NIGERIAN INSTITUTE OF QUANTITY SURVEYORS: 5TH RESEARCH CONFERENCE– NIQS RECON5

9TH – 10TH NOVEMBER 2020

THEME:

Confluence of Research, Theory and Practice in the Built Environment

EDITORS:

Dr L. O. Oyewobi
Dr A. A. Shittu
Dr Y. D. Mohammed
Dr A. A. Oke

Proceedings of the 5th Research Conference of the Nigerian Institute of Quantity Surveyors

ISBN: 978-978-962-473-7

Correspondence:

Chairman
Association of Quantity Surveyors Lecturers/Educator
The Nigerian Institute of Quantity Surveyors
No.84,4th Avenue Gwarinpa, Abuja,
Nigeria.

NOV. 9TH – NOV. 10TH 2020

Federal University of Technology, Minna 2020

SCIENTIFIC COMMITTEE

Dr. E. O. Nnadi	Federal University of Technology, Akure. Nigeria
Dr. E. Oke	Federal University of Technology, Akure. Nigeria
Dr A. M. Lashinde	University of Uyo

CONFERENCE ORGANISING COMMITTEE

Prof. A. D. Ibrahim (Chairman)	Ahmadu Bello University, Zaria.
Prof. D. R. Ogunsemi	Federal University of Technology, Akure
Dr. G. Amuda-Yusuf	University of Ilorin
Dr. I. Katun	Federal Polytechnic, Bauchi
Dr. A. A. Arowosegbe	Federal Polytechnic, Offa.

LOCAL ORGANISING COMMITTEE

Dr. Y. D. Mohammed (Chairman)	Federal University of Technology, Minna, Nigeria
Prof. A. D. Ibrahim	Ahmadu Bello University, Zaria.
Dr. A. A. Oke	Federal University of Technology, Minna, Nigeria
Dr. K. A. Mohammed	Federal Polytechnic Bida, Nigeria
Dr. A. W. Ola-awo	Federal University of Technology, Minna, Nigeria
Mrs. H. M. Audi	NIQS, Niger State Chapter
Mr. S. Ibrahim	NIQS, Niger State Chapter
Mr. I. I. Adamu (Co-opted)	Federal University of Technology, Minna, Nigeria
Dr. L. O. Oyewobi (Sec. LOC)	Federal University of Technology, Minna, Nigeria

INFLUENCE OF PROJECT RISK MANAGEMENT IN HIGH-RISE BUILDING CONSTRUCTION ON PRODUCTIVITY OF WORKERS IN ABUJA, NIGERIA

Emmanuel EKWO [1] and Joseph Kolawole MAKINDE [2]
[1] *MTech Candidate, Dept of Project Management, Federal University of Technology Minna*
[2] *Lecturer, Dept of Project Management, Federal University of Technology Minna*

ABSTRACT

Although building construction projects are some of the most dynamic, complex and risky human endeavours, the traditional building construction process is fragmented, complicated, uncertain and risk-prone. Risk in high-rise projects, which can affect the productivity, performance, quality, and budget of such projects, may be impossible to eliminate, but it can be minimized, transferred or retained. The aim of this study was to evaluate the influence of project risk management in high-rise building construction on productivity of workers in Abuja, Nigeria through the ranking of key risk factors and relating artisan productivity to risk perception. The study adopted a quantitative research design through survey with close-ended, self-administered questionnaires. Data was gathered from a purposive sample of 37 artisans built up through a snowballing approach and was analysed using Mean Item Score and Kendall's tau-b Correlation. The study identified six key risk items, which included 'Poor competence and productivity of labour'; 'Poor coordination with subcontractor'; and 'Payment delays'. It thus concluded that labour productivity was not significantly related to risk in high-rise projects. It was recommended that risk management in high-rise projects should focus on the Technical, Logistical, Financial and Socio-Political risk factors. Suggested mitigation measures for these key risks include on-site testing of labour before recruitment; use of Project Managers to carry main and sub-contractors along; and use of payment bonds by clients. Further studies could focus on the influence of work height on labour productivity risk in high-rise building construction projects.

Keywords: building, high-rise, labour, productivity, risk.

INTRODUCTION

Buildings are one of the most valuable assets of any nation that provide people with shelter and facilities for work and leisure (Lam *et al*., 2010). Consequently, the construction industry plays a key role in the economy of any nation, more so in a developing country like Nigeria. According to the Frontier Market Intelligence report (2012) building construction in Nigeria accounted for 1.33% GDP in 2012 which is below the global average benchmark of 9% of GDP, and is indicative of the huge room for growth in the construction of buildings. Building construction projects are complex, dynamic and risky endeavours (Kangari, 1995; Mills, 2001), which traditionally span four sequential stages: conceptual design, construction, operation and maintenance (John *et al*., 2005). Clients' briefs are prepared during the conceptual stage; this initial design of the building and services is expanded by construction professionals (e.g. architects, engineers and quantity surveyors, etc.) who produce the design information required for the next stages. Contractors make use of this design information during the construction stage, in order to actually erect the building. On completion, the building will be operated and maintained, by either an estate department or a facilities management team.

However, the traditional building construction process as described is fragmented, complicated, uncertain and risk-prone (Arayici et al., 2012; John et al, 2005). Risk and the costs associated with it are abstract concepts that construction contractors rarely think about; this is despite the fact that it is one of the largest expense items (Cavignac, 2009). The structured, systematic and scientific management of risk helps the key project participants - client, contractor or developer, consultant, and supplier - to meet their commitments and minimize negative impacts on construction project performance in relation to cost, time and quality objectives (Banaitiene *et al*., 2011). This is the essence of risk management, the absence of which has several negative consequences for participants in a building project due to lack of preventive action against the risks and uncertainty that any project presents (Serpell *et al*., 2014).

A large number of building construction projects in developing countries suffer setbacks in completion of projects at the stipulated time, cost and quality, a situation that quite often turns profitable projects into losing ventures (Sweis *et al*., 2008). Oyewobi *et al*. (2011) pointed out that cost and time overruns have become associated with lack of good quality end products. To address this challenge, risk management has to become an important part of decision-making process in construction industry (Abujnah and Eaton, 2010). Risk affects the productivity, performance, quality and budget of high-rise building construction projects; it can however be minimized, transferred or retained (Smith *et al*., 2006). This paper evaluated the influence of project risk management in high-rise building construction on productivity of workers in Abuja, Nigeria. The two objectives of the paper were to rank the key risk factors, and determine the influence of risk factors on labour productivity in high-rise building construction projects.

LITERATURE REVIEW

Construction Risk

Risk, a complex phenomenon having many dimensions (Loosemore et al, 2006), which comes from the French word risqué (Abujnah and Eaton, 2010) first appeared in 18th century insurance transactions (Flanagan and Norman, 2000). The word 'risk' best describes a situation in which the outcome of decisions is predicted based on the probability of recurrence of past recorded similar experiences (Oztas and Okmen, 2004). According to Smith et al. (2006), risk exists when a decision is expressed in terms of a range of possible outcomes, to which known probabilities can be attached. According to Odeyinka *et al*. (2006), risk is a variable in the construction process whose occurrence renders uncertain the final cost, duration and/or quality of a project. From these definitions of risk, two common elements can be identified: uncertainty and loss. Hence, to discuss the presence of risk, there must be at least two possible outcomes; at least one of the possible outcomes must be undesirable. For example, if it is known that a loss will definitely occur; there cannot be any risk (Oztas and Okmen, 2004).

Risk management is one of the ten project management areas (i.e., integration, scope, time, cost, quality, human resource, communications, risk, procurement and stakeholders) propagated by the Project Management Institute (PMBoK, 2013). British Standard 31100 (2011) defined risk management as the process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequences or probability of occurrence. Risk management strategies employed by clients and project owners include (i) risk ownership (which party owns the risk; risk exposure and transfer) and (ii) risk financing (how to budget for risk through allowances or contingency) (Smith et al., 2006). Serpell *et al*. (2015) posits that a major role of project managers is dealing with risks continuously during a project.

There are many benefits of risk management in construction. A properly implemented risk management process will enhance the successful completion of building construction projects and thereby make the project more profitable. Key advantages of risk management process as described by Toader *et al*. (2010) and Poh (2005) include (i) it is efficient: project managers are aware about the risks which influence the activity of the project and manage them so that they do not occur; (ii) application of risk analysis in the tendering stage enables a realistic project pricing; (iii) efficient risk management increases the chances of success of the project, despite the uncertainties in the project environment, and (iv) in the presence of risk information, more comprehensive and accurate decisions about risks can be made. Other benefits are (v) availability of risk knowledge will help avoid mistakes made in past projects when planning for risk in future projects; (vi) good track record and proven risk management systems of construction firms will enhance their chances to secure future projects from the same project owner; (vii) an effective risk management process can improve communication among project participants.

Construction Risk Factors

The risk factors and associated risk items employed in this study were extrapolated mainly from a study carried out by Altoryman (2014), which had been sourced from an extensive review of literature from across the globe. The complete list of risk factors and items are given below.

Management-related RF: Decision making process M01; Communication and coordination between parties (clients, consultants and contractors) M02; Unclear responsibility M03; Availability of capable representatives M04; Postponement of work (held orders) M05; Issuance of instructions M06; Availability of project management team members (experience) M07; Information dissemination M08 Q09 - Site mobilisation and delay in site handover M09; Contractor's experience M10; Availability of competent subcontractors / suppliers M11; Rework due to errors during construction M12; Availability of disputes and claims – comprehensive dispute resolution M13; Conflicts in subcontractor's schedule in execution of project M14; Delays in subcontractor's work M15; Unsatisfactory work of contractor M16; Delay in approving major changes in the scope of the work M17; Long wait for approval of tests and inspection M18; Quality assurance / control M19; Excessive use of contractors / subcontractors M20; Unreasonable risk allocation M21; Frequent change of subcontractors because of their inefficient work M22; Revising / approving design documents, shop drawings and sample materials M23.

Design -related RF: Design team experience D01; Complexity of project design D02; Confusing requirements D03; Design modifications D04; Data collection and survey before design D05; Complete documents and drawings of projects D06; Producing design modification documents D07; Clarity of details in drawings D08; Excessive change order D09.

Finance-related RF: Payment for completed work F01; Financing project by contractor /client F02; Cash flow plan analysis F03; Cost estimation accuracy F04

Material-related RF: Quality of materials (below standard) MAT01; Availability of construction materials in market MAT02; Change in material types and specifications during construction MAT03; Material delivery MAT04; Manufacturing of special building materials MAT05; Material supplier problems MAT06; Material waste handling MAT07; Compliance of material to specification. MAT08

L&E-related RF: Labour performance / productivity L&E01; Equipment availability L&E02; Productivity and efficiency of equipment L&E03; Labour and management relations L&E04; Necessity of skills L&E05; Labour strikes and disputes L&E06

External-related RF: Site's topography is changed after design EXT01; Civil disturbances EXT02; Problems with neighbours EXT03; Government permits EXT04; Changes in regulations EXT05.

Construction Risk Management Process

Risk management is the effort to optimize decisions in order to reduce uncertainty about future events when the information is incomplete or unclear (Jafari *et al*., 2011). The risk management process is made up of a number of critical cyclical steps. Early studies on risk management had outlined different approaches to risk management. For example, Chapman (1997) outlined a generic project risk management process consisting of nine phases: (i) Define the key aspects of the project; (ii) Focus on a strategic approach to risk management; (iii) Identify where risks might arise; (iv) Structure the information about risk assumptions and relationships; (v) Assign ownership of risks and responses; (vi) Estimate the extent of uncertainty; (vii) Evaluate the relative magnitude of the various risks; (viii) Plan responses, and (ix) Manage by monitoring and controlling execution.

Akintola and Macleod (1997) suggested a four-stage process that consists of (i) identification, (ii) analysis, (iii) assessment and (iv) control. The need for a systematic risk management is essential to manage construction projects risks has for long been recognized. Jafari et al. (2011) identified four well-known approaches to risk management as PMBOK (2008), Project Risk Analysis and Management (PRAM) (APM, 2004), Management of Risk (MOR) and the standard AS/NZS4360:2004 (Australia Standard / New Zealand Standards, 2007). All of these approaches are based on the key steps of planning, identification, qualitative and quantitative analysis, reaction to risk, and controlling.

High-Rise Building Projects

The increasing need for space and limited land especially in urban areas have necessitated the construction of many high-rise building projects in big cities. Basari (2017) reported that in the Special city of Jakarta, of the 189 multi-story buildings (including those under construction) 113 buildings are apartments, 31 hotels and 45 offices. There are many definitions about high-rise building projects; from the civil engineer's perspective, a building can be described as 'high-rise' when its height has significant impact on its design. Such impact might be from lateral forces like earthquakes or winds. This engineering perspective will classify buildings with more than 10 floors or buildings which having a height of more than 32 meters as high-rise buildings (Mabhoot *et al*., 2013). Construction of high-rise building projects takes place in complex and dynamic environments that are fraught with uncertainty and high levels of risk. There are several characteristics associated with such projects such as deadlines, special objects, financial constraints, economic requirements, organizational conditions, special laws, and systematic complexity (Basari, 2017). These features mean that risk always exists in construction projects and often leads to delay schedules or cost overruns.

Construction Labour Productivity

Labour is one of the main resources employed in the construction process, so labour productivity has a key influence on the time and cost of construction activities (Hoła and Nowobilski, 2019). Kathiravan *et al*. (2014) defined productivity, for the purpose of their research, as the amount of work done by a workman in either a day or an hour. In construction management literature, the term "productivity" is defined in different ways. However, it is most common in construction to take productivity as referring to labour productivity (Halligan *et al*., 1994). Labour productivity has been most often defined as a relationship between human hours and work accomplished (Moselhi and Khan, 2012). Some researchers have however gone further to include other variables in the equation apart from output and time. Hwang and Soh (2013) as well as Yi and Chan (2014) defined labour productivity as the relationship between the output produced and the inputs used during the production process period. Moselhi and Khan (2012) as well as Nguyen and Nguyen (2013) defined labour productivity as a ratio of output to input while producing a product. Economically, this ratio is usually expressed as a percentage, e.g., 100% productivity means that the person is working as per the standard employed in evaluating the worker. A higher score means that the worker is working more efficiently, that is, above the level of efficiency specified in the evaluation standard. This paper follows Kathiravan *et al*. (2014) definition of productivity as being equal to Total quantity of work done/ Number of workers involved.

Since labour is one of the most unpredictable inputs in construction, some of the greatest risks in a construction contract arise from the use of labour. Labour must thus be controlled and its performance continuously improved upon. It goes without saying that the construction company with the most efficient labour operations has a greater chance to make more money and deliver construction projects in a faster manner. There are several factors that can affect the productivity of construction labour on a jobsite. These factors include weather conditions, workers' skill level, overcrowding of work crews, type of construction methods used, and material delivery/ storage/handling procedures.

METHODOLOGY

This study adopted a quantitative research design approach through survey with close-ended, well structured, self-administered questionnaires that were designed in two main sections, using Likert-style response options. Data was gathered through a purposive sample of 37 artisans, partially through a snowballing approach, and partially through the researcher's personal knowledge of the study area. The study was limited to construction artisans performing bricklaying, carpentry, iron-bending and plastering trades on high-rise building projects. It is believed that they have adequate experience about working on high-rise building projects, and about the ways in which risk factors affect their productivity on such projects. such artisans can thus answer the questions of this study.

The questionnaire data was analysed using descriptive statistical method (Mean Item Score and Standard Deviation), as well as inferential methods (Kendall's tau-b correlation). A total of 60 risk items (10 risk items each from six risk factors) were identified from review of construction management literature. A 4-item semantic Likert scale was then used to obtain rankings of the risk factors from artisans. Mean Item Scores (MIS) were computed and used to rank the risk factors in order to identify the risks that respondents considered to have a higher influence on their productivity. To be considered a key risk factor, risks must have an MIS higher than 3.50.

Kendall's tau-b correlation was carried out by using the average of semantic scores computed for each respondent in each of the six risk categories considered in this paper. This enabled the level of association between artisans' perception of risk factors and the daily productivity of such artisans to be assessed. The assessment was carried out in three phases; first, the linearity of the association was observed. Then, the strength of the association was examined through the computation of coefficient of determination (R^2) values. Thereafter, the level of significance of the association was determined through the 2-tailed 'Sig' values obtained from the correlation analysis; 'Sig' values lower than 0.05 were taken to be statistically significant. All of the results of these analyses were presented in tables.

RESULTS AND DISCUSSION

Demographic analysis of the data

Bricklayers made up 35% of the sample, followed by carpenters (27%), iron-benders (24%) and least of all plasterers, who made up 14% of all respondents. This result is presented in pie chart form as Fig. 1.

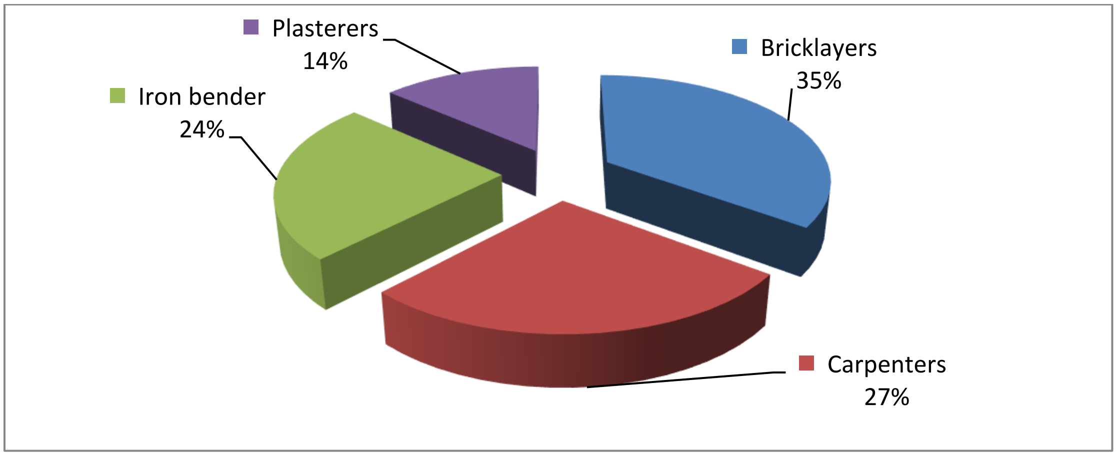

Fig. 1: Trades practiced by respondents

With respect to hourly and daily quantities of work done, bricklayers laid around 28 blocks per hour or 222 blocks per work-day; carpenters were able to complete carpentry works covering an average of 2.75 square meters per hour or 28 square meters per work-day.The work values presented in Table 1 are average estimates, and do not reflect the rate of working over the entire work-day. Detailed analysis of rates of work would have to take into account rest periods, slack periods, waiting for material periods and inspection periods. The monetary value of the work done by the artisans was relatively similar for all of the four trades. The least cost of work was 437.50 Naira per hour for bricklayers while the highest was 562.50 Naira for iron-benders. In the Nigerian construction industry, minimum thresholds for wages of artisans are fixed centrally by the National Joint Industrial Council (NJIC). Although some level of variation exists across the different construction firms, considerable similarity in wages should be expected.

Table 1: Descriptive statistics of work quantity and cost

Trade	Quantity /hour	Quantity /day	Cost /hour	Units measured in
Bricklayers	27.69	221.54	437.50	Blocks; Naira
Carpenters	2.75	28.00	500.00	Sq.m; Naira
Iron bender	2.39	22.22	562.50	Kg; Naira
Plasterers	7.56	28.00	500.00	Sq.m; Naira

Source: Fieldwork (2020)

Key risk factors in high-rise building construction projects

Technical risk factors

Only one risk factor from the ‘Technical risks’ category qualified to be referred to as a key risk, as is evident from the results in Table 2. This was ‘Poor competence and productivity of labour’, which had an MIS of 3.84. Seven other risk factors qualified to be described as ‘high technical risk’ only, since they had MIS values ranging from 2.65 to 3.43. Two factors ‘Delay in availability of drawings' and 'Risk of defective design' constituted 'low technical risks' to the productivity of artisans on high-rise building projects; these had MIS values of 2.30 and 2.24 respectively.

Table 2: Ranking of Technical risk factors in high-rise building projects

Risk code	Risk description	Mean Score	SD	RII	Rank	Remark
TR8	**Poor competence and productivity of labour**	**3.84**	**0.37**	**0.96**	**1**	**Very High Risk**
TR10	Less control and coordination in team	3.43	0.50	0.86	2	High Risk
TR5	Labour Shortage	3.38	0.49	0.84	3	High Risk
TR7	Lack of qualified Craftsmen	3.38	0.49	0.84	3	High Risk
TR3	Accidents/safety during construction	3.35	0.48	0.84	5	High Risk
TR6	Risk of insufficient technology	3.30	0.46	0.82	6	High Risk
TR9	Inaccurate estimation of quantities of work	3.19	0.81	0.80	7	High Risk
TR4	Inaccurate execution plan/schedule	2.65	1.06	0.66	8	High Risk
TR2	Delay in availability of drawings	2.30	0.91	0.57	9	Low Risk
TR1	Risk of defective design	2.24	0.95	0.56	10	Low Risk

Source: Fieldwork (2020)

Logistical risk factors

Only one risk factor from the 'Logistical risks' category qualified to be referred to as a key risk, as is evident from the results in Table 3. This was 'Poor coordination with subcontractor', which had an MIS of 3.65.

Table 3: Ranking of Logistical risk factors in high-rise building projects

Risk code	Risk description	Mean Score	SD	RII	Rank	Remark
LR8	**Poor coordination with subcontractor**	**3.65**	**0.48**	**0.91**	**1**	**Very High Risk**
LR9	Risk of defective material from supplier	3.49	0.87	0.87	2	High Risk
LR4	Theft/robbery of material at site	3.22	0.71	0.80	3	High Risk
LR6	Poor performance of subcontractor	3.19	0.40	0.80	4	High Risk
LR1	Shortage/delay of material supply	3.16	0.37	0.79	5	High Risk
LR7	Slow delivery	3.11	1.05	0.78	6	High Risk
LR5	Labour, materials and equipment availability	3.08	0.28	0.77	7	High Risk
LR10	Shortage of plant and equipment	2.73	0.61	0.68	8	High Risk
LR3	Third party delays	2.68	1.11	0.67	9	High Risk
LR2	Risk of labour disputes and strikes	2.35	1.25	0.59	10	Low Risk

Source: Fieldwork (2020)

Eight other risk factors could only be described as 'high risk' only; these had MIS values ranging from 2.68 to 3.49. Only one other factor was found to constitute a 'low logistical risk' to the productivity of artisans on high-rise building projects. This was 'Risk of labour disputes and strikes', which had an MIS value of 2.35.

Environmental risk factors

No risk factor from the 'Environmental risks' category qualified to be referred to as a key risk, as is evident from the results in Table 4. Only one factor was found to constitute a 'high environmental risk' to the productivity of artisans on high-rise building projects. This was 'Terrorism/war threats', which had an MIS value of 2.78. Eight other risk factors qualified to be described as 'low risk' only; these had MIS values ranging from 1.68 to 2.24.

Table 4: Ranking of Environmental risk factors in high-rise building projects

Risk code	Risk description	Mean Score	SD	RII	Rank	Remark
ER5	Terrorism/war threats	2.78	0.82	0.70	1	High Risk
ER1	Risk of natural disasters	2.24	1.16	0.56	2	Low Risk
ER7	Risk to Flora and Fauna	2.19	1.15	0.55	3	Low Risk
ER2	Risk of unforeseen site conditions	2.03	1.24	0.51	4	Low Risk
ER9	Risk of Air Pollution	2.03	1.04	0.51	5	Low Risk
ER8	Risk of Water Pollution	1.97	1.21	0.49	6	Low Risk
ER10	Risk from Noise and Vibration	1.97	0.96	0.49	7	Low Risk
ER6	Risk of Land Degradation	1.92	0.98	0.48	8	Low Risk
ER3	Risk of differing site conditions	1.86	1.00	0.47	9	Low Risk
ER4	Adverse weather conditions	1.68	1.08	0.42	10	Low Risk

Source: Fieldwork (2020)

Management-related risk factors

No risk factor from the 'Management-related risks' category qualified to be referred to as a key risk, as is evident from the results in Table 5. Seven factors were found to constitute 'high management-related risk' to the productivity of artisans on high-rise building projects. These seven factors had MIS values of between 2.46 and 3.08. Three other risk factors that had MIS values ranging from 1.81 to 2.19 were 'low management-related risks' only.

Table 5: Ranking of Management-related risk factors in high-rise building projects

Risk code	Risk description	Mean Score	SD	RII	Rank	Remark
MR6	Management of project resources (material, equipment, employee, financial, and method)	3.08	0.86	0.77	1	High Risk
MR8	Strategic risks	2.89	0.94	0.72	2	High Risk
MR9	Operational risk	2.88	1.12	0.66	3	High Risk
MR10	Incomplete daily report and low level of project document management	2.86	1.16	0.72	4	High Risk
MR2	Risk of Changes in scope of work	2.73	0.80	0.68	5	High Risk
MR4	Accuracy in determination of the organization structure	2.68	1.11	0.67	6	High Risk
MR3	Risk of Construction Management	2.46	1.19	0.61	7	High Risk
MR7	Governance risk	2.19	1.22	0.55	8	Low Risk
MR5	Complexity of license and regulation in implementation of project activities	2.19	1.00	0.55	9	Low Risk
MR1	Delays in obtaining permits	1.81	0.94	0.45	10	Low Risk

Source: Fieldwork (2020)

Financial risk factors

Only two risk factors from the 'Financial risks' category qualified to be referred to as key risks, as is evident from the results in Table 6. These were 'Payment delays' and 'Bankruptcy of project partner', which had MIS values of 4.00 and 3.54 respectively. Four other risk factors qualified to be described as 'high financial risk' since their MIS values ranged from 2.70 to 3.49. Two other factors ('Fluctuation of interest rate' and 'Rise in fuel prices'), which had MIS values of 2.35 and 1.81 respectively constituted a 'low financial risk'. The last two factors qualified to be described as 'very low financial risks'; these were 'Insurance risk' and 'Liquidity Risk', which had MIS values of 1.41 and 1.19 respectively.

Table 6: Ranking of Financial risk factors in high-rise building projects

Risk code	Risk description	Mean Score	SD	RII	Rank	Remark
FR2	**Payment delays**	**4.00**	**0.00**	**1.00**	**1**	**Very High Risk**
FR5	**Bankruptcy of project partner**	**3.54**	**0.51**	**0.89**	**2**	**Very High Risk**
FR3	Level of overheads	3.49	0.87	0.87	3	High Risk
FR1	Risk of funding problems for project	3.46	0.51	0.86	4	High Risk
FR10	Fraud risk	3.30	0.85	0.82	5	High Risk
FR4	Exchange rate fluctuation and inflation	2.70	1.20	0.68	6	High Risk
FR6	Fluctuation of interest rate	2.35	0.95	0.59	7	Low Risk
FR7	Rise in fuel prices	1.81	0.97	0.45	8	Low Risk
FR8	Insurance risk	1.41	0.93	0.35	9	Very Low Risk
FR9	Liquidity Risk	1.19	0.52	0.30	10	Very Low Risk

Source: Fieldwork (2020)

Socio-Political risk factors

Only two risk factors from the 'Socio-Political risks' category qualified to be referred to as key risks, as is evident from the results in Table 7. These were 'Social Safety' and 'Unaccepted work by Owner', which had MIS values of 3.51 and 3.59 respectively. Seven other risk factors were described as 'high socio-political risk' since their MIS values ranged from 2.57 to 3.11. One other factor was found to constitute a 'low socio-political risk' to the productivity of artisans on high-rise building projects. This was 'Inadequacy of insurance', which had an MIS value of 2.35.

Table 7: Ranking of Socio-Political risk factors in high-rise building projects

Risk code	Risk description	Mean Score	SD	RII	Rank	Remark
SPR9	**Social Safety**	**3.59**	**0.50**	**0.90**	**1**	**Very High Risk**
SPR8	**Unaccepted work by Owner**	**3.51**	**0.51**	**0.88**	**2**	**Very High Risk**
SPR2	Corruption including bribery at sites	3.11	0.31	0.78	3	High Risk
SPR1	Political instability	3.05	0.62	0.76	4	High Risk
SPR6	Low level of employee's discipline	2.89	0.94	0.72	5	High Risk
SPR7	Submission of construction claim	2.84	1.26	0.71	6	High Risk
SPR10	Religious and Ethnic Tension	2.68	0.94	0.67	7	High Risk
SPR5	Inappropriate risk allocation in contract	2.57	1.30	0.64	8	High Risk
SPR4	Delays due to disputes with contractor	2.57	0.83	0.64	9	High Risk
SPR3	Inadequacy of insurance	2.35	0.95	0.59	10	Low Risk

Source: Fieldwork (2020)

Risk factors and labour productivity on high-rise projects

Negative linearity was observed in four out of six risk categories (Logistical, Environmental, Management-related and Socio-Political); this implied that higher levels of daily productivity are associated with higher risk factor influence. Associations between risk categories and labour productivity were observed to be extremely weak; in most cases less than 1% of the variance in labour productivity was explained by the influence of risks. It was therefore not surprising that none of the associations between the six risk categories and artisans' productivity was found to be of statistical significance (see Table 8).

Table 8: Correlation result of Productivity and risk factors in high-rise projects

Parameter examined (Influence of risk perception on the daily productivity of artisans in high-rise building construction projects)	**N**	**Kendall's tau-b**	**Linearity**	**R^2 (%)**	**Sig. (2-tailed)**	**Remark**
Technical Risks	37	0.037	Positive	0.14	0.785	NS
Logistical Risks	37	-0.048	Negative	0.23	0.728	NS
Environmental Risks	37	-0.070	Negative	0.49	0.591	NS
Management Related Risks	37	-0.116	Negative	1.35	0.376	NS
Financial Risks	37	0.022	Positive	0.05	0.866	NS
Socio- Political Risks	37	-0.017	Negative	0.03	0.900	NS

Source: Fieldwork (2020)

The importance of payment delay risk has been brought out by the results presented in this subsection. This was the only risk factor that had respondents in complete agreement about the importance of the factor, which was why the factor had an MIS value of 4.00. The finding of the study that the perception of risk factors by artisans in high-rise building projects does not significantly impact the productivity of such artisans helps to focus research effort elsewhere, on other variables that may influence artisans' productivity, and which have not been included in this study. In their own study, Kathiravan *et al*. (2014) found that demanding increased productivity from construction labour might create special risks that would adversely affect the project. This is in line with this study's result regarding technical and financial risks; positive linearity in the result implies that increasing productivity would be accompanied by an increase in the influence of these categories of risks.

CONCLUSION

This paper evaluated the influence of risk factors on the productivity of workers in high-rise building construction projects in Abuja, Nigeria. Six key risk items from the Technical, Logistical, Financial and Socio-Political risks factors were identified. These were (i) 'Poor competence and productivity of labour', (ii) 'Poor coordination with subcontractor', (iii) 'Payment delays', (iv) 'Bankruptcy of project partner', (v) 'Social Safety' and (vi) 'Unaccepted work by Owner'. It was also found that the productivity of artisans was not significantly influenced by how the artisans perceived risk factors. From the foregoing, this study has concluded that labour productivity on high-rise building construction projects is not significantly affected by perceptions of project management risk.

The main recommendations of this paper are that risk management in high-rise building construction projects should be focused on the identified six key risk items belonging to the Technical, Logistical, Financial and Socio-Political risks factors as listed in the preceding paragraph. These key risk items could be mitigated by (i) Carrying out on-site testing of labour before recruitment; making effort to retain satisfactory artisans even between projects; (ii) using Project manager to provide leadership for main and sub-contractors; (iii) exploring the use of payment bonds by Clients (upon work being certified acceptable, contractors can be paid by a third party such as a bank on behalf of the client, as a result of a bond taken by the client guaranteeing timely payment to the contractor); (iv) exploring the use of work completion bonds by Contractors; (v) implementing corporate social responsibility (CSR) initiatives for large high-rise building projects, in order to endear the project to the immediate host community; and (vi) avoiding unaccepted work by adhering to the specifications laid down in the contract documents, ensuring timely work inspections, and having all Supervising Officer's instructions promptly confirmed.

REFERENCES

Abujnah, M. and Eaton, D. (2010): Towards a risk management framework for Libyan house-building projects; University of Salford available online at http://www.irbnet.de/daten/iconda/CIB14781.pdf assessed 05/09/2014

Akintoye, A. S. and MacLeod, M. J. (1997): Risk analysis and management in construction; *international journal of project management*; 15 (1); 31-38. Available online at http://ac.els-cdn.com/S026378639600035X/1-s2.0-S026378639600035X-main.pdf?_tid=0d736f0c-f742-11e1-8739-00000aab0f26&acdnat=1346840066_2da1f633a58b2c05f49d7fde0ee591ef assessed 05/09/14

Altoryman, A. (2014). *Identification and assessment of risk factors affecting construction projects in the Gulf region: Kuwait and Bahrain* (Doctoral dissertation, The University of Manchester (United Kingdom)).

Arayici, Y, Egbu, C. and Coates, P. (2012): Building Information Modelling (BIM) Implementation and Remote Construction Projects: Issues, Challenges, And Critiques; *Journal of Information Technology*; 17; 75-92; available online at http://usir.salford.ac.uk/22736/1/BIM_AND_REMOTE_ CONSTRUCTION _PROJECTS.pdf assessed 20/10/15

Association for Project Management (APM) (2004): *PRAM: Project risk analysis and management guide*; The APM group, UK.

Australian/New Zealand standard (2007): *Risk management AS/NZS 4360:2004*; available online at http://cid.bcrp.gob.pe/biblio/Papers/Documentos/AS-NZS4360SETRiskManagement.pdf assessed 15/01/2015

Banaitiene, N., Banaitis, A. and Norkus, A. (2011): Risk management in projects: Peculiarities of Lithuanian construction companies; *International Journal of strategic property management,* 15(1), 60-73.

Basari, I. (2017). Estimation Risk of High Rise Building on Contractor, IPTEK, *Journal of Engineering*, 3 (2), 29-34.

British Standard 31100 (2011): *Risk management: Code of Practice and Guidance for the Implementation of BS ISO 31000*; BSI (British Standards Institute).

Cavignac, J. (2009): Managing risk in a construction company. *Construction Business Owner*, November. [Online] Available at: http://www. constructionbusinessowner.com/topics/construction- insurance/managing-risk-in-a-construction- company.html [accessed 03/03/2013]

Chapman, C. (1997). Project risk analysis and management-PRAM the generic process. *Int. Journal of Project Management*, 15(5): 273–281.

Flanagan, R. and Norman, G. (2000): *Risk Management and Construction*; Blackwell Science

Frontier Market Intelligence (2012): Financial Business News-Nigerian Business Stories; The Four Factors Driving Growth in construction and property; available online at http://www.tradeinvestnigeria.com/news/1141421.htm assessed 01/08/2014.

Halligan, D. W., Demsetz, L.A., Brown, J. D. and Pace, C. B. (1994). Action-response model and loss of productivity in construction. *J. Constr. Eng. Manag*., 120, 47–64.

Hoła, B. and Nowobilski, T. (2019). Analysis of the influence of socio-economic factors on occupational safety in the construction industry. *Sustainability*, 11, 4469.

Hwang, B. and Soh, C. K. (2013). Trade-level productivity measurement: Critical challenges and solutions. *J. Constr. Eng. Manag*., 139, 04013013.

Jafari, M., Rezaeenour, J., Mazdeh, M. M. and Hooshmandi, A. (2011). Development and evaluation of a knowledge risk management model for project-based organization; A multi-stage study; *Management Decision*; 49 (3); 309-329; available online at http://www.emeraldinsight.com/doi/pdfplus/10.1108/00251741111120725 assessed 15/01/2015

John, G. A., Clements-Croome, D. J, Fairey, V. and Loy, H. M. (2005): Contextual prerequisites for the application of ILS principles to the building services industry; *Engineering construction and architectural management*; 12(4); 307-338

Kangari, R. (1995). Risk management perception and trend of US construction; *Journal of Construction Engineering and Management*; 121 (4); 422-429 available online at http://ascelibrary.org/doi/abs/10.1061/(ASCE)0733-9364(1995)121:4(422) assessed 20/11/2012

Kathiravan, R., Ravichandran, G. and Kumar, S. S. (2014). Assessment of labour Risk in High-Rise Building, *International Journal of Engineering Research and General Science* 2 (3) 76-84.

Lam, E. W. M., Chan, P. C. A. and Chan, W. M. D. (2010): Qualitative Survey on managing building maintenance projects; *world academy of science, engineering and technology*; 65; 232-236; available online at http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=4&sid=45b277d8-de9b-40e3-832c-8da1778889e0%40sessionmgr113&hid=14 assessed 3/2/13

Loosemore, M., Raftery, J., Reilly, C. and Higgon, D. (2006): *Risk management in projects*; 2nd edition, Taylor and Francis.

Mabhoot, M. R., Soroush, F. and Rahmani, S. (2013). Assess the positive and negative effects of a high-rise building with respect to the goals of sustainable urban development, Case study: Zone 9 in Mashhad city. *The 8th Symposium on Advances in Science and Technology* (8thSASTech), Mashhad, Iran.

Mills, A. (2001): A systematic approach to risk management for construction; *Structural Survey*; 19 (5); 245-252.

Moselhi, O. and Khan, Z. (2012). Significance ranking of parameters impacting construction labor productivity. *Constr. Innov*., 12, 272–296.

Nguyen, H. T. and Nguyen, L. D. (2013). Relationship between building floor and construction labor productivity. *Eng. Constr. Arch. Manag*., 20, 563–575.

Odeyinka, H. A, Oladapo, A. A. and Akindele, O. (2006): Assessing Risk Impacts on Construction Cost. *Proceedings of the Annual Research; Conference of the Royal Institution of Chartered Surveyors*, pp. 7-8; University College London; available online at http://eprints.ulster.ac.uk/10612/1/COBRA_2006_Risk_%2B_Construction_Cost.pdf assessed 15/01/2015

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; 4 (3); 147-151. Available online at http://www.academicjournals.org /jgrp/fulltext/2011/Mar/Oyewobi%20et%20al.htm assessed 20/11/12

Oztas, A. and Okmen, O. (2004): Risk analysis in fixed-price design-build construction projects; *Building and Environment*; 39; 229-237; available online at http://ac.els-cdn.com/S0360132303002026/1-s2.0-S0360132303002026-main.pdf?_tid=a0883496-9c5c-11e4-89a6-00000aacb35d&acdnat=1421288417_c364c3cf2e41372c70b3e2da773c6adc assessed 15/01/2015

PMI (2008). *A Guide to the Project Management Body of Knowledge* (PMBOK Guide). 4th ed. Newtown Square: Project Management Institute.

PMI (2013). *A Guide to the Project Management Body of Knowledge* (PMBOK Guide). 5th ed. Newtown Square: Project Management Institute.

Poh, Y. P. (2005) Integrated Project Duration-Cost Risk Simulation Model. A Thesis Submitted for the Degree of Doctor of Philosophy in Department of Surveying and Construction Management, London South Bank University.

Serpell, A. F., Ferrada, X., Rubio, L. and Arauzo, S. (2015). Evaluating risk management practices in construction organizations; *Procedia- Social and Behavioural Sciences*; 194; 201-210 available online at http://ac.els-cdn.com/S1877042815036149/1-s2.0-S1877042815036149-main.pdf?_tid=f2f4d5d6-4e4f-11e5-9fc5-00000aacb35e&acdnat=1440854279_dbbe52de50caec736952aac5a39f37b9 assessed 29/08/15

Serpell, A. F., Ferrada, X, Howard, R. and Rubio, L. (2014). Risk management in construction projects: a knowledge-based approach; *Procedia-Social and Behavioural Sciences*; 119; 653-662; available online at http://ac.els-cdn.com/S1877042814021648/1-s2.0-S1877042814021648-main.pdf?_tid=fc957a5a-5ec2-11e4-9fc0-00000aacb361&acdnat=1414515408_4f5843ef9d5afc12bc32023c9d534d65 assessed 28/10/14.

Smith, N. J, Merna, T. and Jobling, P. (2006): *Managing Risk in Construction Projects*, Blackwell Science, Oxford.

Sweis, G., Sweis, R., Abu Hammad, A. and Shboul, A. (2008): Delays in construction projects: The case of Jordan; *International Journal of Project Management*; 26;.665-674; available online at http://ac.els-cdn.com/S0263786307001573/1-s2.0-S0263786307001573-main.pdf?_tid=aca4a794-41bd-11e5-9fc5-00000aacb360&acdnat=1439472040_d50d07c56dae8d2ac062299ee34395d0 assessed 13/08/2015.

Toader, C. M., Brad, I., Radac, A. M. and Marin, D. (2010): Aspect regarding risk management in projects; *Animal Science and Biotechnologies*, 43(2); 454-457. Available online at http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=c2531f94-95c3-4206-a0bb-b272f0aa0523%40sessionmgr113&vid=4&hid=104 assessed 14/11/12.

Yi, W. and Chan, A. P. C. (2014). Critical review of labor productivity research in construction journals. *J. Manag. Eng.*, 30, 214–225.