a betterment which others whose land are not acquired could benefit from, creating a huge disparity of value between the claimants and their unaffected neighbour. The compensation bases shifted in 1917 to market value from the view of the court and through the Land Compensation Act of 1961 in its section 5, compensation for acquired

land is ….***"the amount which the land if sold in the open market by a willing seller might be expected to realize"*** – the open market value (Plimmer & Dubben, 2003). Scotland in addition provided for home loss (rent or buying) and farm loss (Scottish government, 2011)

The notion of adequate compensation is conceived in the Article 13 of Malaysia Federal Constitution of 1957 but the attributes of adequate compensation is yet to be fulfilled by Land Acquisition Act, 1960 which is the stipulated law on compulsory land acquisition and compensation in Malaysia (Alias and Daud, 2006). In Nigeria, the Land Use Act (Decree No. 6) of 1978 governs the process of public land acquisition for public purpose, the reasons and procedure are contained in section 28 and section 29 of the same Act provided for compensation with clear mention of items that can be compensated for and the method of assessment of compensation amount (Bello & Olanrele, 2016).

A fair approach to land acquisition arise when the people's right over their land is respected and adequate compensation is paid to displaced people. This is provided in the different laws on compulsory acquisition of land across countries and also in the constitutions of different countries. There are also declarations for the protection of land rights and payment of compensation when land rights are compulsorily acquired. Such declarations include:

- Universal declaration of human rights (Article 17)
- The American convention in human right 91996 Article 21 – Right to property)
- African chapter in human and peoples right, 1986 (Article 14 and 21)
- European convention in human right and fundamental freedoms 1950 "(Article 8)
- Habitat Agenda – Istanbul Declaration in human settlement 1996 (Paragraph 40 m,r,s)
- Intentional labour organisations Convention concerning indigenous and tribal people in independent countries (No.109) Article 14 (1)

Valuation for Compensation in Compulsorily Land Acquisition

In the process of compulsory acquisition is the valuation of the acquired landed property for compensation to the displaced land owners/holders. Usually the acquiring authority values the property in accordance with the provision of the relevant statute. Where another body or institution does the valuation, the acquiring authority considers the claim and offer what it believes is appropriate and adequate to land owners. This usually results in claim and counterclaims over the adequacy of the compensation value in line with the principle of fair and just compensation. An early example of 'fair value' for a compulsorily acquired land was presented in the Holy Bible "*And it came to pass after these things, that Naboth the Jezreelite had a vineyard, which was in Jezreel, hard by the palace of Ahab king of Samaria. And Ahab spoke unto Naboth, saying, Give me thy vineyard, that I may have*

it for a garden of herbs, because it is near unto my house, and I will give thee for it a better vineyard than it, or if it seem good to thee, I will give thee the worth of it in money – 1King 21:1-2". Fair value is defined in the same spirit with the market value as "the amount for which an asset could be exchanged, or a liability settled, between knowledgeable willing parties in an arm's length transaction.

Open market basis of value estimate for compensation purpose

The open market value contains no ambiguity to valuers (valuators or appraisers) as it is properly defined in valuation standards to mean "the estimated amount from which a properly should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion (Blackledge, 2009, Plimmer and Dubben, 2003). This means the valuers can still go ahead to value acquired property on the basis of actual transaction in the open market despite the acquisition nature which is compulsory. However, it may be difficult to use the market value for a variety of reasons in a poor economy due to nature of land right and quality of property. Therefore, alternative approach can be employed. In most cases replacement cost is adopted in many countries and inserted in the land acquisition laws. South Africa uses the replacement cost to value properties/improvement for compensation purpose, but the replacement cost is added additional fund (a percentage of the cost) to arrive at adequate value of improvements for the purpose of compensation. In India, various approaches are adopted to assess the replacement cost of the acquired land and then the highest value is chosen as compensation sum. Nigerian Land Use Act of 1978 specifies Depreciated Replacement Cost (DRC) to determine a value for compensation (Bello and Olanrele, 2016, Kakulu, 2008).

In Poland, agricultural land is valued with regard to location, soil quality, timber, agricultural infrastructure and the extend of development and any lost profit and it can be concluded that improvement is valued in various ways depending on their nature. Buildings on the basis of their market value, or replacement costs, perennial crops or trees can be based on their yearly produce value and capitalised for their productive years at the industry's competitive rate of return while timber can be on market value (FAO 2008). Vaughan and Smith (2014) affirmed that compensation assessment in an event of compulsory land acquisition is to be based on the "principle of equivalence" in other to ensure that disposed owners are fully compensated for the loss suffered (open market value basis). The cost of relocation of business and temporary loss are also part of the compensation sum under the principle of equivalence in public land acquisition and compensation exercise.

Assessment of value for compensation purpose

Assessment of amount of compensation in an event of compulsory land acquisition in the United Kingdom is carried out on the basis of a "no scheme world" considering a situation where the project behind the compulsory acquisition has not come into existence so that no addition of the benefit

from the proposed project is considered in the valuation process and such cannot be compensated for. This means that acquiring authority, will not pay compensation for value created by its own project underlying the acquisition (Plimmer and Dubben, 2003). It was further opined that claimants are likely not to get the true value of their landed property and will definitely be unable to replace their acquired property. This is because after the scheme, the value increment will not be benefitted by the claimant. This is in consideration of the benefit of enhanced value from the new project to other owners whose property may not be acquired. The creation of the statute is an unequal financial position as benefits of enjoying value appreciation goes to the owners of the retained lands (in form of betterment) while same is denied to others (who sacrifices their interest in land) for the project as the betterment value is not considers as loss suffered. Rowan-Robinson and Hutchison (1995) reported dissatisfaction of claimants to the settlement and compensation process and suggested changes to the compensation process in order to reduce hardship on affected land owners during public land acquisition.

In Australia, various levels of government (Commonwealth, State and Territory) have separate laws that guide compulsory land purchase and compensation. The compensation valuation principle in respect of freehold land is straight forward and consistent but different assessment principle for leasehold land in different states and territories (Chan, 2008). The principle of ***"value to the owner"*** is incorporated into the nine (9) compensation laws across the Australia. The matters for compensation under Australian laws as identified by Brown (2004) are described differently in the statutes but include:

- Market value of land
- Special value as may be due to ownership or use of land
- Severance loss
- Disturbance
- Injures affection
- Solation (Payment for disruption, nuisance or inconvenience)

The compensation provision in Hong Kong does not consider injurious affection and solatium, and 'value to the owner' is not applicable. The compensation principles are contained in the Land Resumption Ordinance (LRO) in Chapter 12 (Chan, 2008). The compulsory purchase and compensation practice in US provides payment for loss of goodwill, loss of earnings, disturbance as well as cost of relocation, cost of new stationery and professional fees (in respect of business premises). Malaysia law agrees with the open market value basis for compensation but no provision is made for the losses of goodwill and earnings. The compensation for compulsorily acquired land under the Nigerian Land Use Act of 1978 did not accept the market value approach but a DRC for unexhausted improvements with no compensation for incidental losses.

Generally, compensation valuation should be based on the value of land right, any improvements to the land and other related costs or incidental losses. The principle should make reference to the market value or just compensation. Subsequently, compensation is expected to cover all losses arising from compulsory land purchase including the following:

- Land acquired
- Building
- Other crops improvements
- Reduction in value of retained land
- Disturbances
- Severance
- Injures affection
- Fees

The appropriate method to determine compensation is the open market value approach.

Public land acquisition and compensation experience in Nigeria

The provision for compensation in recognition of the compulsory nature of the public land acquisition with disregard for decrease or increase in value created by the underlying scheme can be interpreted and analysed, where there is reduction in value it is understandable that the reduction in not the making of the claimants. So, open markets value will be favourable and ensure that compensation will place the claimant on a position not less than before acquisition, however, what is the consideration for the others whose land were not acquired but suffers loss in value due to the project of acquisition. The law disregarded any compensation for such people. On the other end, where a value increase is created after acquisitions, the claimant will not be able to purchase a similar property to the one acquired, then, the land owners whose land are not acquired will then gain more than the claimants. Although, the betterment tax is meant to reduce irregularity arising from this scenario but to what extent can this be achieved? Betterment tax is a fraction of the increment in value and not the total value gain.

The public purpose/public interest need for compulsory land acquisition is of good and clear intention when such land is required for public uses like school, hospital, road airport, railway or electricity. However, it can be confusing where private land is acquired, subdivided and transferred to private developers/business for private use based on a belief that change in use and ownership of land will give highest and best use of land and benefit the public. In some developing countries (Nigeria inclusive), land is usually assembled through compulsory acquisition to support urban renewal programme to attract commercial development in blighted/slum areas, where there is obvious deterioration of building and infrastructure (FAO, 2008).

In Nigeria, the power of expropriation is abused through unfair procedures or purposes and inequitable compensation with high level of corruption (Bello and Olanrele, 2016). The power to revoke land right is often used to victimise and frustrate political opposition members where the purpose of the acquisition is bias and not for the public interest. In some cases, acquisition was done and the acquired land is not committed to any use or development for a long period that the original land owners re-enter to sell same land to unsuspecting members of the public. Only to come to the awareness of the acquisition when they are about to commence their private development. In other cases, compensation is grossly inadequate while public officials enrich themselves in a corrupt way. The staff of acquiring authority does the valuation and payment of compensation. The exercise, apart from the inadequacy provided by the law, is bedevilled with corrupt practices where officials feed fat on the compensation sum while the claimants are paid peanuts and cannot recover their losses (Bello and Olanrele, 2016). According to FAO (2008), there can be land restitution opportunity where claims and compensation can be subjected to negotiation or appeal if land that is acquired is more than needed for the purposes of acquisition or when the purpose is no longer relevant. This rarely occurs in Nigeria

Oladapo and Ige (2014) investigated claimant's satisfaction of compensation in respect of public land acquisition in Ondo State of Nigeria, their study reported a wide disparity between the amount of compensation and market value of the acquired properties. Bello and Olanrele (2016) found a difference of 46% in the claimant's expected value and the actual compensation paid for a compulsory purchase in Ogun State of Nigeria in the year 2012. There is evidence of lack of a suitable method for compensation assessment and non-standard in the compensation process in Nigeria, the law is full of ambiguity and lack of clarity (Kakulu et al., 2009). Kakulu (2008) earlier found the provision for compensation in Nigeria to be inadequate Nuhu (2008) noted, in addition to delayed payment, the inadequacy of compensation under the Land Use Act of 1978. Famuyiwa and Omirin (2011) found inadequate compensation to the land owners whose rights were acquired in Victoria Island, Lagos, Nigeria especially with no provision for injurious affection. In an interview with Associate Professor Dr. Anuar Alias by the Malaysia News Straits Times in 2015 for its cover story "Acquisition quandary", compensation inadequacy was also noted in China where an old couple refuse to vacate their home inside a half demolished building with a highway built around the un-vacated property. As a result, the building became solitary in the middle of the highway as the only building standing and the undaunted couple reside in their apartment. This is only possible because there is no law that empowers the government to forcibly acquire land.

METHODOLOGY AND DATA

In the sense of global uniformity for compensation valuation in the case of compulsory land acquisition, the study is a qualitative review of provisions

for compensation of some selected countries across the continents in comparison with Nigerian experience. A content analysis methodology is adopted for this study. The relevant provisions for claims as well as the basis and method of assessment as contained in the enabling statutes of the countries reviewed were extracted and compared. The analysis focused on the meaning of compensation, the heads of claims and the method(s) of assessment as contained in the compulsory purchase laws. The data set for the study include the view of the word compensation, items to be compensated for and methods of assessment as may be contained in the relevant statutes as these are the pointers to valuation process and value adequacy. In an attempt to have global representation, the selected countries cut across five continents of North America, Europe, Asia, Pacific and Africa. South America is unintentionally left out though it shares similarities with the Africa continent in terms of development. Tables 1 and 2 presents the summary of the extracted data relating to the heads of claims for compensation, principle and basis of value assessment.

ANALYSIS AND RESULT

A search through the provisions of the countries statutes gave the same definitions for the term 'compensation. The laws used the different terminologies to aggregate 'adequate compensation' without a commonly acceptable definition. The laws also itemised the components of compensation as heads of claim as presented in Table 1. The items that were recognised and provided for by each country's law were marked accordingly. Additional amount is provided for in Australia (called solatium) and South Africa (called special value). However South Africa like Nigeria has no payment for severance, injurious affection and disturbance. Nigeria do not compensate for the land beyond the ground rent (or its proportion unexhausted) paid to the government in the year of acquisition. Malaysia and Hong Kong do not provide for injurious affection in land compensation. Denmark, New Zealand, Rwand, United Kingdom and United States of America provided for all identified heads of claim (except solatium of special value).

The principles and basis of valuation for compensation purpose are also provided for in the enabling laws of the countries selected for this study. Table 2 presents the various principles and basis adopted as marked against each country respectively. Denmark adopted 'equity and equivalence value' principle; the three African countries considered 'fair value' principle; other countries studied adopted 'just – value to the owner' principle. With respect to the basis and method of valuation, South Africa specified Replacement Cost basis for compensation value assessment; Nigeria prescribed Drpreciated Replacement Cost basis while other countries adopt Market Value basis.

Table 1: Heads of Claim for Compensation for Compulsory Purchase in Selected Countries.

Country	Heads (Items) of Claims							
	Land	Improvement/ Building	Severance	Injurious Affection	Disturbance	Solatium (Disruption, Nuisance, Inconvenience)	Special Value	Crop
Australia	√	√	√	√	√	√		√
Denmark	√	√	√	√	√			√
Hong Kong	√	√	√		√			√
Malaysia	√	√	√		√			√
New Zealand	√	√	√	√	√			√
Nigeria		√						√
Rwanda	√	√	√	√	√			√
South Africa	√	√					√	√
United Kingdom	√	√	√	√	√			√
United States	√	√	√	√	√			√

Table 2: Principle and Basis of Compensation for Compulsory Purchase in Selected Countries.

Country	Compensation Principle				Basis of Valuation		
	Just/Value to the Owner	Equity and Equivalence	Fair Value	Cost	Market Value	Replacement Cost	Depreciated Replacement Cost
Australia	√				√		
Denmark		√			√		
Hong Kong	√				√		
Malaysia	√				√		
New Zealand	√				√		
Nigeria			√				√
Rwanda			√		√		
South Africa			√			√	
United Kingdom	√				√		
United States	√				√		

DISCUSSION OF FINDINGS

The study found compensation as a term that is used in compulsory land acquisition to have the same meaning in all the land acquisition statutes across the countries that were examined in this study. Compensation therefore means 'the sum payable to a dispossessed land owner (claimant) for the compulsorily acquired land, to place the claimant in the same

position he was immediately before his/her right in land is taken, not better, not worse'. Such amount is expected to include all other incidental losses that may be suffered by the displaced land owner. However, the principle and basis of assessment are the area of differences in compensation process.

Table 1 presents the various items upon which a dispossessed land owner can make a claim and be compensated for in the different countries studied. Except for a special value which only South Africa provided for in addition to replacement cost of acquired property, Australia portend the most adequate compensation with the inclusion of 'solatium'- which is payment for disruptions, nuisance and inconveniences caused land owners as a result of the compulsory purchase of land. Hong Kong and Malaysia do not recognise injurious affection as an item of compensation claim. Most developed western countries of Denmark, New Zealand, United Kingdom and United States recognised all listed items of compensation claim to the exclusion of solatium. Rwanda in the African continent also has similar provision like most of the developed western countries, land is also compensated for in Rwanda. Nigeria only provided for unexhausted improvement on land and perennial crops, this is the least and most inadequate compensation provision among the countries examined in this study. No compensation for land in the Nigeria arose from the Land Use Act (1978) because all lands are held in trust by governor of each state as provided by the law. The South Africa provision of special value in addition to the replacement cost of the acquired landed property can be assumed to suffice for severance, injurious affection and disturbance but its adequacy is in doubt as a percentage of replacement cost that is considered as special value may not be enough to cover disturbances and injurious affection in the real sense. The Scotland provision for home (or farm) loss as the case may be in addition to other head of claims is in term of true compensation. Alias and Daud (2006) suggested an inclusion of solatium or premium through review of compensation claims in Malaysia in support of the submission of Dundas and Evans (2001) that if market value basis of valuation is considered satisfactory towards achieving adequate compensation, an additional payment should be made to all disposed land owners. This current study lends support to this advocacy for additional payment.

The principle behind compensation in the advent of public land acquisition is related to the valuation basis and methodology for assessment of compensation amount. The three African countries in this study operate 'Fair Value' principle. Other countries adopted 'Just – Value to the Owner' principle with the exception of Denmark that adopted 'Equity and Equivalence' principle (see Table 2). The fair principle of African nations reveal the level of development in the continent as the word 'fair' can become subjective in its usage both in respect of each country and in relation to each Claimant. Whatever is considered fair is then paid as compensation. Nigeria system allows for the use of public land acquisition as an instrument of political war within the political class.

The countries studied except the two African giants (Nigeria and South Africa) adopted a market value basis for valuation for compensation

purpose. This suggests that the open market value of the acquired properties is considered adequate compensation. This will however include a financial assessment of all losses in addition to the market value of the acquired landed property. South Africa adopted a replacement cost basis for the assessment of the fair value of acquired property and as such cost method of valuation become appropriate. Nigeria goes further to depreciate the replacement cost of unexhausted improvement on land, thus the law prescribes depreciated replacement cost (DRC) for its fair value assessment. Rwanda, though on the same fair compensation principle with Nigeria and South Africa, agreed with developed countries on the market value basis (Table 2). For the countries that consider market value basis for the value assessment, the valuer/appraiser is left to the choice of appropriate valuation method to arrive at market value in full consideration of the type and usage of each subject property of valuation (residential, office/retail, hotel, hospital, logistics etc). Oladapo and Ige (2014) in their study called for valuation methods that will reflect the meaning of compensation because their study identified lack of a uniform standard method for compensation value assessment. Bailey and Clough (2009) earlier reported a similar finding of lack of standard method to compensation assessment for farmers in New Zealand when their lands were acquired for power transmission lines prior to 1988. This study corroborates the earlier findings of inappropriate method resulting in inadequate compensation in not only African developing nations but also in Malaysia, China and Hong Kong. The study therefore present that adequate compensation is a function of heads of claims and basis of value assessment.

CONCLUSION

Compensation is not expressly defined in most land acquisition laws, neither does its basis but left in the hands of operators to assume what it means. This has resulted in the admission of the court definition of compensation with the global understanding that the displaced property owners are put in the same position they were immediately before the acquisition of their right in land. This has led to the adoption of different principles to portray adequate compensation, such as 'Just Compensation'; 'Fair Compensation'; 'Value to the Owner'; or 'Equity and Equivalence' with the basis being the market value. However, method of valuation is mentioned in the land acquisition laws of some countries and the items to be compensated for are listed in the statutes. The study found that the concept of compensation for acquired land rights is same and understandable across the globe, but the actualisation of adequate compensation for global uniformity seems eluded. It is assumed that the compensation will take into account all incidental losses, and costs to the claimants in other to be placed in the same situation before the acquisition. This could be achieved only if the market value basis of valuation is adopted in compensation value assessment with an addition for distruption, nuisance and inconvenience as provided by Australia in form of 'solatium'. In view of the variation in provision for adequate compensation in different

countries, this paper suggests an establishment of global uniformity in terms of head of claims covering all losses, and method of assessment which can be recommended for inclusion in every country's law of compulsory purchase and compensation. Perhaps, an introduction of 'compensation standard code' which will be guided by International Standard for Valuation Committee. This paper recognised the non-inclusion of South America and Middle East countries as limitation, as well as the difficulty in implementing the recommendation globally, it therefore opens the campaign for global uniformity in compensation valuation.

REFERENCES

Alias, A. 2015. Acquisition quandary. *New Straits Times*.

Alias, A. & Daud, M. N. 2006. Payment of Adequate Compensation for Land Acquisition in Malaysia. *Pacific Rim Property Research Journal,* 12, 326-349.

Bailey, P. & Clough, P. 2009. Compensation for transmission infrastructure: A Report Presented to the Federal Famers. New Zealand: New Zealand Institute of Economic Research (NZIER).

Bello, N. A. & Olanrele, O. O. 2016. Value gap in Nigerian property compensation practice: measurement and economic effects. *Pacific Rim Property Research Journal,* 22, 101-113.

Blackledge, M. 2009. *Introducing Property Valuation,* Oxon, UK, Routledge Taylor & Francis.

Brown, D. 2004. *Land Acquisition,* Sydney, Butterworths.

Chan, N. How Australia deals with land acquisition compensation for land subject to a leasehold title. 14th Pacific Rim Real Estste Society Conference, 20-23 January 2008 Kuala Lumpur, Malaysia.

Dundas, I. H. M. & Evans, W. M. 2001. Review of Compulsory Purchase and Compensation. Scottish Executive Central Research Unit.

Famuyiwa, F. & Omirin, M. M. 2011. Infrastructure provision and private lands acquisition grievances: Social benefits and private costs. *Journal of Sustainable Development,* 4, 169–180.

FAO 2008. Compulsory Acquisition and Compensation. *FAO Land Tenure Studies 10.* Rome: Food and Agricultural Organisation.

Federal Republic of Nigeria 1978 Land Use Decree (now Act) of 1978. Federal Government Press, Lagos

Kakulu, I. I. 2008. The Assessment of Compensation in Compulsory acquisition of oil-and-gas bearing land in the Niger Delta. *Land Reform,* 1, 57-65.

Kakulu, I. I., Bryne, P. & Viitanen, K. 2009. Phenomenological Research in Compulsory Land Acquisition and Compensation: Surveyors Key Role in Accelerated Development. *FIG Working Week* Eilat, Israel.

Nuhu, M. B. 2008. Compulsory Purchase and Payment of Compensation in Nigeria: A Case Study of Federal Capital Territory (FCT) Abuja. *Nordic Journal of Surveying and Real Estate Research,* 3, 102-126.

Oladapo, R. A. & Ige, V. 2014. Assessment of Claimants' Satisfaction to Variation in Compensation Paid for Compulsory Land Acquisition in Ondo State, Nigeria. *FIG Congress 2014* Kuala Lumpur, Malaysia.

Plimmer, F. & Dubben, N. The land of Make Believe: An Overview of the Assessment of Compensation for Land Taken in Compulsory Acquisition in the nited Kingdom. 2nd FIG Regional Conference, 2-5 December 2003 Marrakech, Morocco.

Rowan-Robinson, J. & Hutchison, N. 1995. Compensation for the compulsory acquisition: Satisfaction or sacrifice *Journal of Property Valuation and Investment,* 13**,** 44-65.

Scottish Government 2011. Compulsory purchase and compensation: A guide for owners, tenants and occupants.

Vaughan, D. & Smith, L. C. 2014. An Introduction to compulsory purchase valuation principles spanning 150 years. *Journal of Building Survey, Appraisal and Valuation,* 3, 184-189.

ANALYSIS OF PREFERENCE FOR RESIDENTIAL NEIGHBOURHOOD IN ILORIN, NIGERIA

Adeogun, A. S.[1] , Raheem, W. M.[2] , Shittu, W. O.[3] and Bako A. I.[4]

[1]*Department of Estate Management, Faculty of Environmental Sciences, University of Ilorin, Kwara State, Nigeria*

[2,4]*Department of Urban and Regional Planning, Faculty of Environmental Sciences, University of Ilorin, Kwara State, Nigeria*

[3]*Department of Estate Management and Valuation, Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State, Nigeria*

There are hierarchies of residential neighbourhoods in human settlements depending on the quality, space and number of inhabitants among others. These, to a large extent dictate the choice of or preference for neighbourhood by the residents. This study is on the assessment of Residential Neighbourhood Preference of residents in Ilorin metropolis. Data for the study were collected using random sampling method from nine different neighborhoods in the order of low, medium and high residential densities. These are GRA, Adewole Estate, Onikanga axis (Low Density), Kulende, Basin and Fate-Tanke (Medium Density) Gaa-Akanbi, Oloje and Sango (High Density). The study employed primary and secondary data such as the quality of dwelling units in each neighbourhood, which highlights the state of individual houses, the physical structure and the quality of the environment. Also assessed was the accessibility to urban infrastructures. In all, questionnaires were administered on 300 respondents. Data were analysed using descriptive and inferential statistics. Descriptive statistics such as chi square, frequency and percentage were used to present results. Also, One Way Analysis of Variance (ANOVA) was used to examine the variation among the preferred facilities in the areas while Likert rating was used on residents' preference for locational attributes. Preference level by residents across the study area indicated that the most preferred neighbourhoods are GRA, Adewole Estate and Onikanga axis; the fairly preferred are Kulende, Basin and Fate-Tanke while Gaa akanbi, Oloje and Sango are the least preferred neighbourhoods. It also revealed that, residents generally place more emphasis on social settings, proximity to and availability of urban infrastructure, neighbourhood quality and the quality of immediate surroundings, in the selection of their most preferred neighbourhood. The study recommended the execution of appropriate urban renewal strategies by the government in areas fairly and least preferred by residents to engender better habitation and enhance quality life.

[1] adeoluwawa@gmail.com

[2] raheemwasiumayowa@gmail.com

[3] wasiushittu220@gmail.com

[4] alibbako@yahoo.com

Adeogun, A. S., Raheem, W. M., Shittu, W. O. and Bako, A. I. (2017) Valuations for compensation purpose: the need for global uniformity In: Laryea, S. and Ibem, E. (Eds) Procs 7th West Africa Built Environment Research (WABER) Conference, 16-18 August 2017, Accra, Ghana, 1448-1461

Keywords: neighbourhood quality, preference, residential property, residents, urban infrastructure

INTRODUCTION

Residential preference is an element in the complex relationship between environmental perception and spatial decision making. Residential satisfaction is an important theme in the field of residential environment. Life satisfaction is closely related to residential satisfaction and residential neighbourhood preference is another significant topic in the research of residential environments. There are deep relationships between residential choice and satisfaction. (Gbokeji and Magnus 2007)

It is a generally known fact that spatial organization of the neighbourhood may be quite different between regions, cultures and societies, because societies establish an order on their living spaces and reflect their characters in these spaces. Residential mobility and housing decisions underlie much of urban growth and change (Wu, 2003). Just as housing consumption is of prime importance to an individual's well-being, so also is the process of residential location and relocation central to our understanding of urban dynamics and the changing social and spatial stratification in our cities.

Residential areas have generated a lot of researches. Investigations have been carried out on their structure, form and composition (Mabogunje 1968, Abiodun 1990, Sanni 1997). Various residential areas have been identified, and efforts have been made to determine the level of provision of social facilities and amenities in various residential wards. From empirical studies, diverse reasons have been proposed why residents prefer a certain neighbourhood to another.

The impossibility of everyone living where they would prefer is not debatable. This presupposes some form of competition for the most desired locations, resulting in a situation where price plays a crucial role in limiting the options available. However, the restricted choice which is an offshoot of this competition for the most desired locations may be considerably reduced as a result of the variation between people in the locations and lifestyles they prefer. For instance, while some people may choose a city-centre location, others may prefer a suburban one, and yet others, an intermediate-urban one.

It must be stressed, though, that the reasons for choice of locations among different people varied. These include but not limited to access to employment, business, educational, cultural or recreational opportunities and affordability. Others are familiarity with one location or type of location, perhaps as a result of growth; dwelling characteristics such as age, number of rooms, type of appliances or facilities available or emotional attachment to a place or a lifestyle (Garling and Friman, 2002). One approach therefore,

to understanding preferences for different locations is to study the degree of similarity in the choices made by people who are similar to each other and by those who differ and this is the justification for this study.

This paper is therefore aimed at assessing the residents' preference for residential neighbourhood in Ilorin, Nigeria with reference to attributes of the neighbourhoods.

Research questions

1. Do residents attach any preference to neighbourhood?
2. What locational attributes determine residential preference?

LITERATURE REVIEW

Urban Residential Location Models

Three prominent landuse theories that have included the description of the spatial distribution of households in the urban areas are

1. The Concentric Ring Theory of Burgess (1925): In the concentric ring theory, the city's residential areas are arranged in concentric circles with the rich people progressively living farther out from the city centre. The theory infers that the city expands by the continuous tendency of each inner zone to extends its area by the invasion of the outer zone, in a process of succession of "filtering" or "trickling down", in which case the well to do must have absorbed most of the initial construction cost before the house is passed down to the people of the lower income.

2. The Sector Theory of Hoyt (1939): The sector theory sees city growth in sector form with the richer people occupying advantageous sectors, usually on water fronts, hill tops and generally located away from traffic noise, while the poor live close to their work places.

3. The Multiple Nuclei Theory of Harris and Ullman (1945): The multiple nuclei theory postulates that land use pattern in most cities are not built around the single centre as postulated by the concentric ring theory, but rather they are developed around several centres within the urban area. Separate nuclei arise because of the differing access requirements of activities, the grouping of complimentary activities, the mutually repellent of certain landuses and the fact that some uses cannot afford the most desirable sites (Goodall, 1972).

The economic equilibrium theory has also been developed to provide explanations for the observed urban residential locations (Alonso, 1964; Kain, 1968; Muth, 1969). In these theory, the household residential location is a function of its income, space preference, transport cost to workplaces and price of residential space. The theory assumes that everyone works at a monocentric central space in the city (CDB) and lives in circular areas around it. It also assumes that everyone can buy as much space as one wants it. Availability of good transport services everywhere is assumed and that lot size and location are determined on the basis of bids differing among households.

Evidences from accessibility to workplaces studies have, however shown conflicting results. Guest and Cluett (1976) suggest the clear interrelationship of residence and workplaces among the Los Angeles suburbs, particularly for non-blacks.

The simulation of travel cost by Broughton and Tanner (1983) shows that it is better for households to locate near their workplaces. Quigley (1985) also discovered that housing choice might be more sensitive to variation in workplaces accessibility than was indicated by a more restricted model of household choice. Desalvo (1985) found that housing consumption and location were negatively related to consulting time.

Some studies however have identified some shortcomings in the use of the type of work as a determining factor for residential location. Cooke (1978) and Steinnes (1977, 1982) concluded that "jobs follow people". This result is opposed to the prevailing view of casualty implicit in the traditional equilibrium model of residential location which attempt to explain them on the basis of journey to work.

The Alonso-Muth model holds that the poor stay near the CBD while the rich people stay at the outskirts. Stokes (1962) and Okpala (1978) on the other hand discovered that slums were often at the fringes of cities than at the centres. To et al (1983) also found the converse of Alonso-Muth's preposition in European cities and observed that the tendency for higher-income households to locate at the core of European cities could be attributed to a different preference ordering of land and travel costs of Europeans when compared with the North Americans.

Studies on residential location in Nigerian urban centres generally reveal the limitations of the economic equilibrium model and its assumptions. Findings by Mabogunje (1962, 1968), Sada (1972), Onibukun (1974), Okpala (1978), Yirenkyi-boateng (1986) and Abiodun (1990) show that, some particular social or ethnic groups concentrate in certain parts of Nigerian cities. The rich and the poor co-exist in many parts of Nigerian cities as against the clears dichotomy often indicated by the equilibrium model. It was also noted that the assumption of laissez-faire economic system in which people and business compete for land and the highest bidder wins might have to be revised in certain cultural context, because evidence in Lagos, for instance, suggested the stronger influence of public and traditional institution on land market. (Abiodun 1990)

Rational Choice Theory

This theory according to Lawrence and David (2008) is also known as choice theory or rational action theory; it is a framework for understanding and often formally modelling social and economic behaviour. The basic premise of rational choice theory is that aggregate social behaviour results from the behaviour of individual actors, each of whom is making their individual decisions. The theory also focuses on the determinants of the individual choices.

Rational choice theory then assumes that an individual has preferences among the available choice alternatives that allow them to

state which option they prefer. These preferences are assumed to be complete (the person can always say which of two alternatives he considers preferable or that neither is preferred to the other) and transitive (if option A is preferred over option B and option B is preferred over option C, then A is preferred over C).

The Residential Neighbourhood

The term neighbourhood is often used to describe the sub-divisions of urban or rural locations such as cities, villages, and towns. In its purest definition, a neighbourhood is the vicinity in which people live. People live next to or near one another in sections of an area and form communities. Those sections have some particular physical or social characteristics that distinguish them from the rest of the settlements. (See, Duanyn *et al* (2003) for elaborate details of the term neighbourhood defined in the context of basic physical attributes of the space). Accordingly, the neighbourhood is a comprehensive planning increment. The clustering of neighbourhoods forms towns, villages, and cities. The neighbourhoods vary in population and density to accommodate localized specific conditions. The size is limited so that a majority of the population is within walking distance of its centre where the needs of daily life are available. The centre of the neighbourhood provides facilities for transit stops, work places, retail, community events, and leisure activities. The streets provide alternate routes to most destinations at an equitable manner for both vehicles and pedestrians. Due to the incremental development, there is a mixture of large and small houses, shops, restaurants, offices etc. Civic buildings (schools, theatres, worship areas, clubs, museums, etc.) are often placed in the centre. At that location open spaces, playgrounds, and parks are also provided (Duany *et al,* 2003).

It has been demonstrated that the physical layout of the neighbourhood may help democratic initiatives to be encouraged and a balanced evolution of society is facilitated.

At that sense, the concept of neighbourhood is used also to describe the social environment formed by communities at distinguished urban sections. The social composition of the residential environment is constituted by a set of physical spaces integrated with each other through a hierarchical order.

The concept of neighbourhood forms an integral part of the residential environment. While attempting to assess the dwelling occupants' satisfaction from the overall residential environment, it should be considered that different performance criteria apply to different physical components of the residential environment. Those components and the relevant performance criteria are evaluated with a user / user group and physical space interaction.

There is generally no consensus as to the definition of residential neighbourhoods. Different authors have tried to define it based on their school of thought or field of disciplines. According to Schuck *et al* (2006), a residential neighbourhood is a geographically localised community within a larger city, town or suburb. Neighbourhoods are often social communities

with considerable face-to-face interaction among members. Neighbourhood is also generally defined spatially as a specific geographic area and functionally as a set of social networks. Neighbourhoods, then, are the spatial units in which face-to-face social interactions occur, the personal settings and situations where residents seek to realize common values, socialize youth, and maintain effective social control.

Neighbourhood is an area within which residents may all share the same common services, social amenities and facilities provided, for use within the vicinity of residential dwellings. Perry (1929) in a regional survey of New York and its environs describes it as that populated area which would require support of a primary school with an enrolment of between 1000-1200 pupils. The total population of the neighbourhood should be between 5000-6000 people. Perry (1929) further stated that it should be laid out in such a manner, which would make it unnecessary for any child to work a distance or a kilometre to get to school from his or her home.

Perry (1929) formulated six principles that summarized the main features of a good urban residential neighbourhood. These are size (a residential unit development should provide housing for that population for which one elementary school is ordinary required, its actual area depending upon its population density), boundary (bounded by arterial streets, sufficiently wide to facilitate it by passing, instead of penetration through traffic), open space (a system of small parks and recreation spaces), institutional sites, local shops and an internal street system.

Expectations of a residential neighbourhood

According to The Committee for Stabilizing America's Neighbourhoods, which is a Political Action Committee (PAC) registered with and recognized by the U.S. Federal Elections Commission, the best neighbourhoods have certain characteristics such as having a majority of the homes owned by the people who live in them, good walk-ability, an attractive civic core with local retailers, and a community square or park, safety that is, a place where can citizens live and play comfortably, a working public-private partnership, with locally supported businesses, privacy and protection from excessive traffic and noise and a clear neighbourhood identity and boundaries. But in dealing with a symbolic function of housing. Cox (1972) listed eight criteria by which one would probably judge whether an urban environment is good or bad or more tolerable. They are:

- The good environment quality.
- Housing stock opportunity environment.
- An educational opportunity environment.
- A modern amenity environment.
- A health opportunity environment.
- A recreational opportunity environment and a healthy environment.

Carter and Jones (1989) undertook a study on housing and define three levels of satisfaction that housing is expected to offer upon its occupants.

They are material utility, symbolic status and the externalities of residential location. In mentioning these last points, they refer to the quality of the general environment. Onibokun (1990) in the same aspect noted that the quality of the housing environment depends more on the degree of the availability of essential social services and infrastructural facilities. Leonard (1991), going back to the quality of residential neighbourhood at large, argues that the quality of a residential neighbourhood not only mirrors the cities development, planning and a locative mechanism between socio-economic groups, it shows the quality of life of the urbanites. Roberts (1996) in dealing with the expectations of the quality of an urban regeneration proposal programme noted that the provision of community facilities and training schemes are other intended outputs not only that of physical renewal.

The importance of understanding neighbourhood preferences in policy and research has been of continued interest. Urban planners and many politicians have long been promoting compact, mixed-use, and pedestrian friendly neighbourhoods for their travel related benefits (e.g. decreased congestion). More recent health concerns have caused many planners, epidemiologists, and public health advocates to promote the use of neighbourhood design as a means to spur active travel and encourage physical activity.

While advocacy and enthusiasm is welcome, recent research suggests heeding possibly unmet expectation of such initiatives. Residential self-selection could play a role in limiting the success of these initiatives. Households may choose to live in areas that match their preferences, either for neighbourhood design or to satisfy a particular behaviour. For instance, a 'walker' might choose to live in a community that supports walking, suggesting that person's travel behaviour should not be credited to neighbourhood design alone. Any effort to analyse the factors affecting residential relocation decisions must consider self-selection.

The difficulty is understanding causality; did household choose to relocate to a neighbourhood or did the neighbourhood characteristics themselves cause the relocation.

In contrast to typical research that solely address causality, this study creates taxonomy of neighbourhoods and then examines preferences for neighbourhood types. This taxonomy provides both a simple answer as to whether households move to the same type of neighbourhood and a more complex answer as to why. An investigation of preferences could help planners, policymakers, and developers determine design characteristics that household's prize, identify the potential market for various types of neighbourhoods, and inform the prospect of using neighbourhood design to moderate travel demand.

Perceptions on Residential Neighbourhood Preference

Man inhabits the corners of the earth and one space station. People live in grass or ice huts and subsist essentially as hunters and gatherers in intimate association with the natural environment. Numerous researches

have shown that residential preference varies not only with household structure and income, but also with lifestyles and personality factors. This is because residential preferences play a central part in neighbourhood type's satisfaction. The more scenes differ, the more likely that environmental factors influence the preference.

According to Gbakeji *et al.,* (2007) on their examinations of the residential and neighbourhood preferences of residents in the Warri metropolis in Nigeria, their findings reveal that residents generally place more emphasis on environmental quality, proximity to and availability of neighbourhood facilities and the quality of the immediate surroundings, when taking decisions on where to relocate to within the urban space whereas Abolade (2004) proved that some residential locations are viewed as satisfactory living environment because of factors and forces which ranges from demographic, economic to social factors. The author pointed out that Nigerians are rational in their behaviour and choice of residential location, thus closeness to work places and quality of the environment and peace seem to influence residential location more than economic factors (income status), these corresponds with the results of Gbakeji *et al*, (2007).

MATERIALS AND METHOD

Data for this study were primary in nature; oral interview and administration of questionnaires were used to obtain information from the respondents using random sampling technique. The study area was divided into three different residential zones- high density residential zone, medium density residential zone and low density residential zone**.** The study area has a population of 300045 out which 300 residents were sampled. The random sampling method was used to administer 300 questionnaires in ratio 3:2:1 consisting of 150,100 and 50 for high, medium and low-density areas with GRA, Adewole Estate and Onikanga axis (Low Density), Kulende, Basin and Fate-Tanke (Medium Density) Gaa akanbi, Oloje and Sango (High Density).

Descriptive statistics such as chi square, frequency and percentage were used to present result before analysing using inferential statistics. One Way Analysis of Variance (ANOVA) was used to examine the variation among the preferred facilities in the areas and Likert rating was used on residents' preference for locational attributes.

RESULTS AND DISCUSSION

The study reveals that male residents dominate in the area with 66.6% while their female counterpart has 33.4%. This may just be as a reason that male adults tend to attend to external people of guest entering their houses. The age of the respondents shows that people within the age bracket 40-65 years dominate with 66% and majority of them are married with 98% while the overwhelming majority of the respondents are of Yoruba extraction having 88.7%, this is quite understandable as the study area are predominantly inhabited by the Yorubas.

Table 1: Socio-economic characteristics of respondents

Sex of respondents	Frequency	Percentage (%)
Male	200	66.6
Female	100	33.4
Total	300	100.0
Age	Frequency	Percentage (%)
18-28	39	13
29-39	50	16.7
40-65	198	66
66 and above	13	4.3
Total	300	100.0
Marital status	Frequency	Percentage (%)
Single	6	2
Married	294	98
Total	300	100
Ethnicity	Frequency	Percentage (%)
Yoruba	266	88.7
Igbo	28	9.3
Hausa	6	2
Total	300	100.0

Source: Authors' Field Survey 2015

Table 2: Distance by preferred place of residence

Distance of residential areas		Preferred accommodation		Total
		Present residence	Elsewhere	
High density	Number	94	56	150
(Gaa akanbi, Oloje and	Row %	62.7	37.3	100
Sango)	Column %	70.1	33.7	50.0
Medium density	Number	25	75	100
(Kulende, Basin and	Row %	25.0	75.0	100
Fate-Tanke)	Column %	18.7	45.2	33.3
Low density	Number	15	35	50
(GRA, Adewole Estate,	Row %	30.0	70.0	100
Onikanga axis)	Column %	11.2	21.1	16.7
Total	Number	134	166	300
	Row %	44.7	55.3	100
	Column %	100.0	100.0	100.0

X^2= 39.665, df = 2, P= 0.000

Source: Authors' Field Survey, 2015

The study as depicted in table 2 shows the respondents' preferred location of accommodation by the distance. In the overall, majority of the respondents 55.3% would have loved to be accommodated elsewhere, while 44.7% of them prefer their present location. Based on their place of residence however, 70.1% of those staying in high density areas claimed to prefer their present location and 33.7% of them prefer elsewhere. Of all the respondents in medium residential density areas, 25% and 75% prefer their present location of their residence and elsewhere respectively. Also, 44.7% of respondents in the low-density areas prefer to stay in their present location while 55.3% would love elsewhere.

From this analysis, it can be deduced that distance among other things has a significant contribution to play in the choice of location of accommodation preferred by the respondents. Substantial percentage of those respondents who stay in areas close to other facilities such as place of work, markets and place of children's school among others prefer to remain where they are at present while those far from those facilities are longing to secure accommodation elsewhere. This may not be among other things, unconnected to the cost, stress and the time taken to getting to other basic facilities. The chi square statistical result indicates a significant variation in the preferred location of accommodation by places of residence of the respondents.

Table 3: Likert rating of locational attributes on residents' preference

Locational Attributes	Weight Value (Percentage %)				SWV
	Very Significant	Significant	Fair	Not Significant	
	4	3	2	1	
Proximity or and/or availability of neighbourhood infrastructure	17.7	55.2	16.8	9.2	368.9
Neighbourhood quality	41.8	32.6	18.6	7.0	402.2
Distance of house to place of work	46.8	31.4	20.0	1.8	323.2
Housing Facilities	31.2	46.2	14.5	7.0	299.4
Quality of immediate surroundings	36.5	39.4	18.9	5.2	402
Access to Recreation	33.2	33.0	27.6	6.2	293.2
Access to Shopping	24.1	41.8	28.9	5.2	284.8
Transport fares to area of activities	20.8	47.3	20.5	11.5	366.2

Source: Authors' Field Survey, 2015 SWV = Sum of Weighted Value

Descriptive percentage was computed for the responses of respondents on the preference for areas due to locational attributes using likert rating as shown in table 3. Weighted valued of the percentages was also calculated and the result shows that neighbourhood quality has highest summation of weighted value with 402.2, followed closely by quality of immediate environment 402, proximity or and/or availability of neighbourhood infrastructure 368.9 and transport fares to area of activities 366.2 Other locational attributes which have influence on preference for residential area include distance of house to place of work 323.2, housing facilities 299.4, access to recreation 293.2 and access to shopping has 284.8 It can thus be deduced from the analysis that neighbourhood quality and the quality of the immediate environment among others largely dictate the preference of residents in selecting their areas of residence. This corroborates the finding of Gbakeji *et al.,* (2007) in a study of the residential and neighbourhood preferences of residents in the Warri metropolis in Nigeria, where it was

revealed that residents generally place more emphasis on environmental quality, proximity to and availability of neighbourhood facilities. In the same vein, the result is in tandem with the finding of Onibokun (1990), that some residential locations are viewed as satisfactory living environment because of factors such as closeness to work places and quality of the environment and peace.

Table 4: ANOVA of preferred facilities in the residential areas

ANOVA					
		Sum of Squares	df	Mean Square	F	Sig.
size of room	Between Group	.203	2	.102	.344	.605
	Within Groups	87.743	297	.295		
	Total	87.947	299			
Roof type	Between Group	14.083	2	7.042	44.249	.000
	Within Groups	47.263	297	.159		
	Total	61.347	299			
Availability of open space	Between Group	3.883	2	1.942	9.690	.000
	Within Groups	59.513	297	.200		
	Total	63.397	299			
availability of pipe borne water	Between Group	.867	2	.433	3.430	.028
	Within Groups	37.520	297	.126		
	Total	38.387	299			
Availability of fence	Between Group	.387	2	.193	3.838	.015
	Within Groups	14.960	297	.050		
	Total	15.347	299			
Floor type	Between Group	5.430	2	2.715	12.661	.000
	Within Groups	63.690	297	.214		
	Total	69.120	299			
Surrounding environment	Between Group	8.603	2	4.302	19.918	.000
	Within Groups	64.143	297	.216		
	Total	72.747	299			

Source: Authors' Field Survey, 2015

The ANOVA result compares the preferred facilities of the houses in the three residential areas and it shows the variation in the preference for those facilities by the residents. It reveals that apart from room size with $p = 0.079$ which shows no significant variation, all the other facilities (roof type, availability of open space, pipe borne water, fence and floor type and surrounding environment) show significant variations with p values of 0.000, 0.000, 0.028, 0.015, 0.000 and 0.000 respectively. This implies that only preference for room size remains the same across the residential areas while others show variation. While some of the facilities are most preferred, some are least preferred while in some other areas the housing facilities are not given preference but other things best known to the residents. These situations could be responsible for the level of preference attached to a particular density of residential areas.

RECOMMENDATIONS AND CONCLUSION

Emanating from the findings of this study and given the fact that most people give preference to particular residential areas at the expense of

others due to facilities, distance and neighbourhood qualities, it is important that areas deficient in infrastructure be upgraded while facilities provision is also given consideration. Specifically, therefore, the following recommendations are made:

1. Enactment of relevant byelaws to make the acquisition of land very accessible and reduce more formation of squatter settlements.
2. Carrying out urban renewal activities to upgrade moribund facilities in areas affected by deterioration of facilities. The status of neighbourhood that are not highly preferred or preferred at all such as Oloje and Kulende can be enhanced for good habitation through reconstruction and rehabilitation of blighted houses and existing facilities such as schools, roads, electricity, and water among others.
3. Land lords and home owners should be enlightened and encouraged to imbibe maintenance culture of their properties so as to increase their attractiveness and satisfaction to residents. This can be achieved through periodic repairs from time to time. This is necessary as findings show that neighbourhood qualities have correlation with preference.
4. The social climate of the neighbourhood can be enhanced and sustained through the formation of neighbourhoods associations. Neighbourhood association is a process whereby residents and other stakeholders meet regularly to learn about their neighbourhood with regards to identifying their problems and challenges, envision a shared future, and develop strategies to shape it. This will in the long run, enhance social interaction within the neighbourhood, provide opportunities to develop new entrepreneurial activities which may enhance the local economic opportunity structure.
5. Encouragement of the establishment of recreational facilities and modern shopping arena across the residential neighbourhoods in the town.

In conclusion, there are hierarchies of residential neighbourhoods in human settlements depending on the quality, space and number of inhabitants among others. These, to a large extent dictate the choice of or preference for neighbourhood by the residents as had been shown by this study. This paper therefore recommends that certain facilities be added to residential areas where such are lacking to ensure better living for the inhabitants.

REFERENCES

Abiodun V.O. (1990): "Spatial Differentiation in the Level of Living within a Metropolis: The Case of Ibadan, Nigeria" In Ogunjumo A, Aloba, Adesina A. (Eds) contemporary Research in Geography of Life. Ile-Ife: Ife Research Publication in geography

Alonso W. (1964) "Location and Land use" Cambridge: Howard university press.

Broughton J. and Tanner V.C. (1983): "Distributional Models for the journey to work", Quigley Environmental and planning A vol. 15, pp 31-33.

Burgess E.W (1925): "the growth of city" Chicago: university of Chicago press

Berk, Mehmet and Gokhan. (2005): "the concept of neighborhoods in contemporary residential

Cooke T. (1978): "causality reconsidered: A note, journal of urban economics October, Pp 538-547.

Cox Kelvin (1972): "Man Location and Behavior: An Introduction to Human Geography New York" John Wiley and Son Mc.

Desalvo J.S. (1985): "A model of urban household behavior with leisure choice". Journal of Regional Science, vol.25, No 2 pp.159-174.

Goodall B. (1972): "the economics of urban areas". Oxford Pergamon Press.

Guest, A.M. and Duett C. (1976): "workplace and residential location: A push-pull model". Journal of regional science, vol. 16 pp. 399-410.

Gbokeji S. and Magnus O. (2007) "Aspect of residential and neighborhood preferences in the Warri metropolis, Delta State, Nigeria

Harisson K.L (2009) "Best residential neighbourhood characteristics.

Kain J. (1968):"housing segregation negro employment and metropolitan decentralization". Quality Journal of Economics Vol.72 No. 2

Lawrence, E.B. and David E. (2008). "rationality," *The New Palgrave Dictionary of Economics*, 2nd Edition.

Moth R.F (1969): "cities and housing" Chicago: university of Chicago press.

Mabogunje A.L (1962): the growth of residential district in Ibadan" Geographical review Vol.52 No. 1, 56-77.

Mabogunje A.L (1968): Urbanization in Nigeria. London: university of London press Ltd.

Okpala D.C.I (1978) "urban ecology and residential location theories: Application in Nigeria's Socio-cultural Milieu", socio-economic planning science, vol., 12. pp 177-183.

Onibokun A.G (1990). "A System of Evaluating the Relative Habitability of Housing" Ekistic Vol. 36, No 216 Pp 313- 317.

Perry R.E (1929) "Pattern of Urban Life" Longman, London

Robert M. (1996): Introductory Urban Design Intervention and Responsibility

Sada P.O. (1972) "Residential Land Use in Lagos: Balance of Traditional Models "African urban Note Vol.8i, Pp 3-25.

Schuck, Amie and Dannis Rosenbuam (2006) "Promoting Safe and Health Neighborhoods: What Research Tells Us about Interventions" The Aspen Institute.

Sanni L. and Akinyemi F. (2009) "Determinant of Household Residential Districts within Metropolitan City of Ibadan, Nigeria.

Steinnes D. (1977): casualty and intra-urban location" Journal of Urban Economics, January pp 69-79.

Strokes C.J. (1962): “A theory of slums", Land Economics vol. 38 pp 187-197.

Wu, F. (2003) "Transitional Cities" Environment and Planning 35:1331-1338.

Yirenkyi-Boateng (1986): "Spatial Analysis of variation in level of living within the Ibadan Metropolis region". An unpublished Ph.D. thesis. Department of Geography, O.A.U Ile-Ife.

INDEX OF AUTHORS

A
Abba, M. A., - 911 -
Abdulfatai, S. O., - 1171 -
Abdulganiyu, O., - 178 -
Abdullahi, D., - 1111 -
Abdullahi, M., - 814 -
Abubakar, A., - 506 -
Adekunbi, A., - 1366 -
Adeogun, A. S., - 1448 -
Adeokun, C., - 1344 -
Adeokun, C. O., - 1189 -
Adepeju, A. A, - 443 -
Aderogba, A., - 898 -
Adetokunboh, O. O., - 945 -
Adjei-Kumi, T., - 121 -, - 1063 -
Adogbo, K. J., - 208 -, - 219 -
Afolami, A. J., - 337 -
Agbato, S. E., - 945 -
Agbesi, K., - 1225 -
Ahmad, A., - 271 -
Aigbavboa C.O., - 1211 -
Aigbavboa, C. O., - 394 -
Ajani, U. Y., - 160 -
Akande, O. K., - 978 -
Akeremale, I. D., - 337 -
Akinkumi, A. O., - 1144 -
Alias, A., - 1433 -
Alinaitwe, H. M., - 465 -
Allen, C., - 827 -, - 1300 -
AlShamisi, H. A., - 1314 -
Ameyaw, E. E., - 243 -
Ameyaw, S., - 773 -
Amusu, O. R. O., - 1366 -
Ankrah, N., - 1314 -
Anosike, N. M., - 380 -
Ansah S.K., - 1211 -
Antwi, K., - 1274 -
Antwi-Afari, M. F., - 607 -
Aremu, S. C., - 978 -
Attakora-Amaniampong, E., - 1027 -
Attakora-Amaniampong, E., - 773 -
Auduga, J. B. M., - 761 -
Azhar, S., - 287 -, - 1097 -
B
Bako A. I., - 1448 -
Balarabe, H., - 761 -
Bamidele, E. O., - 682 -
Bello, B S, - 655 -
Bello, N. A., - 1433 -
Bello, N. A., - 444 -
Brisibe, W. G., - 1009 -
Bustani, A. S., - 38 -
C
Chan, A. P. C., - 243 -
Chindo, P. G., - 814 -
Crews, E., - 287 -
D
Dadu, D. W., - 961 -
Dahiru, A., - 49 -
Dalibi, S G., - 655 -
Dalibi, S., - 628 -
Dalibi, S. G., - 761 -
Danja, I. I., - 761 -
Danso, H., - 886 -
Dansoh, A., - 302 -
Dauda, A., - 870 -
Deacon, C., - 494 -
Dlamini, S., - 364 -
Douh, S., - 1417 -
E
Effah, B., - 1274 -
Ehoche, E. P., - 961 -
Ekunday, F, - 543 -
Eludoyin, O. M., - 1374 -
Emuze, F. A., - 13 -
Enenmoh, R. C., - 380 -
Enenmoh, R. C.,, - 195 -
Enu-Kwesi, F., - 1281 -
Eyiah, A. K., - 260 -
F
Fagbemi, K., - 90 -
Faremi, O. J., - 898 -
Fatoye, E. O., - 479 -
Fatoye, E. O.,, - 195 -
Fawale, T. S., - 1160 -
Feng, J. C., - 655 -
Fobiri, G., - 302 -
Fugar, F.D.K., - 1225 -
G
Gambo, N., - 38 -
Gibberd, J., - 62 -, - 76 -
Gimba, S D., - 271 -
Goshi, S. K., - 347 -
H
Haupt, T. C., - 994 -
Hughes, W., - 3 -
I
Ibem, E. O., - 443 -
Ibrahim, A., - 565 -
Ibrahim, A., - 715 -
Ibrahim, A. D., - 208 -, - 219 -, - 814 -
Ibrahim, G., - 38 -
Ibrahim, K., - 25 -
Ibrahim, K., - 1048 -
Ibrahim, Y. M., - 208 -, - 219 -, - 814 -
Idoro, G. I., - 682 -, - 1144 -
Idowu, F. A., - 1171 -
Ikudayisi, A. E., - 337 -
Inuwa, I. I., - 1397 -
Isa, Y.M, - 1239 -
Isah, A. D., - 347 -

J
Jalam, A. A., - 761 -
Jimoh, A. A., - 49 -
John, I. B., - 898 -
Jolaoso, A. B., - 444 -
Jolaoye, A., - 271 -
K
Kadzunge,T. M., - 524 -
Kevin, L., - 897 -
Kpamma, Z. E., - 1314 -
Kumo, H A., - 655 -
Kunya, S. U., - 1397 -
Kwofie, T. E., - 394 -
L
Laryea, S., - 897 -
Laryea, S., - 853 -
Laryea, S., - 1079 -
Lawal, B. T., - 898 -
Leburu, M., - 827 -
Li, H. I., - 607 -
M
Maina, J. J., - 870 -, - 930 -
Maina, J. J., - 911 -
Maleka, S. M., - 1397 -
Mathebula, A M, - 106 -
Mbohwa C., - 524 -
Mensah, I, - 121 -
Mensah, I., - 1063 -
Mensah, S., - 302 -, - 803 -
Metu, J. N., - 978 -
Mhando, Y. B., - 465 -
Mlinga, R. S., - 465 -
Mohammed, L. A., - 616 -
Mollo, L. G., - 13 -
Morenikeji, O., - 1 -
Mpambela, J. S., - 394 -
Muhammad, A. Y., - 761 -
Muhammed, M. A., - 49 -
Musa, A. A., - 616 -
Mushatat, S., - 1314 -
Mushiri, T., - 524 -
N
Nadeem, A., - 1097 -
Nani, G, - 121 -
Nani, G., - 1063 -
Narh, N., - 642 -
Nti Asamoah, J., - 1274 -
Nuramo, D. A., - 994 -
Nwabueze, M. A., - 479 -
Nwuba, C. C., - 140 -
Nyewie, R. F., - 1281 -
O
O'Connor, N., - 1300 -
Ogunbiyi, M. A., - 516 -, - 579 -, - 674 -, - 1327 -
Ogunleye, M. B., - 160 -
Okafor, M U, - 230 -
Okechukwu, B. I., - 314 -
Okosun, B., - 178 -
Olagunju, R. E., - 178 -
Olagunju, R. E., - 978 -
Olaleye, Y. O., - 208 -, - 219 -
Olamilokun, O., - 1160 -
Olanitori, - 589 -
Olanitori, L M., - 599 -
Olanrele, O. O., - 1433 -
Olanrele, O. O., - 444 -
Olawale, S. O., - 516 -, - 579 -, - 1327 -
Olawale, S. O. A., - 674 -
Oloke, D., - 1111 -, - 1314 -
Olorunlana, F. A., - 843 -
Oluwatayo, A. A., - 443 -
Omotola, A., - 90 -
Onuwe, J. O., - 347 -
Onyemaechi, P. C., - 430 -
Opara, V. I., - 195 -
Opoko, A. P., - 1189 -
Oppong, G. D., - 243 -
Otuaga, - 589 -
Owusu-Manu, D., - 243 -
Owusu-Sekyere, E., - 1027 -
Oyaromade, R., - 1327 -
Oyedale, T., - 90 -
Ozumba, A. O. U., - 730 -
Ozumba, C., - 730 -
P
Polukuu, F.,, - 773 -
R
Raheem, W. M., - 1448 -
Renukappa, S., - 1111 -
Robinson, D., - 1097 -
S
Saan, R., - 1281 -
Sadiq, A., - 655 -
Sagada, M. L., - 911 -
Said, R., - 1433 -
Saidu, I, - 25 -
Saidu, I., - 1048 -, - 1123 -
Salawu, A O., - 271 -
Saleh, I., - 761 -
Salman, A., - 287 -
Salvador, K. A., - 1366 -
Sam, A., - 803 -
Seo, J., - 607 -
Shakantu, W., - 730 -
Shakantu, W. M. W., - 25 -
Shakantu, W. M. W., - 1123 -
Shakantu, W. M. W.., - 1048 -
Shaw, C., - 642 -
Shaw, J.D., - 5 -
Shaw. J.D., - 7 -
Shehu, M. A., - 314 -
Shittu, A. A., - 314 -
Shittu, W. O., - 1448 -
Smallwood, J J, - 106 -
Smallwood, J., - 494 -
Sodiya, A. K., - 945 -
Stanley, A. M., - 961 -
Suresh, S., - 1111 -

T
Tahiru, A., - 773 -
Tasiu, M., - 715 -
Thwala W., - 1211 -
Tifase, T. O., - 599 -
Tsado, A. J., - 314 -
Tukur, A., - 616 -
U
Usman, N., - 38 -
W
Waziri, B S, - 1239 -
Wilson, P., - 1314 -
Windapo, A., - 642 -
Wong, A. Y. L., - 607 -
Wumnoribi, V. A., - 773 -
Y
Yakub, A. A., - 271 -, - 410 -
Yakubu, R. A., - 1027 -
Z
Zadawa, A. N., - 49 -
Zaid, Z. M., - 410 -
Zakariyyah, K. I., - 898 -
Zukani, M., - 730 -

INDEX OF KEYWORDS

A
a structural failure, - 178 -
accelerated erosion test, - 886 -
access to land, - 140 -
accessible environment, - 543 -
adaptability, - 1009 -
adhocracy, - 208 -
adoption, - 1160 -, - 1172 -, - 1225 -
adoption, - 715 -
affordability, - 803 -
affordable homes, - 1189 -, - 1344 -
Africa, - 62 -, - 76 -
ageing, - 543 -
agent, - 494 -, - 897 -
AHP, - 1417 -
air temperature, - 230 -
alternative dispute resolution, - 160 -
analytical tools, - 1225 -
application, - 565 -
architectural design, - 347 -, - 1009 -
architecture, - 443 -, - 930 -
assessment, - 62 -, - 76 -, - 828 -
automated, - 524 -
B
balance control, - 607 -
BEST, - 62 -
Blue Horizon Bay, - 1300 -
bridges, - 121 -, - 1063 -
British Standard, - 674 -
build operate and transfer, - 1239 -
building, - 195 -, - 565 -, - 898 -
building construction, - 1009 -
building element, - 195 -
building fabric, - 230 -
building industry, - 506 -
Building Information Modeling, - 1172 -
building materials volume, - 1123 -
building size, - 1123 -
buildings, - 178 -
BuildingSMART, - 814 -
built environment, - 90 -
built environment, - 628 -
built environment, - 762 -
built environment, - 978 -
Built Environment Sustainability Tool, - 62 -
C
carbon dioxide, - 674 -
careers in construction, - 1098 -
case studies, - 347 -
case study, - 302 -
cash flow management, - 814 -
cashflow, - 642 -
causality, - 1327 -
causes, - 465 -
CBD, - 445 -
cement, - 589 -
cementitous materials, - 961 -
central market, - 1027 -
certification, - 828 -
challenges, - 1172 -
characteristics, - 178 -
choosing by advantages, - 13 -
clan, - 208 -
classification, - 260 -
Client Relationship Management (CLiREM), - 443 -
Client Relationship Management(CRM), - 443 -
climate change, - 1274 -
coarse aggregate, - 589 -
cocoa pod husk ash, - 674 -
collapse, - 178 -
commercial property, - 445 -
community squares, - 750 -
compact fluorescent bulbs, - 337 -
compensation, - 1433 -
competitive negotiation procedure, - 854 -
competitive tendering, - 1417 -
compressed earth blocks, - 886 -
compressive strength, - 579 -, - 616 -
compressive strength, - 589 -
compressive strength, - 599 -
compulsory acquisition, - 1433 -
computerized maintenance management system, - 715 -
conceptual framework, - 38 -
conceptualising research projects, - 3 -
concrete, - 599 -
concretes, - 13 -
conflict of interest factors, - 50 -
construction, - 479 -, - 494 -, - 897 -
construction education, - 1098 -
construction firms, - 260 -, - 1145 -, - 1160 -
construction industry, - 380 -, - 1160 -, - 1211 -
construction industry, - 1366 -
construction project success, - 302 -
construction projects, - 244 -, - 682 -
construction sector, - 1327 -
construction site, - 565 -
construction superintendent, - 1098 -
construction worker, - 607 -
contemporary architectural practice, - 506 -
continuity, - 1281 -
contract duration, - 1063 -
contract sum, - 195 -
contractor, - 1172 -
control beam, - 599 -
control measures, - 1048 -
corporate social responsibility, - 25 -
cost, - 195 -, - 288 -
cost overrun, - 479 -
cost overruns, - 1048 -

cost planning techniques, - 380 -
CPD challenges, - 394 -
CPD compliance, - 394 -
crafting research methods, - 7 -
crafting research results, - 7 -
critical success factors, - 1211 -
D
decision-making, - 13 -
delay, - 121 -
delays, - 642 -
design, - 524 -, - 994 -
design innovation, - 516 -
detrimental variations, - 465 -
developing countries, - 260 -, - 524 -, - 994 -, - 1417 -
development, - 364 -, - 730 -
disability, - 543 -
disaster, - 1027 -
discipline, - 628 -
disussing research results, - 7 -
dry joint construction, - 516 -
duration methods, - 1063 -
E
eco-design, - 978 -
ecological footprint, - 25 -
economic growth, - 364 -
economy, - 38 -
education, - 870 -
electricity supply, - 1111 -
employability, - 628 -
end-user, - 762 -
energy efficiency, - 978 -
environments, - 930 -
equity release loans, - 774 -
ergonomics, - 565 -
escape routes, - 314 -
estate surveyors, - 945 -
expatriate consultants, - 682 -
F
factors, - 628 -
fall injuries, - 607 -
family-owned business, - 1281 -
farmers, - 843 -
feedback system, - 750 -
finance, - 642 -
fire safety provision, - 314 -
flooding, - 1009 -
framework, - 565 -
framework, - 1239 -
G
GDP, - 1327 -
general hospital, - 524 -
Ghana, - 121 -, - 260 -, - 803 -, - 1063 -
global, uniformity, - 1433 -
good governance, - 90 -
graduate, - 628 -
granite, - 579 -
green building, - 272 -, - 828 -
green building, - 288 -
green building, - 656 -
green building, - 762 -
green materials, - 828 -
green star rating, - 828 -
H
hazard, - 1366 -
health, - 730 -, - 1300 -
health and safety, - 494 -, - 897 -
health and safety, - 1366 -
heritage, - 750 -
hierarchical, - 208 -
higher education, - 1 -
higher institution, - 410 -
hindrance, - 762 -
homelessness, - 1189 -
homeownership, - 140 -
hospitals, - 870 -
hostel accommodation, - 410 -
hot weather, - 616 -
hotel property, - 445 -
housing, - 1344 -
housing, - 430 -
housing markets, - 140 -
housing satisfaction, - 1254 -
housing sector, - 762 -
housing the elderly, - 543 -
human comfort, - 288 -
I
ICT content, - 698 -
ICT footprint, - 698 -
IFC, - 814 -
inclusive design, - 543 -
indigenous consultants, - 682 -
indigenous material, - 272 -
indoor thermal conditions, - 230 -
informal spaces, - 930 -
infrastructure, - 364 -
infrastructure, - 1239 -
intervening measures, - 38 -
investment attributes, - 445 -
investment capital, - 774 -
K
Kantin Kwari market, - 911 -
key elements, - 994 -
key workers, - 1344 -
Kumasi, - 803 -, - 1027 -
Kurmi Market, - 911 -
L
labor force, - 1098 -
Lagos, - 1366 -
lamp holders, - 337 -
land degradation, - 843 -
land markets, - 140 -
leadership, - 1314 -
lean construction, - 1160 -
learning, - 930 -
lease registration, - 774 -
LEED®, - 288 -
Length, Height, Thickness, - 674 -
lessons learnt, - 1009 -
life cycle assessment, - 1274 -

light levels, - 337 -
literature review, - 9 -
livelihoods, - 843 -
locally manufactured incinerator, - 961 -
M
maintenance, - 715 -
making a research contribution, - 7 -
management, - 898 -, - 1314 -
management, - 410 -
marketing, - 208 -
mass gathering, - 107 -
mass housing, - 1254 -
material waste, - 1048 -, - 1123 -
mediation, - 160 -
mediation model, - 50 -
methodologies, - 1225 -
middle-income, - 1254 -
models, - 1123 -
moderating measures, - 38 -
multifaceted problems, - 506 -
N
natural fibres, - 886 -
neighbourhood quality, - 1449 -
neighbourhoods, - 62 -
Nigeria, - 50 -, - 272 -, - 380 -, - 479 -, - 1145 -, - 1160 -, - 1254 -, - 1327 -, - 1398 -
Nigeria, - 410 -
Nigeria, - 430 -
Nigeria, - 628 -
Nigeria, - 715 -
Nigeria, - 1239 -
Nigerian electricity, - 1111 -
Nigerian universities, - 347 -
non-physical asset, - 945 -
northeast Nigeria, - 870 -
numerical simulation, - 516 -
O
objectives, - 244 -
occupancy rate, - 445 -
Okigwe-Nigeria, - 230 -
OPC brands, - 616 -
oral interview, - 430 -
organisational culture, - 208 -, - 219 -
organisational theories, - 1225 -
overall effectiveness assessment, - 1417 -
P
partial replacements, - 961 -
participant observation, - 854 -
pedagogy, - 347 -
perception, - 656 -, - 1281 -
performance, - 13 -, - 494 -, - 898 -
planning and succession, - 1281 -
political economy, - 364 -
population, - 314 -
postural task, - 607 -
power sector reform, - 1111 -
precedent analysis, - 347 -
preference, - 1449 -
price formation, - 854 -
pricing, - 803 -
private sector, - 479 -
privatisation, - 1111 -
procurement stage, - 1048 -
professional, - 656 -
professional development, - 394 -
professionals, - 1398 -
project, - 730 -
project delivery, - 682 -
project execution, - 642 -
project management, - 244 -, - 1314 -
project outcome, - 682 -
project performance, - 1145 -
project team performance, - 302 -
project teams, - 13 -
projects, - 195 -, - 479 -, - 898 -
public building procurement, - 1398 -
public building projects, - 465 -
public buildings, - 314 -
public construction projects, - 642 -
public health, - 107 -
public opinion, - 750 -
public procurement, - 90 -
public sector, - 479 -
public-private partnership, - 430 -
Q
quadriceps muscle fatigue, - 607 -
quality, - 219 -, - 642 -
quality culture, - 1145 -
quality culture orientation, - 1145 -
R
readiness, - 1160 -, - 1172 -
real estate cases, - 160 -
real estate housing, - 803 -
regional climate, - 1374 -
regulations, - 260 -
relationship between project value and tender period, - 1079 -
relative humidity, - 230 -
relative importance indices, - 302 -
relative important index, - 121 -
repetitive squat lifting, - 607 -
research design, - 5 -
research question, - 5 -
residential property, - 1449 -
residents, - 1449 -
resilience, - 1009 -
reviewing research papers, - 9 -
Rheobuild, - 589 -
rice husk ash, - 961 -
risk accumulation, - 1027 -
risk management, - 1239 -
risk pricing, - 854 -
rural, - 730 -
rural roads, - 121 -, - 1063 -
S
sand, - 589 -
sanitation, - 730 -
SBAT, - 76 -
schools of architecture, - 506 -
self-evaluation, - 1314 -

service hole, - 599 -
setting time, - 616 -
shared ownership, - 1344 -
shelter, - 1189 -
shopping complex, - 978 -
skills, - 1314 -
slender beam, - 599 -
social practices, - 870 -
socio-cultural, - 911 -
socio-economic, - 1254 -
soil erosion, - 843 -
South Africa, - 730 -
space standards, - 1189 -
space use, - 930 -
spatial, - 911 -
specific gravity, - 579 -
staircase climber, - 524 -
stakeholder, - 656 -
stakeholder management, - 244 -
stakeholders, - 244 -, - 506 -
structural engineering, - 516 -
subcontractors' response to tender invitations, - 1079 -
success factor, - 656 -
sugar, - 616 -
sultry, - 1374 -
super-plasticizer, - 589 -
supplementary, - 961 -
survey, - 1366 -
suspected causes, - 178 -
sustainability, - 62 -, - 288 -, - 364 -, - 730 -, - 961 -
sustainability, - 978 -
sustainability housing, - 76 -
sustainability practices, - 1225 -
sustainability reporting, - 25 -
Sustainable Building Assessment Tool, - 76 -
sustainable development, - 272 -
sustainable development goals, - 90 -
sustainable infrastructure, - 994 -
sustainable material, - 1274 -
system dynamic model, - 1274 -
T
Tanzania, - 465 -
temperature change, - 1374 -
tendering, - 90 -, - 854 -, - 1079 -, - 1398 -
tendering costs, - 1079 -
tendering process, - 50 -
theory, - 5 -
thermal climate, - 1374 -
tools and techniques, - 898 -
total quality management, - 219 -, - 1211 -
traditional market, - 911 -
traits, - 1314 -
transparency, - 90 -
transport planning, - 107 -
trolley, - 524 -
U
Uganda, - 465 -
unethical practices, - 1398 -
universal design, - 543 -
un-washed gravel, - 579 -
urban area, - 430 -
urban governance, - 750 -
urban housing problems, - 140 -
urban infrastructure, - 1449 -
urbanization, - 1027 -
V
valuation, - 1433 -
valuation approaches, - 945 -
valuation methods, - 945 -
valuers, - 945 -
Van Stadens wind farm, - 1300 -
visual comfort, - 337 -
W
Wa, - 774 -
washed gravel, - 579 -
waste volume, - 1123 -
water resistance, - 886 -
wayfinding, - 870 -
wind turbine, - 1300 -
wood, - 1274 -