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Critical Risk Factors Affecting Infrastructure Projects in Kwara State, Nigeria

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Abstract

Infrastructure projects are becoming larger in nature, more complex in a dynamic project environment which are vulnerable to various technical, socio-political, business uncertainty and project related risk. As a result, most of these projects are being over running in terms of either cost, time or expected quality. These projects therefore, require complex risk analysis, risk allocation and risk mitigation, given the highly complex nature and enormous amounts of resources required. The aim of this study therefore, is to identify the critical risk factors affecting the infrastructure projects delivery. Forty-eight risk factors were identified through extant literature review. This was followed by administration of questionnaire to construction practitioners involved in infrastructure projects in Kwara State, Nigeria. Three-stage approach was adopted in the data analysis. The first was determination of risk scores, followed by determination of relative significance of each risk factor using relative importance index (RII) and the final stage involved ranking of the risk factors based on their RII values. Based on this analysis, the study uncovered ten (10) critical risk factors namely, financial difficulties, incomplete design, time allotted to design, inadequate program planning and contractors experience. Others include delay in progress payment, inadequacy of site inspections, design team experience, unstable inflationary and foreign exchange rate. Correlation analysis was also conducted between the top 10 critical risk factors and the result revealed that there is a significant relationship between the identified risk factors. The study suggests that risk analysis should be conducted at the early stage of the project to identify and evaluate project related risks and appropriate mitigating measure should be put in place immediately. Findings from this study will be helpful to project stakeholders to understand the highly risky factors in infrastructure project and where applicable, assign responsibility for those who are best suited to control them.

Keywords: infrastructure project; critical risk; risk factors; risk management

1. Introduction

The global civil engineering industry is a trillion-dollar per annum business sector and consists of several sub-division such as, geotechnical engineering, structural engineering, water engineering, environmental engineering, municipal/urban engineering, transportation engineering and materials engineering (American Society of Civil Engineers, 2010). The majority of these sectors are focused on sizeable infrastructure projects, with the bulk of funding from the public sector. The provision of infrastructural project such as roads, highways, dams, bridges, airports, hospitals, power generation and other forms of large structures is the bloodline of every Nation's economy that is critical to the survival of humanity (Nouman *et al.*, 2021). Infrastructural projects improve transportation, communication and boost the business of various industries, thereby, serve the country's development by underpinning the economic and linking social activities which increase the gross domestic product (GDP) of the country (Laila and Mohamed, 2019). These projects are becoming larger in nature, more complex in a dynamic project environment which are vulnerable to various technical, socio-political and business uncertainty and risk. As a result, most infrastructure projects are being over running in terms of either budget, time or expected quality (Koirala, 2017). The construction of these infrastructural facilities requires participation of several stakeholders, these includes the clients, consultants, contractors, users, shareholder, statutory authority including several sub -contractors. These project stakeholders enter project life cycle at different stages with different roles and responsibilities, experience, cultural background, risk management capabilities, and risk bearing capacities (Amuda-Yusuf *et al.*, 2017). Therefore, infrastructure projects require complex risk analysis, risk allocation and risk mitigation, given the highly complex nature and enormous amounts of resources required (Ghada, 2016). It is important to identify and evaluate critical project related risk which can have significant impact on infrastructure projects in developing countries (Laila and Mohamed, 2019).

The topical issue of construction risk has been given serious attention from various scholars (Anood, 2014; Amuda-Yusuf *et al.*,

2017; Idris *et al.*, 2019 and Shubham, 2020) globally and several risks factors have been identified; Unfortunately, the infrastructure projects in least developed countries are still prone to a wide range of risks and uncertainties (Reza, Nicholas & Jacqueline, 2016). Nevertheless, many of these risks can be mitigated through effective identification and evaluation of project related risks.

Considering the paucity of studies on critical risk factors affecting infrastructure project among Nigerian research domain. This study is hinged to fill this gap in knowledge and the aim is to explore industry's practitioners' perception on the critical risk factors affecting infrastructural projects in the context of Nigerian construction industry. Correspondingly, the specific objective of the study is to evaluate the critical risk factors that have significant impact on infrastructure projects delivery. Finding from this study will not only serve as reference materials for academics but also have practical implication as this will enable the project participants to know the critical risks they are exposed to at the early stage of the infrastructure project, it will enable the project stakeholders to understand the highly risky factors in infrastructure project and where applicable, assign responsibility for those who are best suited to control them, findings from this study could also be used as part of invitation to bidders for infrastructure projects, whereby the bidders will be required to state how they intend to solve the problem during construction.

2. Literature Review

2.1 Risk Management Process

There is no ironclad definition of risk, a new definition will be emerged every time an organization faces the challenge of making new decision and most definition of risk will to an extent be dependent on the situation in which the risks may occur (Samson *et al.*, 2008). Risk has different meanings to different people; that is, the concept of risk according to view point, attitudes and experience. Engineers, designers and contractors view it from the technological perspective; lenders and developers tend to view it from the economic and financial angle; health professionals, environmentalists, chemical engineers take a safety and

environmental side; risk is generally seen as an abstract concept whose measurement is very different (Anood, 2014).

Risk management process consists of four main stages; risk identification, risk classification, risk assessment, and risk response (PMI, 2014). For studying the criticality of risks, every risk will be judged on two criteria. The first is the frequency of occurrence of that risk and second is the severity of the occurrence of the risk on the project objectives (Shubham, 2020).

2.2 Risks Identification

This is the first phase of risk management process which has to do with capturing all the risks that tend to have effect on project objectives during construction (Nnadi *et al.*, 2018). This first step lays the foundation for the succeeding steps of risk analysis and control as it is an eye-opener for organizations to understand project associated risk. When risk identification is done accurately, it guarantees effective management of risk as it reveals hidden sources of losses that could result to incidences that could not be managed with unforeseen consequences (Ghasemi, *et al.*, 2018). The result of not being able to identify project related risk is equal to the consequences of not identifying adverse risks (Fadun and Saka, 2018).

Risk Identification is the most important and the most time-consuming phase in risk management process (Worku *et al.*, 2021). The aim of identification is to find substantive risk with the help of selected methods and record it in the register of risks and assign the identified risk to the owner of the risk (PMI, 2014). The first risks and opportunities are considered already in the pre-project studies and in the logical framework (analysis of the assumptions and constraints). A full analysis is done in the context of project planning. However, the project team must work with the risks during the entire phase of the project, not only in its initial stages, risk monitoring thus becomes part of the operational management (PMI, 2014).

Mishra (2019) categorized identification of risk as: Documentation and Information Gathering. According to the referenced author,

Documentation involves study of database, historical data from similar projects, templates, checklists study, project documentation, list of assumptions and constraints, post-project review/ lessons learned, Project documents review and study of specialist literature. On the other hand, Information gathering includes interviews, bench-marking, consulting experts, past experiences, risk breakdown structure, Delphi Technique, Root- cause analysis, Force field analysis, Influence diagrams, Industry knowledge base, SWOT Analysis, Questionnaire, Cause and effect diagrams, Brainstorming, Project Team Workshops and risk breakdown structure.

2.3 Risk Analysis

Risk analysis is a process of using relevant information in determining frequency of occurrence as well as the degree of consequences in risk management (Olamiwale, 2014). Having identified all the project associated risks, the next stage is to conduct qualitative risk assessment which requires additional analysis through evaluation of the tendency of risk occurrence and its effect on each of the identified risk (Nnadi *et al.*, 2018). The different factors that require consideration at this stage include the impact of risk on the objectives of a project and how it can be managed. Other factors include period of an occurrence, the probability of an event as well as its connection with other risks. All these will give proper understanding of each risk and facilitate a better response to each threat.

The ultimate goal of risk analysis is, therefore, to prioritize risks factors that have a significant impact on the project objectives (Ehsanifar and Hemesy 2019; Worku *et al.*, 2021). To identify the potential risk factors and analyze their impact on construction projects objectives, a classification that covers all types of potential risk factors is needed, this will avoid wasting time and resources on analysis of risks that are of relatively less importance in terms of their impact on the project objectives. (Kumar *et al.*, 2018).

2.4 Risk Classification in Construction Projects

Risk classification is defined according to PMI (2014) as a structure that provides an exhaustive process of systematic risk identification

to a constant detailing and which match its contribution to the quality and effectiveness to the risk identification process.

Project risk can be classified in various ways depending on the purpose. For instance, some risks are generally categorized into internal and external risks (Shubham, 2020 and Worku *et al.*, 2021) while others are classified in more detail as client risk, financial risk, design risk, contractor risk, material risk, etc. (Renuka *et al.*, 2014; Mohammed, 2016; Amuda-Yusuf *et al.*, 2017; Nguyen and Nguyen, 2020 and Ishaq *et al.*, 2021)

The leading six categories related to risk factors were management, design, financial, materials, labour and equipment and external (Kim *et al.*, 2019; Ibrahim *et al.*, 2020; Worku *et al.*, 2021). The selection of the categories was based on the most often included categories in risk event taxonomy.

Table 1: Risk Classification in Construction Project

Category	Description
Management	This type of risk includes inefficiency of owner supervisors, productivity of labour, productivity of equipment and labour disputes and lead to problems with the productivity on-site, quality assurance, cost control and human resource management. (Berenger <i>et al.</i> , 2016; Andrey <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020)
Design	One important requirement to minimize time and cost overrun of construction project is the allocation of sufficient time for design. Design related risk factor include lack of coordination of designs, discrepancy in the design and design team experience (Berenger <i>et al.</i> , 2016; Andrey <i>et al.</i> , 2019; Shubham, 2020)
Financial	This category considers factors with respect to possible financial difficulties on the project, which may include difficulties in assessing funds, delay in payment, and cash flow problems (Andrey <i>et al.</i> , 2019; Nguyen and Nguyen, 2020; Ishaq <i>et al.</i> , 2021).
Materials	Use of new and recently developed materials and products is common and some of these materials and products are not analyzed over long-term assessments and tests (Pawel, 2017; Shubham, 2020; Ishaq <i>et al.</i> , 2021).
Labour- and equipment	Shortage of workforce and the existence of unskilled labour are risk factors in relation to Labour issues. (Berenger <i>et al.</i> , 2016; Agyeman, 2017; Worku <i>et al.</i> , 2021)

Category	Description
External	These are risks which beyond the control of project team such as government policy, political risk, economy instability, social risk and natural risk (Andualem, 2019; Worku <i>et al.</i> , 2021).

2.5 Identification of Risks Factors in Construction Projects

Several researchers (Amuda-Yusuf *et al.*, 2017; Dindar, *et al.*, 2018; Idris *et al.*, 2019; Ishaq *et al.*, 2021) have studied potential risks in construction projects in developed and developing countries, looking at a range of projects from small to large scale. Various studies have considered risks relating to the three main parties in the construction industry; clients, consultants, and contractors. Others (Bahamid *et al.*, 2019; Kim *et al.*, 2019; Nguyen and Nguyen, 2020 and Ibrahim *et al.*, 2020) have used sub-categories of related factors, grouping together risks based on their nature. More detailed and diverse classification approaches have been employed by other scholars (Paweł, 2017; Andrey *et al.*, 2019 and Worku *et al.*, 2021;) as summarized in Table 2. Taking this into consideration and through a review of multiple risk taxonomy frameworks, the identified risk factors were categorized into six main groups, i.e., management, design, finance, materials, labour and equipment and external-related events. These categories were further broken down into 48 risk events as shown in Table 2.

Table 2: Summary of identified risk factors

S/N	Critical Risk Factors	Author(s)
1	Unclear responsibilities	(Bahamid <i>et al.</i> , 2019; Andrey <i>et al.</i> , 2019; Kim <i>et al.</i> , 2019; Nguyen and Nguyen, 2020)
2	Contractor's experience	(Gohar et al. 2012; Paweł, 2017; Ibrahim <i>et al.</i> , 2020; Ishaq <i>et al.</i> , 2021)
3	Poor communication and coordination between project team	(Mahamid 2013; Maseko, 2017; Agyeman, 2017; Bahamid <i>et al.</i> , 2019; Kim <i>et al.</i> , 2019; Shubham, 2020)
4	Inadequacy of site inspections	(Befrouei and Taghipour 2015; Helen et al. 2015; Maseko, 2017; Worku <i>et al.</i> , 2021)
5	Conflicts between project participants	(Mohammed, 2016; Jayasudha and Vidiyelli 2016; Andrey <i>et al.</i> , 2019)
6	Poor qualification of the contractor's technical staff	(Maseko, 2017; Ibrahim <i>et al.</i> , 2020; Worku <i>et al.</i> , 2021; Ishaq <i>et al.</i> , 2021)

S/N	Critical Risk Factors	Author(s)
7	Inappropriate procurement method used	(Kim <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020; Shubham, 2020; Worku <i>et al.</i> , 2021)
8	Mistakes and discrepancies in contract documents	(Befrouei and Taghipour 2015; Mohammed, 2016; Agyeman, 2017; Sujata, 2019; Nguyen and Nguyen, 2020)
9	Design team experience	(Agyeman, 2017; Maseko, 2017; Andrey <i>et al.</i> , 2019; Ishaq <i>et al.</i> , 2021)
10	Complexity of the project	(Mahamid 2013; Maseko, 2017; Shubham, 2020; Ibrahim <i>et al.</i> , 2020; Ishaq <i>et al.</i> , 2021)
11	Incomplete design	(Agyeman, 2017; Sujata, 2019; Nguyen and Nguyen, 2020; Ibrahim <i>et al.</i> , 2020)
12	Poor communication and information dissemination between the design team	(Befrouei and Taghipour 2015; Bahamid <i>et al.</i> , 2019; Andrey <i>et al.</i> , 2019; Worku <i>et al.</i> , 2021)
14	Misunderstanding of client requirement	(Andualem, 2019; Kim <i>et al.</i> , 2019; Shubham, 2020; Ibrahim <i>et al.</i> , 2020; Ishaq <i>et al.</i> , 2021)
15	Time allowed for design	(Mahamid 2013; Agyeman, 2017; Kim <i>et al.</i> , 2019; Shubham, 2020; Ishaq <i>et al.</i> , 2021)
16	Discrepancies between the designs	(Maseko, 2017; Andrey <i>et al.</i> , 2019; Bahamid <i>et al.</i> , 2019; Kim <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020)
17	Conflict between the design team	(Goh and Abdul-Rahman 2013; Emuze and Kadangwe 2014; Worku <i>et al.</i> , 2021)
18	Inadequate program planning	(Zou <i>et al.</i> 2007; Goh and Abdul-Rahman 2013; Befrouei and Taghipour 2015; Maseko, 2017; Ibrahim <i>et al.</i> , 2020)
19	Financial difficulties	(Mahamid 2013; Iqbal <i>et al.</i> 2015; Maseko, 2017; Agyeman, 2017; Kim <i>et al.</i> , 2019; Ishaq <i>et al.</i> , 2021)
20	Delay in progress payment	(Yoon <i>et al.</i> 2015; Jayasudha and Vidivelli 2016; Andrey <i>et al.</i> , 2019; Worku <i>et al.</i> , 2021)
21	Fluctuation	(Sujata, 2019; Shubham, 2020; Nguyen and Nguyen, 2020)
22	Variation	(Goh and Abdul-Rahman 2013; Agyeman, 2017; Ibrahim <i>et al.</i> , 2020)
23	Cost estimation accuracy	(Zou <i>et al.</i> , 2007; Emuze and Kadangwe 2014; Jayasudha and Vidivelli 2016; Kim <i>et al.</i> , 2019; Worku <i>et al.</i> , 2021)
24	Project duration	(El-Sayegh 2015; Goh and Abdul-Rahman 2013; Befrouei and Taghipour 2015; Maseko, 2017; Agyeman, 2017; Nguyen and Nguyen, 2020)
25	Quality of material	(Andi 2006; Helen <i>et al.</i> 2015; Iqbal <i>et al.</i> 2015; Agyeman, 2017; Shubham, 2020; Nguyen and Nguyen, 2020)

S/N	Critical Risk Factors	Author(s)
26	Delay in material delivery	(Iqbal et al. 2015; Maseko, 2017; Bahamid <i>et al.</i> , 2019; Worku <i>et al.</i> , 2021)
27	Poor specification	(Yoon et al. 2015; Paweł, 2017; Andrey <i>et al.</i> , 2019; Kim <i>et al.</i> , 2019; Nguyen and Nguyen, 2020; Ishaq <i>et al.</i> , 2021)
28	Noncompliance of material to specification	(El-Sayegh 2015; Helen <i>et al.</i> , 2015; Agyeman, 2017; Ibrahim <i>et al.</i> , 2020; Worku <i>et al.</i> , 2021)
20	Availability of material in market	(Iqbal et al. 2015; Mishra and Mishra 2016; Fernando <i>et al.</i> , 2017; Shubham, 2020; 2019 Ishaq <i>et al.</i> , 2021)
30	Change in material specification and type	(Andi 2006; Paweł, 2017; Kim <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020; Nguyen and Nguyen, 2020)
31	Delay in manufacturing special materials	(Maseko, 2017; Shubham, 2020; Ishaq <i>et al.</i> , 2021)
32	Delay in selection of material	(Agyeman, 2017; Bahamid <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020; Worku <i>et al.</i> , 2021)
33	Lack of skilled labour	(Zou et al. 2007; El-Sayegh 2015; Emuze and Kadangwe 2014; Mishra and Mishra 2016)
34	Labour low productivity	(Wiguna and Scott 2005; Maseko, 2017; Kim <i>et al.</i> , 2019; Bahamid <i>et al.</i> , 2019 Ishaq <i>et al.</i> , 2021)
35	Strike and labour disputes	(Wang et al. 2004; Mahamid 2013; Andrey <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020; Ishaq <i>et al.</i> , 2021)
36	Availability of equipment required	(Kim <i>et al.</i> , 2019; Jayasudha and Vidiwelli 2016; Ibrahim <i>et al.</i> , 2020; Ishaq <i>et al.</i> , 2021)
37	Equipment breakdown	(Befrouei and Taghipour 2015; Maseko, 2017; Bahamid <i>et al.</i> , 2019)
38	High cost of equipment	(Ekung <i>et al.</i> , 2015; Kim <i>et al.</i> , 2019; Worku <i>et al.</i> , 2021; Ishaq <i>et al.</i> , 2021)
39	Project location	(Mahamid 2013; Jayasudha and Vidiwelli 2016; Agyeman, 2017; Bahamid <i>et al.</i> , 2019; Shubham, 2020)
40	Poor communication between the supervisor and labour	(Helen <i>et al.</i> , 2015; Mishra and Mishra 2016; Maseko, 2017; Ibrahim <i>et al.</i> , 2020; Worku <i>et al.</i> , 2021; Ishaq <i>et al.</i> , 2021)
41	Site condition	(Ekung <i>et al.</i> , 2015; Agyeman, 2017; Ibrahim <i>et al.</i> , 2020; Ishaq <i>et al.</i> , 2021)
42	Inclement weather condition	(Wiguna and Scott 2005; Iqbal <i>et al.</i> , 2015; Jayasudha and Vidiwelli 2016; Kim <i>et al.</i> , 2019; Shubham, 2020)
43	Change in government policy	(Jaber 2015; Maseko, 2017; Bahamid <i>et al.</i> , 2019; Shubham, 2020; Ibrahim <i>et al.</i> , 2020)

S/N	Critical Risk Factors		Author(s)
44	Unstable trend	inflationary	(Iqbal et al. 2015; Maseko, 2017; Mishra and Mishra 2016; Fernando et al. 2017; Kim <i>et al.</i> , 2019; Ishaq <i>et al.</i> , 2021)
45	Foreign exchange rate		(Emuze and Kadangwe 2014; Jayasudha and Vidivelli 2016; Fernando et al. 2017; Ibrahim <i>et al.</i> , 2020; Worku <i>et al.</i> , 2021)
46	Technological advancement		(El-Sayegh 2015; Chileshe and Yirenkyi, 201; Bahamid <i>et al.</i> , 2019; Ishaq <i>et al.</i> , 2021)
47	Currency risk		(Andrey <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020; Shubham, 2020; Worku <i>et al.</i> , 2021; Ishaq <i>et al.</i> , 2021)
48	Force majeure		(Ekung et al. 2015; Jayasudha and Vidivelli 2016; Bahamid <i>et al.</i> , 2019; Ibrahim <i>et al.</i> , 2020; Ishaq <i>et al.</i> , 2021)

3. Methodology

3.1 Data Collection

This study examined the risks in infrastructure projects by assessing construction practitioner's perception in Kwara State, Nigeria. Through extensive literature search, 48 risks factors (see Table 3) were identified which were later used to design questionnaire for the survey. The questionnaire contains two sections, first was the demographic information of the respondents while the second evaluated the rate of probability of occurrence (P) of each risk factor and the severity of its impact (I) on the overall performance of infrastructure projects. Respondents were requested to rate the P and I using the five-point Likert scale ranging from 5 = "very high (VH)", 4 = "high (H)", 3 = "moderate (M)", 2 = "low (L)", 1 = "very low (VL)". The questionnaire was purposefully administered to professionals from different organizations such as consulting, contracting, government agencies and academia. In all, a total of 175 copies of questionnaire were administered and retrieved.

Table 3: Risk Factors

Code	Risk factor description	Code	Risk factor description
RSK1	Unclear responsibilities	RSK31	Delay in manufacturing special materials
RSK2	Contractor's experience	RSK32	Delay in selection of material
RSK3	Poor communication and coordination between project team	RSK33	Lack of skilled labour
RSK4	Inadequacy of site inspections	RSK34	Labour low productivity
RSK5	Conflicts between project participants	RSK35	Strike and labour disputes
RSK6	Poor qualification of the contractor's technical staff	RSK36	Availability of equipment required
RSK7	Inappropriate procurement method used	RSK37	Equipment breakdown
RSK8	Mistakes and discrepancies in contract documents	RSK38	High cost of equipment
RSK9	Design team experience	RSK39	Project location
RSK10	Complexity of the project	RSK40	Poor communication between the supervisor and labour
RSK11	Incomplete design	RSK41	Site condition
RSK12	Poor communication and information dissemination between the design team	RSK42	Inclement weather condition
RSK13	Misunderstanding of client requirement	RSK43	Change in government policy
RSK14	Time allowed for design	RSK44	Unstable inflationary trend
RSK15	Discrepancies between the designs	RSK45	Foreign exchange rate
RSK16	Conflict between the design team	RSK46	Technological advancement
RSK17	Inadequate program planning	RSK47	Currency risk
RSK18	Financial difficulties	RSK48	Force majeure
RSK19	Delay in progress payment		
RSK20	Fluctuation		
RSK21	Variation		
RSK22	Cost estimation accuracy		
RSK23	Project duration		
RSK24	Contractual claim		
RSK25	Quality of material		
RSK26	Delay in material delivery		

RSK27	Poor specification
RSK28	Noncompliance of material to specification
RSK29	Availability of material in market
RSK30	Change in material specification and type

3.2 Analytical technique

Three-stage approach was adopted in the data analysis. The first was determination of risk scores, RS_k^a assessed by respondent k for risk factor a, were determined Using Equation (1).

$$RS_k^a = P_k^a \times I_k^a \quad (1)$$

Where P_k^a = Probability of occurrence of a risk factor 'a' assessed by respondent k; and I_k^a = degree of impact of a risk factor a (1 2 3.....48) assessed by respondent k.

The second stage involved determination of relative significance of each risk factor (relative importance index), past studies have adopted this approach (Shen et al. 2001; El-Sayegh 2008; El-Sayegh and Mansour 2015). Relative Importance Index (RII) of each risk factor was calculated using Equation (2).

$$RII = \frac{\sum_k n \cdot RS_k^a}{V \cdot N} \quad (2)$$

Where, V is the highest possible score available (i.e., V= 25, when $P_k^a = I_k^a = 5$) and N is the number of respondents. The Final stage involved ranking of the risk factors based on their RII values

4. Results and Discussion

About 35.2% of respondents sampled work in different government agencies, while 32.8% work in Consulting firms, 26.9% in contracting firms and 5% (academia). In terms of their profession, 51.3% are Engineer, 27.7% Quantity Surveyor and 21% Architect. On their years of experience, 37% have practiced between 11-15

years, 26% (26.1 years above), 24.4% (16-20 years), 6.7% (6-10 years) and 5.9% below 5 years. More than half (52.1%) obtained first degree (B.Sc./B.TECH), while 29.4% have Masters' Degree (M.Sc.), 13.4 Higher National Diploma (HND) and 5% PhD.

Relative significance and rank of risk factors : Prioritization of risk helps in identifying risks that matter most (Ehsanifar and Hemesy 2019). In this study, relative importance index (RII) of 48 risks were examined based on equation 2 above and their corresponding rank (Tables 3 and 4). The professionals were grouped based on their type of organization (i.e., client, contracting, government agencies, academia) along with the RII and rank.

The ten top critical risks identified in the study are presented in Table 4. Past studies have maintained that the first ten ranked risk events are the most critical (Iqbal et al., 2015; Jaber 2015). Financial difficulties (RSK 18) is the most significant risk factor in infrastructure projects in Kwara State Nigeria, based on the perception of professionals from different organizations. This result is not surprising because construction of any kind, requires money and in most developing countries like Nigeria, credits /loans from banks come with two digit high interest rate. Thus, any contractor or consultant approaching banks for loan to finance any project is at risk of defaulting in paying back, due to high interest such loans may accrue within a short period of time.

Incomplete design was identified as one the ten most significant risks in infrastructure projects. This may result from issues such as insufficient time allocated to designer, design team experience, unclear and inadequate information during briefing. The adverse effect of incomplete design may lead to conflicts between project participants, variation, mistakes and discrepancies in contract documents. Design is very crucial in civil works. In fact, without design, there is little or much an engineer can do on site. However, when the design for a project is incomplete, it puts both the client and contractor/consultant on dangerous footing. Incomplete design could lead to cost over estimation or under estimation. The most dangerous being the risk of structural

deficiency which may lead to collapse. Collapse of high-rise buildings in Nigerian major cities have become rampant leading to loss of lives and property. The risk associated with incomplete design in infrastructure projects has become a topical issue among industry practitioners in Nigeria.

Akin to incomplete design is time allotted to design, results (Table 4) reveal that time allowed for design is another major risk factor in infrastructure projects. When enough time is not given to the people drawing the design (design team), there are tendency for mistakes and omission of certain aspects of the design, which may lead to incomplete design.

Again, inadequate program planning was identified as a major risk factor in infrastructure projects. When there is poor planning on how to execute the project by those concerned, the probability of failure becomes high. Many abandoned infrastructures projects in Nigeria, could be linked to inadequate planning on the part of contractors/consultants and sometimes the client. Programme planning involves a lot of things such as finance, material resources, human resources and time.

The contractors experience in infrastructures projects works is a key factor in the success or failure of the project. It was identified in this study as one of the top ten major risk factors. When a contractor is inexperienced, it could lead to unnecessary delay in project execution, financial and material waste and even shoddy project. On the other hand, an experienced contractor will ensure judicious allocation of all resources allotted to the project and also make sure that the project complies with the set standards or terms of reference (TOR).

Delay in progress payment is another rank risk factor in infrastructure projects based on perception of professionals from the different organizations (Table 4). In Nigeria, and most developing countries, delay in progress payment to contractors handling infrastructure works for public entities (local government, state government, federal government) is very rampant. This delay most times, put the contractors/consultants

at risk, because interest on loans taken from financial institutions to execute the project is accumulating. When the money is finally paid, the accrued interest on the loan may be so much that the contractor/consultant will be at loss.

Inadequacy of site inspections is another top risk factor identified in the study. When contractors/consultants refuse to visit project sites regularly and as at when due, there is high tendency for things to go wrong. Not visiting project site regularly could lead to poor project execution, loss of material and financial resources.

Design team experience is another top risk factor the professionals perceived in infrastructure projects. As earlier stated, design plays a vital role in execution of infrastructure projects, and wealth of experience of the design team matters. If the team, is not well experienced or grounded, it could lead to poor or incomplete design.

Unstable inflationary trend poses a risk to contractors/consultants handling infrastructure projects In Nigeria, the hyper-inflation rate, has had negative effect on all sectors of the economy including the construction industry. Many project sites have been abandoned because the client could not be able to meet their financial obligations to contractors/consultants handling civil engineering projects. The unstable inflation trend has effect on both clients and contractors. To the latter, cost estimation of the project is no more feasible, while to the former, sharp increase in prices of materials may lead total abandonment or suspension of the project.

Another top risk identified in the study is foreign exchange rate, which has posed serious risk to businesses operating in Nigeria. Scarcity of foreign exchange from financial institutions, has led to patronage of unlicensed bureau de change operators popularly called “black market” in Nigeria. The daily fluctuation or unpredictable nature of foreign exchange in Nigerian, affects the cost of imported materials used in infrastructure works.

Table 4: Results of Relative Importance Index (RII) and Ranks

Risk event	Consulting		Contracting		Govt.Agencies		Academia		Weighted average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank
RSK1	.54	14	.49	14	.21	27	.23	30	.37	28
RSK2	.80	5	.80	4	.78	11	.80	6	.79	3
RSK3	.36	24	.39	20	.63	15	.55	20	.48	20
RSK4	.45	19	.53	10	.81	9	.73	9	.63	11
RSK5	.50	16	.51	12	.61	17	.58	17	.55	16
RSK6	.38	23	.39	20	.49	22	.46	26	.43	24
RSK7	.17	33	.21	31	.48	23	.42	28	.32	29
RSK8	.50	17	.52	11	.63	15	.61	15	.57	14
RSK9	.63	7	.64	6	.86	8	.77	7	.72	6
RSK10	.43	20	.46	17	.63	15	.60	16	.53	18
RSK11	.83	4	.85	2	.94	4	.97	1	.89	1
RSK12	.22	30	.28	26	.59	19	.53	22	.40	26
RSK13	.31	26	.47	16	.74	14	.69	11	.55	16
RSK14	.93	2	.87	1	.48	23	.57	18	.71	7
RSK15	.52	15	.56	9	.76	12	.75	8	.65	8
RSK16	.20	31	.31	25	.91	6	.85	5	.57	14
RSK17	.66	6	.68	5	.76	12	.77	7	.72	6
RSK18	.87	3	.82	3	.87	7	.89	3	.86	2
RSK19	.80	5	.80	4	.75	13	.80	6	.79	3
RSK20	.48	18	.48	15	.48	23	.48	25	.48	20
RSK21	.95	1	.87	1	.60	18	.67	13	.77	4
RSK22	.62	8	.60	8	.48	23	.51	24	.55	16
RSK23	.26	29	.27	27	.35	26	.34	29	.30	31
RSK24	.29	28	.33	24	.57	21	.54	21	.43	24
RSK25	.41	21	.49	14	.96	2	.89	3	.69	8
RSK26	.34	25	.36	22	.47	24	.45	27	.41	25
RSK27	.60	10	.60	8	.58	20	.60	16	.60	13
RSK28	.52	15	.56	9	.75	13	.75	8	.64	10
RSK29	.18	32	.24	29	.57	21	.52	23	.38	27
RSK30	.39	22	.42	18	.57	21	.56	19	.49	19
RSK31	.31	26	.38	21	.99	1	.71	10	.60	13

	Consulting		Contracting		Govt.Agencies		Academia		Weighted average	
RSK32	.17	33	.26	28	.75	13	.68	12	.47	21
RSK33	.52	15	.56	9	.79	10	.75	8	.65	9
RSK34	.31	26	.38	21	.78	11	.71	10	.54	17
RSK35	.26	29	.31	25	.62	16	.57	18	.44	23
RSK36	.45	19	.50	13	.75	13	.73	9	.61	12
RSK37	.62	8	.60	8	.48	23	.51	24	.55	16
RSK38	.29	28	.34	23	.62	16	.57	18	.46	22
RSK39	.26	29	.27	27	.37	25	.34	29	.31	30
RSK40	.52	15	.56	9	.76	12	.75	8	.65	9
RSK41	.52	15	.56	9	.75	13	.75	8	.65	9
RSK42	.62	8	.60	8	.48	23	.51	24	.55	16
RSK43	.61	9	.61	7	.60	18	.63	14	.61	12
RSK44	.55	12	.61	7	.95	3	.91	2	.75	5
RSK45	.55	13	.61	7	.93	5	.91	2	.75	5
RSK46	.50	17	.52	11	.61	17	.61	15	.56	15
RSK47	.15	34	.22	30	.61	17	.55	20	.38	27
RSK48	.30	27	.40	19	.96	2	.87	4	.63	11

Table 5: Top Ten significant Risks

Risk event	Consulting		Contracting		Govt.Agencies		Academia		Weighted average	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Financial difficulties	.87	3	.82	3	.87	7	.89	3	.86	2
Incomplete design	.83	4	.85	2	.94	4	.97	1	.89	1
Time allowed for design	.93	2	.87	1	.48	23	.57	18	.71	7
Inadequate programme planning	.66	6	.68	5	.76	12	.77	7	.72	6
Contractor's experience	.80	5	.80	4	.78	11	.80	6	.79	3
Delay in progress payment	.80	5	.80	4	.75	13	.80	6	.79	3
Inadequacy of site inspections	.45	19	.53	10	.81	9	.73	9	.63	11
Design team experience	.63	7	.64	6	.86	8	.77	7	.72	6
Unstable inflationary trend	.55	12	.61	7	.95	3	.91	2	.75	5
Foreign exchange rate	.55	13	.61	7	.93	5	.91	2	.75	5

Correlation between the 10 top major risk factors: The correlation analysis results in Table 5 suggests that there is a significant association between the risk factors. Inadequate programme planning and financial difficulties were found to have highest correlation ($r = .834$, $p < 0.05$) followed by contractor's experience and inadequate programme planning ($r = .802$, $p < 0.05$), inadequacy of site inspection and delay in progress payment ($r = .773$, $p < 0.05$), delay in progress payment and Unstable inflationary trend ($r = .760$, $p < 0.05$), contractor's experience and financial difficulties ($r = .700$, $p < 0.05$) time allowed for design and incomplete design ($r = -.606$, $p < 0.05$), delay in progress payment and financial difficulties ($r = .691$, $p < 0.05$), inadequate programme planning and incomplete design ($r = .530$, $p < 0.05$).

Table 6: Bivariate correlation between the 10 top risk factors

	Contractor's experience	Design team experience	Incomplete design	Time allowed for design	Financial difficulties	Unstable inflationary trend	Foreign exchange rate	Delay in progress payment	Inadequate programme planning	Inadequacy of site inspection
Contractor's experience	1									
Design team experience	.079 .396	1								
Incomplete design	.282** .002	-.105 .254	1							
Time allowed for design	.000 .996	-.371** .000	-.606** .000	1						
Financial difficulties	.700** .000	-.261** .004	.523** .000	.110 .233	1					
Unstable inflationary trend	-.160 .081	.188* .040	.438** .000	-.642** .000	-.090 .333	1				
Foreign exchange rate	.102 .269	.119 .196	.472** .000	-.611** .000	.156 .089	.559** .000	1			

	Contractor's experience	Design team experience	Incomplete design	Time allowed for design	Financial difficulties	Unstable inflationary trend	Foreign exchange rate	Delay in progress payment	Inadequate programme planning	Inadequacy of site inspection
Delay in progress payment	.294**	-.462**	.408**	.118	.691**	-.028	.133	1		
	.001	.000	.000	.203	.000	.760	.149			
Inadequate programme planning	.802**	-.472**	.523**	.101	.834**	-.080	.196*	.711**	1	
	.000	.000	.000	.276	.000	.386	.032	.000		
Inadequacy of site inspection	-.005	-.649**	.347**	.091	.290**	.090	.178	.773**	.550**	1
	.958	.000	.000	.328	.001	.332	.053	.000	.000	

Note statistics significant at 0.05*, 0.01** level

5 Conclusion

The objective of this study was to systematically identify and evaluates the critical risk that have significant impact on the infrastructure projects delivery. An extant review of literature was conducted and 48 risk factors were identified. Using a questionnaire survey, this study sought the perception of the construction practitioners (Architects, Quantity Surveyors and Engineers) that were involved in infrastructure projects. A Relative Importance Index (RII) was used to analyze the results of the survey and prioritize the identified risk factors. Based on the prioritization of the identified risk factors in terms of their level of significance, the study uncovered ten critical risk that have significant impact on infrastructure projects in Kwara State as financial difficulties, incomplete design, time allotted to design, inadequate programme planning and contractors experience. Others include delay in progress payment, inadequacy of site inspections, design team experience, unstable inflationary and foreign exchange rate.

Further statistical analysis also revealed that there is a significant relationship between the top ten critical risk factors identifies. The study therefore suggests that risk analysis should be conducted at the early stage of the project to identify and evaluate project related risks and appropriate mitigating measure should be put in place immediately. This will enhance timely delivery of the project and within budgeted sum. There is need for the project stakeholders to work cooperatively from the feasibility stage onward to tackle potential risk in time and contractor with robust construction and management knowledge must be engaged early to make sound preparation for delivery of the project. There is need to engage a risk manager from inception of the project as this will enable the project associated risk to be fully analyzed and design appropriate mitigating strategies from various risk mitigating measures available

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