Volume 4, Numbers 1&2, 2020

JOURNAL OF CONTEMPORARY RESEARCH IN THE BUILT ENVIRONMENT (JOCREBE)

ISSN: 2636-4468

PUBLISHED BY
DEPARTMENT OF BUILDING
FACULTY OF ENVIRONMENTAL STUDIES
UNIVERSITY OF UYO,
P. M. B. 1017, UYO, NIGERIA

Journal of Contemporary Research in the Built Environment

Volume 4, Numbers 1&2, 2020 ISSN: 2636-4468

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Editorial Objectives and Scope:
The Journal of Contemporary Research in the Built Environment (JOCREBE) is an interdisciplinary peer-reviewed journal dedicated to publishing papers which advance knowledge on the practical and theoretical developments as well as original research work in all aspects of sustainable built environment, encompassing all capital projects including buildings, civil engineering as well as repair and maintenance of sustainable infrastructures. That is the journal covers all aspects of science, technology, business and management concerned with the whole life cycle of the built environment, from the design phase through to construction, operation, performance, maintenance, conservation and its deterioration and demolition.

Frequency of Publication
The Journal publishes two issues in one volume yearly with the first issue published in March and the second in September.

Subscription and Advertisement
The subscription and advertisement rates can be obtained from the Editor-in-Chief or the Managing Editor.

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PUBLISHED BY
Department of Building
Faculty of Environmental Studies
University of Uyo, Uyo, Nigeria

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EDITORIAL

Dubem Isaac Ikediashi
Editor-in-Chief

It is with great pleasure that I welcome you to the first and second issues of the fourth volume of the Journal of Contemporary Research in the Built Environment (JOCREBE). This volume, in line with previous editions and scope of this journal, presents multi-disciplinary perspectives on contemporary issues associated with the Built Environment. On behalf of the editorial team, I wish to appreciate our worthy contributors for well researched and articulated papers. There are nine (9) papers in this edition and are hereby summarised for you. Enjoy your reading.

The first paper by Ekanem, Opawole and Adewuyi evaluated the effects of road construction delay on cost performance and developed a model for predicting the cost performance of road projects in the Niger Delta region, Nigeria. Primary and secondary data were analysed using a descriptive method, multiple regression analysis, and Kruskal Wallis H test for the hypothesis. Secondary data were obtained from initial and final costs and durations of 136 Niger Delta Development Commission (NDDC) road projects procured between 2008 and 2018. The results revealed that the significant effects of delay on cost performance are inflation of currency/exchange rates, corruption, total abandonment, under-development, and dispute and claims/bad reputation. However the test revealed a significant variation between Delta and Cross River States and between Edo and Cross River States. According to the study, the source of variation might be attributed to frequent patronage of the same contractors and consultants, high rate inflation and fraudulent/corrupt practices in the procurement and execution of the projects.

The second paper by Olatunji, Oladinrin and Jegede examined factors influencing the use of E-procurement in the Nigerian construction industry. The mainly quantitative data were collected from construction professionals. The data were analysed using Mean Item Score (MIS) and Kruskal-Wallis H Test. The results shows that the most important risk factors influencing e-procurement in the Nigerian construction industry are safety and insecurity issues, the unreliability of technology, reduced level of personal contact, resistance to change among others. It was also established that E-procurement implementation can be expensive among construction firms in Nigeria. The factors influencing the use of E-procurement in the Nigerian construction industry include the ease of transitioning from paper to electronic systems as the most important factor influencing the adoption of e-procurement followed by availability of policies to promote e-procurement, and then by the cost of e-procurement technology.

The third paper by Ujene and Inyang provided insight into how procurement methods could influence the effectiveness of risk management practices of housing projects in Akwa Ibom State. The objectives of the study were to evaluate the effectiveness of risk management methods of traditional, direct labour, and labour only procurement methods with a view to enhancing construction projects delivery in Akwa Ibom state and Nigeria

in general. A cross-sectional survey approach was used for the study. Ninety-nine (99) questionnaires were retrieved from purposively selected contractors operating in the study area. Data collected were analysed using mean item score and Kruskal Wallis was used to test the hypotheses. The results indicate that Consulting with experts, past experience and brainstorming were the most moderate effective risk identification techniques employed by the respondents across the three procurement methods while risk analysis was rarely done. Risk response techniques shows 93.75% moderate effectiveness, with avoidance/prevention, transfer and mitigation were mostly employed, while risk retention was never used. Risk assessment was ineffective, while risk monitoring was of moderate effectiveness. Furthermore, the findings revealed that there is no significant variation in the level of effectiveness of risk management methods among risk identification, response, monitoring among the delivery systems, but a significant variation in risk assessment. The study concluded that there is a general lack of knowledge of structured risk management practice by the respondents in housing projects.

The fourth paper by Adeogun, Yusuf, Bako, and Akinsola assessed the effect of urbanization on vegetation cover in the Minna metropolis, Niger State, Nigeria. The remote sensing Quick Bird satellite images of Minna for the year 2010, 2015 and 2020 were used to obtained land use information change. Remote Sensing Data Image (RSDI) was processed using GIS Arc Map 10.1 for digitization and calculation of built up areas and the land use change. Two neighbourhoods were chosen for examination and analysis, Tayi village neighbourhood and old Advanced Teachers' College (ATC) layout; presently called Zarumai New Extension Neighbourhood, all in Minna, Nigeria. The results indicated that study areas have grown double between 2010 and 2020, while speedy urban development due to population increase led to massive de-vegetation. It was also discovered by the study that as at 2010, the built-up area in Tayi was 20%, but by 2020, built up area has increased to 46%. Besides, the old ATC in 2010 was 30.8% but as at 2020 the built-up area has grown to 82.8%.

The fifth paper by Inyang and Ujene provided insights into how several factors influence the effectiveness of risk management practices of housing projects procured by traditional, direct labour and, labour only methods with a view to enhancing construction projects delivery in Akwa Ibom State. A cross-sectional survey approach was used for the study in which ninety-nine (99) copies of questionnaire were retrieved from purposively selected representatives of construction firms operating in the study area. Twenty-five factors were identified from literature and presented for respondents' assessment. Data collected were analysed using relative influence index, while Kruskal Wallis was used to test the hypothesis. Findings from the study established that the five most important factors influencing the effectiveness of risks management in traditional, direct labour and labour-only procurement methods are; timing, environmental factors, funds allocation for risk exercise, complexity and top management support. The result also shows that 4.0% of the whole factors has very high influence, 60% have high influence, while 36% of the evaluated factors have moderate influence on the effectiveness of the procurement methods, with all the methods exhibiting similar influence. The study recommended that advanced formal and informal training in risk management and prioritization of the control of the factors influencing their effectiveness should be regularly conducted among the stakeholders involved in the delivery of housing projects in the study area.

The sixth paper by Umoren and Essien assessed the city centre redevelopment of Ikot Ekpene Urban and its socio-economic implications. The study covered core area of about 14,000 m^2 and expanded area of about 3 km^2 from the city centre. A sample size of 400 respondents was taken from the projected population of the study area by the application

of Taro Yamane sample size technique. A total of 400 questionnaires was administered using both simple random and purposive sampling technique to respondents in the study area. The result revealed that there is a positive relationship. The RSI indicated that 75.75% respondents were satisfied with the redevelopment project in the city centre, 17.17% partially satisfied and 7.08% were not satisfied with the redevelopment project. The study revealed the redevelopment of the city centre therefore represent a strong revitalization strategy in an overall land use planning. The study therefore recommended the introduction of the concept of pedestrianisation, disembarkation point and a lot more which will lead to a total transformation of the study area.

The seventh paper by Asuquo, Oladokun, and Adelakun investigated the concept of the fourth industrial revolution and digitalisation within the Nigeria construction industry from the construction firm's perspective. The study adopted a qualitative research approach through the interview carried out among eight case companies in Abuja, Nigeria. Thematic analysis using conversational model was used in analysing the data generated. The study revealed that fourth industrial revolution systems and processes such as: RFID, BIM, and cloud computing have 87.5% level of adoption; internet of things witness 100% level of adoption; drones with 75% level of adoption and Big data witness 62.5% level of adoption. However, augmented reality, robots and 3D printing have 37.5%; 12.5% and 0% level of adoption respectively, indicating a low level of adoption of the systems and processes that constitute fourth industrial revolution. The study concluded that the adoption of the fourth industrial revolution and digitalisation in the construction industry has started but its full adoption has been slow and foreign construction firms have adopted more of the systems and processes of the fourth industrial revolution when compared to indigenous construction firms.

The eight paper was carried out by Allu-Kangkum and Chong and contextualised the “draw in order to see” innovative reformation in the Nigerian sustainable architectural education. The recent 12 points/Ways identified to Reform Architectural Education by Hewitt’s book titled “Draw in order to see” were adopted by the study in addition to a review of other related literature to form the theoretical underpins. Also, perceptions were collated through hard copy questionnaire and monkey online survey amongst architects within Nigeria in December 2020. A total of 129 responded but only 123 completed the survey questions. Findings suggest that history, site visits, collaborations and abstract critical thinking remain very relevant. Whilst virtual representations of designed environment are opined to be necessary to the architectural education in the Nigerian context.

The last paper by Ujene and Otali examined the extent to which some factors influence the effectiveness of inventory management, as well as the level to which the inventory management affect the performance of firms operating in the construction industry in south-south, Nigeria. Data for the study were collected from 204 small and 46 medium construction industry firms selected using stratified purposive sampling techniques. The relationships and hypothesis proposed in the conceptual framework were tested using structural equation modelling (SEM). Finding from the study shows that the identified factors have positive relationship with the efficiency of inventory management techniques. Besides, it was discovered that a positive relationship exists between efficient inventory management techniques and construction industry firms’ performance in terms of time, cost, quality and profitability, while an indirect positive relationship also exists between the identified influencing factors and the construction industry firms’ performance.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

EFFECTS OF DELAY ON COST PERFORMANCE OF ROAD CONSTRUCTION PROJECT: CASE OF NIGER DELTA DEVELOPMENT COMMISSION PROJECTS IN NIGERIA

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ABSTRACT

Purpose: The reduced cost performance of the Niger Delta Development Commission (NDDC) road construction projects was caused by construction delay. It makes it essential to evaluate the effects of road construction delay on cost performance and developed a model for predicting the cost performance of road projects in the Niger Delta region, Nigeria.

Design/methodology/approach: Both primary and secondary data were used for the study and were analysed using a descriptive method, multiple regression analysis, and Kruskal Wallis H test for the hypothesis. Secondary data were obtained from initial and final costs and durations of 136 road projects procured between 2008 and 2018.

Findings: Based on the 138 copies of questionnaires retrieved involving registered professionals in the six selected States, the results showed that the significant effects of delay on cost performance are: inflation of currency/exchange rates, corruption, total abandonment, under-development, and dispute and claims/bad reputation. However, the test revealed a significant variation between Delta and Cross River States and between Edo and Cross River States. The source of variation might be attributed to frequent patronage of the same contractors and consultants, high rate inflation and fraudulent/corrupt practices in the procurement and execution of the projects.

Research limitation/implications: The squared coefficient of correlation (R^2) value of the relationship between delay and cost performance is 0.237, revealing that 23.7% of the variation in the cost performance of road projects can be explained by the delay. It explained the percentage of delays in the completion of the road project executed by NDDC.

Practical implication: The studied variables that contributed significantly to the effect of delay on the cost performance of road projects procured by NDDC in the study area are nonspecific. Dereliction of such factors can rob both the client and beneficiaries of the economic benefits of such development and may aggravate the recurrent agitations and militancy in the region.

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Originality/value: The identified challenges by this study and their effects could be reduced through the application of the developed model in the execution of road projects in the region by the professionals and stakeholders employed by the commission. Participants in the construction industry in the region, and the world at large, can as well benefit from the application of the model for road projects with similar attributes, thus improving cost performance of projects delivery.

Keywords: Cost performance; delay; effect; NDDC, Niger Delta region; road construction project.

1. INTRODUCTION

The construction industry is a medium through which a society achieves its goals of rural and urban development (Alhomidan, 2013). Construction is one of the sectors that provide essential ingredients for the development of an economy, especially road infrastructures, as it enhances any kind of investment, movement of goods, services, and equally harnessing economic potential. A road construction project is a complex process and involved activities of professionals in the construction industry for its execution at every given time. Mulla and Waghmare (2015) observed that managing these activities to complete a project within budgeted cost and to client's satisfaction is difficult due to delay, despite the inventions and highly developed technologies. Delays in terms of value sometimes become freighting and disturbing, thus, demanding a more programmatic investigation. Shahid et al. (2015) established that delays are the primary cause of disputes confronting the construction industry. As such, road construction delay has assumed a grave concern to the parties in the construction industry.

Delay in construction remains a significant object of dissatisfaction among the stakeholders in the construction industry. An attempt to tackle the effects of delay on cost performance of road projects delivery becomes abortive, mostly in the developing countries. Documented findings revealed that new skill and improved expertise have not been able to prevent delay occurrences in civil engineering construction projects, including road projects procured by the Niger Delta Development Commission (Ekanem, 2019). The Federal Government of Nigeria assigned huge budgetary allocation for the construction of road projects through the NDDC since the year 2000. However, construction and delivery effects in terms of cost and time performance are poor as most of the road projects had either not commenced, partially completed, or in some cases, were abandoned (Isidiho & Sabran, 2015). Ekanem (2019) explained further that this scenario could be due to embezzlement, agitation, militancy, corruption, political interference, and insincerity among the stakeholders, which is very common in the Niger Delta region.

Though cost overrun remained a significant characteristic of road construction projects in the area, empirical studies on the effect of delays on cost performance of NDDC road projects delivery seems scarce. Thus, the scarcity of local literature has made it complicated to ascertain the impact and extent of delay in the cost performance of road projects procured by NDDC in the region. Mahamid (2011) examined the similarity between the estimated and actual cost of 100 road projects secured in the West Bank in Palestine. Deviations occurred on the value of execution of earthworks, asphalting, and furniture works to the extent of 15.7%, 18.5%, and 36.4%, respectively. However, the drivers resulting in these deviations remained uncaptured. According to Gebrehiwet and Luo (2017), construction projects experienced 70% of the time overruns

attributing 76% to contractors and 56% to consultants, given an overall average time overrun of 10 to 30% from the original period that causes 50% cost overrun.

Cost and time performances become the principal concerns in the construction sector, due to late completion of projects, thus exposing the stakeholders, especially the clients and contractors, to severe economic and financial risks such as loss of income, profit, bad reputation, and a lot more. Ghana's Statistical Services (2019) observed that, between 1997 and 2010, materials prices and labour costs increased by 1,229% in Africa. Construction projects, especially road projects, experience inflation, and fluctuation that affect cost and time performances as a result of claims and extension of time. Because of this, some previous studies developed cost-time relationship models for building projects to minimise the frequent occurrence of cost overrun in the construction industry, such as Bromilo (1974), Choudhury and Rajan (2003), Ogunsemi and Jagboro (2006) and Hoffman et al. (2007). Nevertheless, Kaka and Price (1991) and Tawiah (2014) developed similar models for road construction projects in the United Kingdom and Ghana, respectively. However, the foregoing studies did not focus on the evaluation of the delay effect on the cost performance of regional intervention projects. But this present study specifically focused on road construction projects with similar socio-political, environmental, and economic climates, which could pose significant delays on road construction projects in the Niger Delta region. This research investigated the effect of delay on the cost performance of road construction projects executed by the NDDC in the Niger Delta region, giving attention to the peculiar economic, environmental, and socio-political characteristics of the region.

This study sought solutions to two questions: (a) How does delay impact on cost performance of road project delivery in the study area? (b) How can the effect be modelled to predict the cost performance of such road projects? This study sought answers to these research question to help achieve aim and objectives. Therefore, the objectives of the study are: (1) to evaluate the effect of delay on the cost performance of road construction projects procured by NDDC in the Niger Delta region. (2) to determine the relationship between delay and the cost performance of road projects in the study area. Two hypotheses derived from the objectives of this study include: (i) There is no significant variation in the effect of delay on the cost performance of road projects procured by NDDC among the six selected States in the study area. (ii) There is no significant relationship between delay and cost performance of road projects procured by NDDC in the Niger Delta region.

1.1. The study area

The South-South of Nigeria comprises of Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and the River States selected from the nine States and is geographical located within the Niger Delta region, Nigeria. The study focused on this area due to familiarity with the environment for the sake of data collection and also due to numerous on-going road construction. Niger Delta region is rich in oil and gas, it remains the primary source of income for the country, accounting for about 97% of the total export item generating revenues (Agbu, 2005 and Jike 2005). They further explained that, this mineral became well-known in the region in 1958, and since then, the resources accruing from the exploration of crude oil has dominated the country's economy. The indigenes of the area depend on their land, water, and forest as farmers, fishermen, and hunters, for their survival before the discovery of mineral resources. These economic activities were

devastated as a result of the operation of exploration by oil companies. As a result of the exploration activities, the region becomes unproductive and undeveloped for survival, thus necessitating the establishment of NDDC to implement developmental projects as a means of compensating the inhabitants of the area. The lack of completed desired and impacting development demands this study.

2. REVIEW OF RELATED LITERATURE

Although construction delay is an occurrence that is common to construction projects but the level of effect and what led to cost overrun differ from project to project and from region to region (Kasima & Abubakar, 2012). Ashwini and Rahul (2014) defined cost overruns as the distinction between the estimated cost of projects and actual project cost at the completion time of the work; that is, the amount by which real value surpasses the approved cost or an increase in a completed price higher than what was estimated. While Benon and Milton (2012) termed time overruns as the degree by which the proportion of the finishing time of a project closes up to the initial commencement duration, that is, the extent by which the percentage of final finishing duration differs from the initial completion time. Furthermore, time overruns point out the gap between the final and initial completion time prescribed at the commencement of work.

Shahsavand et al. (2018) defined delay as the extra time incurred either beyond completion date specified or beyond the date that was agreed and signed upon by the parties in the contract document for delivery of a project. Client described delay as a loss of income through lack of production facilities and rentable space or a dependence on present facilities. While to a contractor, delay means higher overhead costs due to additional task leading to extension project duration, higher material costs through inflation, and as a result of labor cost increases. However, to complete projects on schedule is an index of efficiency, but the processes involved in the construction project is subject to countless variables and unpredictable factors, which may result from many sources. It is necessary that a detailed assessment and investigation is carried out and analysed the effects resulting from delays on the stakeholders in the projects with time required for the extension of projects time whenever the project is delayed. Kikwasi (2012) opined that delays occur in road construction projects as a result of the parties involved regarding the road project merely as linear and straight-line projects with no adequate planning attached at the inception. Construction delays were reported to be a common phenomenon in civil engineering projects in Egypt, where road construction projects were not excluded (Aziz et al., 2016). Therefore, it is essential to study and analyse the causes of road construction delay. Asish and Pratheeba (2015) enunciated that delay or cost overrun occurs due to ineffective and thorough investigations, planning, and scheduling. The preparation of valuation and payment, ineffective managerial technique, lack of incentive, delay in approving design documents, poor communication network among working teams, lack of teamwork among the workers on-site, and change order by clients due to errors were included among the cases of overrun. Enshassi, Mohamed and Madi (2005) attributed project location, fluctuation in material prices, interference by political leaders, and poor financial status of the client as the significant factors influencing cost overrun in road construction projects in Gaza. Ramabodu and Verster (2010) discovered critical factors causing cost overruns of road construction projects as incomplete design at tender stage, claims, inadequate planning and supervisions, delays in scope, which led to variations and change-orders by clients. EnasFaith and Pandey (2013) affirmed that changes in the client's requirement ordered by the consultant could contribute significantly to delay and cost overruns, especially during

the construction phases. Patil et al. (2013) established sixty-four causes of construction delays in transportation infrastructure projects in India, which were grouped into five related-causes. These included land acquisition, lack of environmental impact assessment; financial instability; change orders by the client, ineffective project monitoring, and supervision by the site engineers.

Larsen et al. (2016) analysed twenty-six factors that project managers experience as having the most significant effect on time, cost, and quality, and to determine whether the impact of these factors are significantly different from each other. The result revealed that the most influential factor for time is unsettled or lack of project funding; for cost, errors or omissions in consultant material; and for quality, inaccuracies, or omissions in construction work. The results derived by Jhawar and Bajpai (2014) revealed the top three significant causes of cost overrun. The factors included delayed payment of compensation, lateness in approvals of the plan, as well as bureaucracy and organizational gaps. These identified factors ultimately affect the delay in land acquisition and environment, especially in the case of a road construction project. Towhid and Amiruddin (2012) identified causes of cost overrun as underestimation of materials and quantities, the discrepancy in design, changes in the project schedule, change in the scope of the projects, inclement weather conditions, increase in material and labour cost and unforeseen events. Olawale and Sun (2010) itemised sixteen (16) variables that could cause cost overruns. These include risk and uncertainty associated with projects, imprecise project cost, program ambiguity, lack of coordination among parties, discrepancies in design bill of quantities, fluctuation in prices, lack of incentive, inexperienced professionals, dependency on imported materials, low skilled human resources, unpredictable weather condition, lack of software, unstable profit, inflation of currency/exchange rate, project fraud and corruption, and unstable policies based on a change in government. According to Mahamid and Bruland (2012), most road construction projects in the West Bank during 2004-2008 suffered an increased cost of up to 132% due to underestimation and fluctuation in material prices.

Additionally, an examination of the effects of delay in road construction projects revealed negative implications on the project objectives. Haseeb et al. (2011) studied the impact of delay in the construction industry of Pakistan. They pinpointed them to include disputes, negotiation, lawsuit, total desertion, litigation, inconsistent growth of the construction sector, and abandonment. While Haseeb et al. (2011) postulated that, the effects of delays relative to location and parties are the forfeiture of wealth, capacity, and time, Aboubaker et al. (2018) findings showed that the most important effects were cost overrun, and obstruction of economic and country development in Tripoli, Libya. Ekanem (2019) study revealed cost overrun, dispute, arbitration, litigation, and total abandonment as the most dominant effects of delay affecting road construction projects in Nigeria. Umoren (2014) asserted that the consequences in the delay of road construction might hinder the fruitful process and trigger the reduction of economic expansion. Therefore, Aysha et al. (2015) established that delays are major disputes confronting the construction industry and that the degree and how the delay factors influence cost performance concerning the estimated budget and specified quality is becoming frightening and disturbing, thus demanding a pragmatic evaluation.

3. RESEARCH METHODOLOGY

The study adopted a quantitative approach for data collection with the sample drawn from the client, consulting, and contracting firms engaged by NDDC in the region. Both primary and secondary data were used for the study. The study used a questionnaire to

measure the perceptions of respondents on an ordinal scale. The study adopted a total enumeration procedure with a population size of 153 professionals comprising Civil/Structural Engineers and Quantity Surveyors. The first part of the questionnaire captured information concerning the respondents such as gender, age, academic and professional experiences to ascertain the reliability of the data. At the same time, the second part factors affecting the cost performance of road construction projects exceuted by NDDC were considered. The second part considered the factors that affect the cost performance of road construction projects executed by NDDC. Five-point Likert scale ratings of 1 to 5 were assigned to the options of very low, low, moderate, high, and very high respectively to obtain the level of the respondent's ratings of the variables. The questionnaire was validated with an internal consistency reliability test to measure the Cronbach's alpha coefficient (which ranges from 0.886 to 0.969) among the factors affecting the cost performance of road construction projects. The study evaluated the effect of delay on the cost performance of road projects procured by NDDC with descriptive analysis (mean score). Kruskal Wallis H-test was employed to test hypothesis one, and the Bonferroni Dunnett test was used for the post-hoc test.

The data mean score (MS) was employed to analyse the data collected through the questionnaire for the objective one, using the expression in Equation 1 which was adopted from Kazaz, et al., (2008) with 1 representing the lowest level of effect and 5 representing the highest level.

$$MS = \frac{\sum_{j=1}^{5} W_i X_i}{\sum_{j=1}^{5} X_i}, \qquad (1 \leq MS \leq 5) \qquad \text{Equation 1}$$

where:

Wi is the rating given to each factor by the respondents ranging from 1 to 5, with 1 representing 'not significant' and 5 representing 'extremely significant';

Xi is the level of scoring, and

i is the order number of respondents.

The mean score was used by Kometa *et al*. (1996) and Awodele *et al.* (2012) in construction management studies, to measure the level of significance of variables. The cut-off points of the mean score (MS) computed were determined by summing the nominal values and dividing it by the total number of scaling items: (1+2+3+4+5)/5 = 3. Thus, events that have a mean greater than 3.0 and above are significant; those equal to 3 are moderately significant, while those below 3 are of insignificant. Ekanem (2019), as well as similar studies by Mojekeh and Eze (2011), Imonikebe (2013), and Ujene (2014), adopted this approach. The expectation that the use of 3.0 as a reference score can adequately cover only essential variables in terms of the substantial effect of delay on cost performance in road construction projects delivery.

The development of the model in this study used multiple linear regression analysis. Thus, the model explains the relationship between delay and cost performance of the road projects procured by NDDC in the Niger Delta region of Nigeria. The second objective of this study was realised with the information sourced through secondary data collection were the numbers of completed road construction projects, as procured by NDDC from 2009 to 2019 in the study area. Data collected from a total of 136 highway projects in the six States selected for this study, including Akwa Ibom, Bayelsa, Cross River, Edo, Delta, and the Rivers States, expressed the distribution as 27, 22, 18, 20, 23 and 26 respectively. The evaluations of the model originated from Pallant (2007) assumptions in the first stage of

exploration analysis. These include the correlation between dependent and independent variables, and the corresponding value of R, which is the correlation coefficient. The values of R ranging from 0.10 to 0.29 represent low correlation, 0.30 to 0.49 as the mean correlation, while 0.50 to 1.0 becomes the most relevant to the analysis. Secondly, the preliminary step of the analysis was done to ensure that there is no violation of the rules of normality, linearity, and homoscedasticity, and outliers.

A statistical significance test using the F-statistic determined whether or not the model, with its independent variable, is a significant predictor of the dependent variable (that is, significant test for R^2). The R^2 value is statistically significant or different from zero if the computed F-statistic is higher than the F-critical value for the defined probability level. For this study, the p-value used was at 0.05 level of significance, therefore, for the output interpretation, if obtained significance level (p-value) associated with the F-statistic is less than 0.05 (95% confidence), then R^2 is statistically significant. The level of significance in the regression analysis offered an explanation for or realisation of hypothesis two such that if the p-value is less than 0.05, the relationship is significant and vice versa.

4. Data Analysis, Results and Discussion of Findings

A total of 153 questionnaires were administered, only 138 usable questionnaires were collected and analysed for the research. The respondents with HND educational qualification were about 15.40%, while approximately 47.90% obtained B.Sc. and 36.80% had MBA/M.Sc. The result portrayed that all the respondents were literate enough to understand the subject matter of the study in the course of completing the questionnaires. Engineers were 73.50%, while 24.80% obtained Quantity Surveying degree indicating the respondents' relevance in the construction industry, showing that the data collected were viable and suitable for the study. 35.04% of the respondents reported having worked in the construction sectors between 1-10 years, while 43.59% of respondents had 11-20 years of experience revealing that the majority of the respondents possess considerable knowledge and could give reliable information required for the study. In respondent designation, about 38.50% of the respondents were either project managers or site managers, and 68.30% served as a consultant (quantity surveyors or engineers). The result revealed that all respondents participated actively in the construction of road projects and the encouragement of the stakeholders, especially those within the Niger Delta, portraying the purpose of establishing NDDC for the development of the region.

4.1. Presentation of findings

The effect of delay on cost performance of road project delivery was sourced through a structured questionnaire survey and analysed using the mean score (MS). The second objective involves the collection of archival data on initial and final costs together with the initial and final durations of the road projects procured by NDDC, which were obtained from the States' offices of NDDC in the six selected States for the study. Multiple linear regression was employed for the analyses. This study identified 14 effects of delay on cost performance, and the mean score (MS) was used to rate the variables in their order of significance as it affects the cost performance of road construction projects delivery. The result is presented in Table 1. The significant factors were determined by the cut-off score of 3.0, as earlier stated in the methodology. Table 1 showed both the significant and

insignificant effects of delay on cost performance in the study area. Based on the overall rating, inflation of currency/exchange rate ranked first as the most significant effect on the cost performance with a mean score of 3.70. This effect brought about an increase in market prices of materials and labour, thereby altering the established estimated budget of the road construction project creating a negative impact on the project performance in terms of time and cost. This effect generally concerns the ability to manage the contract within time and budgeted limits to avoid fluctuation in market prices as a result of inflation and exchange rate.

Table 1: Effect of Delay on Cost Performance of Road Projects

	AKS		BYS		CRS		DTS		EDO		RVS		Overall
Effects	**MS**	**R**	**MS**	**R**	**MS**	**R**	**MS**	**R**	**MS**	**R**	**MS**	**R**	**MS**	**R**
Inflation of currency/ exchange rate	3.63	3	2.68	12	3.46	1	4.13	4	4.25	3	4.15	2	3.70	1
High rate of fraud and corruption	3.56	5	2.37	15	2.92	5	4.7	1	5.00	1	3.89	4	3.69	2
Total abandonment	3.78	2	3.53	5	2.38	13	4.26	3	4.75	2	3.33	7	3.60	3
Under-development	3.59	4	3.32	6	2.38	13	4.00	5	4.25	3	3.37	5	3.50	4
Disputes and claims	3.41	7	3.74	4	3.38	2	3.87	7	2.5	13	2.93	9	3.40	5
Bad reputation	3.37	8	3.00	8	2.38	13	3.48	12	3.5	8	3.96	3	3.40	5
High cost of living	3.19	10	2.68	12	3.23	3	3.96	6	3.75	7	3.37	5	3.38	7
Materials waste	3.19	10	3.95	2	3.00	4	3.61	10	3.25	10	2.93	9	3.35	8
Unemployment	3.56	5	3.00	8	2.92	5	3.78	9	3.50	8	2.89	11	3.33	9
Renegotiation	3.22	9	3.95	2	2.77	10	3.52	11	3.25	10	2.85	12	3.30	10
Impede movement	2.89	12	3.00	8	2.85	8	3.83	8	4.00	6	3.07	8	3.26	11
Arbitration	2.67	14	3.26	7	2.69	11	2.78	14	2.00	14	2.70	13	2.80	12
High accident rate	2.26	15	2.68	12	2.85	8	3.04	13	3.00	12	2.48	15	2.77	13
Litigation	2.81	13	2.74	11	2.46	12	2.74	15	2.00	14	2.52	14	2.65	14

AKS =Akwa Ibom, BYS = Bayelsa, CRS = Cross River, DTS= Delta, EDS =Edo, RVS = River States, MS = Mean Score; R = Rank

Procurement of specified required materials without delay and prompt payment to workers encourage timely completion, and it is among the robust parameters to achieve cost performance in construction projects. A similar study by Al-Hazrm and Abusalem (2015) revealed material price fluctuation as the significant effect of cost overruns in road construction projects in Jordan. More so, Adam et al. (2012) reported that Yamuna road construction witnessed a four-fold materials labour fluctuation since inception owing to farmer's protest for compensation leading to a negative effect on the cost performance of the construction project. Mohammed and Isah (2012) study revealed a shortage of construction materials supply due to inflation, and the exchange rate was ranked fifth with a mean score of 3.60 in the Nigerian construction site as another effect of cost performance. The high rate of fraud and corruption ranked second with a mean score of 3.69. The result may be a reflection of current practices in the present situation in almost all the sections of the economy, especially in the study area. Corrupt practices may significantly affect the performance of infrastructural projects, not only road construction procured by the Commission, thus increasing the unsatisfactory performance of developmental projects in the region. The political insensitivity and agitations of resident communities contribute significantly to delay as a result of constant change in bureaucracy, communal crises, policy formation, high rate of inflation, and similar or associated issues. Project delay may result

from the client's alteration of the scope of the work, thereby affecting the construction cost performance.

The study also ranked the total abandonment in the third position with a mean score of 3.64. A similar result was obtained in Sudan by Khair et al. (2016). Project abandonment hinders the free movement of economic activities that mostly depend on the road network as the only mean of transportation, thus preventing growth and development in the region. The findings of Rawat and Sharmai (2016) explained that road network is a prime index of development, a marker of economic growth of an area as it provides access road, the necessary infrastructure for any kind of investment, and harnessing the commercial potentials. Therefore, the effect of abandonment of road construction networks deprived the area of investment opportunities, growth, and development in the region. Construction project abandonment has a significant impact on project performance as supported by the findings of Desai and Desale's (2013), which ranked total abandonment fifth position in the survey of road projects executed in Nasik City, India. Abisuga et al. (2014) rated complete abandonment fourth position with a mean value of 3.72 based on indigenous construction firms' perceptions in Sudan. This result explains how greatly the abandonment of projects, especially road projects, can affect an economy not only in Nigeria but in other countries in the world.

Under-development with a mean score of 3.49 ranked fourth in this study. This factor becomes the fourth most significant one affecting the cost performance of road projects procured by NDDC in the Niger Delta region. The cut-off point in this study identified other noteworthy factors to include disputes and claims, bad reputation, high cost of living, material waste, unemployment, renegotiation, and impede movement. In contrast, this study showed that litigation, high accident rate, and arbitration have less effect on the cost performance of road projects executed by NDDC in the Niger Delta region. In conclusion, based on the ranking, the identified results known to have a significant influence on the cost performance of road construction projects in any nation or community. Therefore, NDDC road projects in the Niger Delta region suffered a similar experience.

For the comparison of the effect of delay on cost among the States, the non-parametric equivalent of analysis of variance (ANOVA), Kruskal-Wallis H test was used because of the ordinal nature of the data collected and the result is as shown in Table 2 to clarify hypothesis one (H01).

Table 2: Test of Variation among the Selected States using Kruskal-Wallis test

	Mean Rank	Chi-Square	Df	Asymp. Sig.	Decision
Akwa Ibom	45.07	18.370	5	0.003	Reject
Bayelsa	40.97				
Cross River	25.40				
Delta	63.40				
Edo	54.77				
River	43.40				

Table 2 showed that there is a significant variation in the mean responses from different States. The result led to the rejection of hypothesis one, and the study concluded that there are significant variations in the mean responses obtained on the factors affecting delay concerning cost. The considerable differences among the selected States imply that there is a location effect of delay on cost.

4.2. Post-Hoc test using Bonferroni and Dunnett test for comparison

In contrast, the Post-Hoc test using the Bonferroni and Dunnett test was carried out to substantiate the source of variation in hypothesis one (H01), and the result is presented in Table 3. The result of the test revealed that there is a significant variation between Delta and Cross River States and between Edo and Cross River States as revealed by the $p < 0.05$ (with asterisk signs in Table 3) in the post hoc test, showing the source of variation among the selected States.

Table 3: Post-Hoc test using Bonferroni and Dunnett test for comparison

Type of Test	(I) Fac	(J) Fac	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Bonferroni	Akwa Ibom	Bayelsa	0.067	0.218	1.000	-0.594	0.727
		Cross River	0.431	0.218	0.775	-0.229	1.092
		Delta	-0.463	0.218	0.557	-1.123	0.198
		Edo	-0.279	0.218	1.000	-0.940	0.381
		River	0.009	0.218	1.000	-0.651	0.670
	Bayelsa	Akwa Ibom	-0.067	0.218	1.000	-0.727	0.594
		Cross River	0.365	0.218	1.000	-0.296	1.025
		Delta	-0.529	0.218	0.263	-1.190	0.131
		Edo	-0.346	0.218	1.000	-1.006	0.314
		River	-0.057	0.218	1.000	-0.718	0.603
	Cross River	Akwa Ibom	-0.431	0.218	0.775	-1.092	0.229
		Bayelsa	-0.365	0.218	1.000	-1.025	0.296
		Delta	-0.894*	0.218	0.001*	-1.554	-0.234
		Edo	-0.711*	0.218	0.025*	-1.371	-0.051
		River	-0.422	0.218	0.852	-1.082	0.238
	Delta	Akwa Ibom	0.463	0.218	0.557	-0.198	1.123
		Bayelsa	0.529	0.218	0.263*	-0.131	1.190
		Cross River	-0.894*	0.218	0.001	0.234	1.554
		Edo	0.183	0.218	1.000	-0.477	0.844
		River	0.472	0.218	0.504	-0.188	1.132
	Edo	Akwa Ibom	0.279	0.218	1.000	-0.381	0.940
		Bayelsa	0.346	0.218	1.000	-0.314	1.006
		Cross River	-0.711*	0.218	0.025*	0.051	1.371
		Delta	-0.183	0.218	1.000	-0.844	0.477
		River	0.289	0.218	1.000	-0.372	0.949
	River	Akwa Ibom	-0.009	0.218	1.000	-0.670	0.651
		Bayelsa	0.057	0.218	1.000	-0.603	0.718
		Cross River	0.422	0.218	0.852	-0.238	1.082
		Delta	-0.472	0.218	0.504	-1.132	0.188
		Edo	-0.289	0.218	1.000	-0.949	0.372
Dunnett t (2-sided)[a]	Akwa Ibom	River	0.009	0.218	1.000	-0.550	0.569
	Bayelsa	River	-0.057	0.218	0.999	-0.617	0.502
	Cross River	River	-0.422	0.218	0.203	-0.982	0.138
	Delta	River	0.472	0.218	0.127	-0.088	1.032
	Edo	River	0.289	0.218	0.547	-0.271	0.848

*. The mean difference is significant at the 0.05 level.

a. Dunnett t-tests treat one group as a control and compare all other groups against it.

Ekanem (2019) stated that such variation might be attributed to the high rate of inflation of currency and exchange rate, fraudulent and corrupt practices in the procurement process, and as a result of frequent patronage of the same consultants and contractors in the

procurement and execution of the projects. It can, therefore, be concluded that the studied variables that contributed significantly to the effect of delay on the cost performance of road projects procured by NDDC in the study area are nonspecific. However, there is no significant variation in the effect of delay in terms of cost between Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and River States. Similarly, there is no significant variation between Bayelsa, Akwa Ibom, Cross River, Delta, Edo, and the Rivers States, among others.

Table 4: Delay and Cost Performance of Road Projects Procured by NDDC

S/N	CR (Million)	CR-log	DL	DL-log	S/N	CR (Million)	CR-log	DL	DL-log	S/N	CR (Million)	CR-log	DL	DL-log
											0			
1	0	0	0	0	47	0	0	44	1.64	93		0	11	1.04
2	0	0	21	1.32	48	0	0	48	1.68	94	0	0	12	1.08
3	0	0	25	1.4	49	0	0	57	1.76	95	11	7.04	12	1.08
4	100	8	0	0	50	100	7	14	1.15	96	20	8.3	83	1.92
5	0	0	0	0	51	0	0	24	1.38	97	66	7.82	114	2.06
6	700	7.85	30	1.48	52	22.7	6.36	60	1.78	98	53	7.72	63	1.8
7	0	0	27	1.43	53	200	7.3	12	1.08	99	50	7.7	44	1.64
8	0	0	0	0	54	0	0	12	1.08	100	0	0	27	1.43
9	0	0	40	1.6	55	0	0	0	0	101	0	0	61	1.79
10	100.2	7	32	1.51	56	0	0	4	0.6	102	0	0	55	1.74
11	839	8.92	27	1.43	57	208.69	9.32	65	1.81	103	0	0	54	1.73
12	100.00	8	24	1.38	58	416	8.62	78	1.89	104	0	0	14	1.15
13	0	0	39	1.59	59	0	0	6	0.78	105	1.02	6.01	42	1.62
14	0	0	-2	0	60	0	0	72	1.86	106	0	0	70	1.85
15	0	0	36	1.56	61	0	0	60	1.78	107	0	0	20	1.3
16	700.00	8.85	48	1.68	62	0	0	-2	0	108	0	0	17	1.23
17	0	0	32	1.51	63	150	7.18	6	0.78	109	12	7.08	19	1.28
18	0	0	11	1.04	64	300000	5.48	19	1.28	110	0	0	31	1.49
19	800.00	8.9	12	1.08	65	0	0	0	0	111	20	7.3	16	1.2
20	0	0	84	1.92	66	0	0	15	1.18	112	20	7.3	20	1.3
21	0	0	108	2.03	67	0	0	17	1.23	113	0	0	25	1.4
22	0	0	88	1.94	68	0	0	0	0	114	0	0	10	1
23	3000	9.48	94	1.97	69	30	6.48	17	1.23	115	20	7.3	40	1.6
24	1300	9.11	82	1.91	70	0	0	13	1.11	116	166	8.22	32	1.51
25	0	0	0	0	71	1054	9.02	54	1.73	117	400	8.6	98	1.99
26	40	7.6	10	1	72	0	0	8	0.9	118	0	0	25	1.4
27	20	5.3	12	1.08	73	109	8.04	70	1.85	119	8	6.9	70	1.85
28	18	5.26	13	1.11	74	0	0	62	1.79	120	0	0	44	1.64
29	0	0	31	1.49	75	0	0	15	1.18	121	0	0	0	0
30	0	0	42	1.62	76	0	0	43	1.63	122	0	0	44	1.64
31	0	0	14	1.15	77	1000	9	19	1.28	123	24	7.38	52	1.72
32	200	8.3	30	1.48	78	0	0	35	1.54	124	60	7.78	21	1.32
33	4	6.6	60	1.78	79	1100	9.04	148	2.17	125	0	0	28	1.45
34	0	0	41	1.61	80	900	8.95	83	1.92	126	10	7	26	1.41
35	0	0	1	0	81	520	8.72	90	1.95	127	0	0	14	1.15
36	44	7.64	71	1.85	82	0	0	62	1.79	128	0	0	43	1.63
37	0	0	2	0.3	83	32	7.51	32	1.51	129	0	0	12	1.08
38	100000	5	-12	0	84	0	0	57	1.76	130	0	0	26	1.41
39	50	7.7	13	1.11	85	100	7.85	36	1.56	131	0	0	21	1.32
40	30	7.48	9	0.95	86	100	7	0	0	132	60	7.78	34	1.53
41	0	0	0	0	87	180	7.26	74	1.87	133	400.18	8.6	132	2.12
42	200	8.3	84	1.92	88	0	0	21	1.32	134	30	7.48	25	1.4
43	902	8.96	117	2.07	89	200	7.3	30	1.48	135	23	7.36	32	1.51
44	29	7.46	12	1.08	90	0	0	22	1.34	136	20	7.3	16	1.2
45	0	0	31	1.49	91	0	0	12	1.08					
46	2300	9.36	45	1.65	92	6	6.78	24	1.38					

Cost = Overrun_log, Delay = Del_log

4.3. Relationship between delay and cost performance

The study used multiple regression analysis to establish the quantitative relationship between delay and cost performance of road projects. The secondary data set for 136 road construction projects were used for the analysis. In this study, the dependent variable (cost overrun) and independent variable (duration overrun) were measured on a continuous scale. The extracted data for the calculated delay (the difference between the initial and final project duration, which were also in continuous scale) were equally transformed. The project cost overruns and the computed delay, with their respective transformed version, are presented in Table 4. The data sets were converted to logarithm to base 10 of the data set to ensure homogeneity among the data set and for the better predictive ability of the proposed relationship (that is, the construction costs and delays overruns of selected projects for this study). The transformation also reduces the effect of the standard error in the model, as indicated by previous studies (Otali & Adewuyi, 2015). Table 4 shows the construction costs and delays the overruns of selected projects for this study.

Cost performance was the cost overrun of the projects and regarded as the dependent variable. At the same time, the delay was the time overrun and viewed as the independent variable in this study, while the necessary parameters of the model revealing the relationship are presented in Table 5. It is clear from Table 5 that the model resulting from the regression analysis is significant with a p-value of 0.001. Equation 2 captures the quantitative relationship, and the R^2 is 0.237, indicating that about 23.7% of the variation occurring in the cost overrun of road projects procured by NDDC is explained by the delay in the completion of the project. The balances of 76.3% of the variation are explained by other effects not captured by this relationship.

Table 5: Parameters of Relationship between Delay and Cost Performance

	Estimates	Std. Error	Beta	T	R^2	MSE	F	Sig.
(Constant)	5.545	0.525				13.710	17.972	
Del_log	1.415	0.334	.486	4.239	0.237	0.763		0.001

$$C = 5.545 + 1.415\ D \quad \text{------} \quad \text{Equation 2}$$

where: C = Cost
D = Delay
R^2 = Variation

5. CONCLUSION AND RECOMMENDATIONS

The socio-economic effects of road projects to the development of a nation, the improvement upon the conditions of living of the populace, and the enhancement of economic activities cannot be over-emphasised. The necessity and relevance of such development in the Niger Delta region of Nigeria prompted a study of this kind. The critical effects obtained from descriptive analysis and subsequent comparison of the effect of delay revealed the precarious elements prone to an increase in the cost of completion of road construction projects in the study area. The findings showed that 11 were significant out of 14 effects identified by this study, represent about 78.57% and can adequately define the effect of delay on road construction projects in the Niger Delta region, Nigeria. Furthermore, the tested first hypothesis was rejected as there was a significant variation in the mean responses from different states. The post hoc test result affirmed the presence of

significant variation and revealed the source of variation between Delta and Cross River States and Edo and Cross River States among the selected States. It concluded that significant variation does exist among the selected States in the effect of delay in terms of cost. Submissions were made, as reflected in the developed model, that 23.7% of the variation in the cost performance of road projects can be explained by the delay. Therefore, it was concluded that such cost performance, if derelicted, can rob both the client and beneficiaries of the economic benefits of such development and can aggravate the recurrent agitations and militancy in the region. Therefore, it was recommended that professionals and stakeholders employed by the commission and Niger Delta region in construction industries should pay adequate attention to the identified significant effects to improve upon the cost performance of road projects. The adoption of the model developed by this study is canvased for the successful delivery of road construction projects within budgeted cost, most notably the intervention projects with similar geographical peculiarities.

REFERENCES

Alhomidan, A. (2013). Factors Affecting Cost Overrun in Road Construction Projects in Saudi Arabia. *International Journal of Civil & Environmental Engineering (IJCEE-IJENS)*, 13(3), 1-4.

Aboubaker, Y. Y, Alfakhri, A. I., and Muhamad, A. K. (2018). The Effects of Delays in Road Construction Projects in Tripoli, Libya. *International Journal of Technology* 9(4), 167- 175. https://doi.org/10.14716/IJTECH.V9I4.2219

Abisuga, A. O., Amusu, O. R., and Salvador, K. A. (2014). Construction Delay in Nigeria: A Perception of Indigenous and Multinational Constructions Firms. *Journal of Emerging Trends in Economics and Management Science* (JETEMS), 5(3), 371-378.

Adam, A., David, B., and Xavier, H. (2012). Project Execution Strategy Road Special Report for Global Carbon Capture and Storage Institute, Gurgaon, Haryana, India.

Agbu, O. (2005). Oil and Environmental Conflicts, in A. Hassan Saliu (ed) *Nigeria under Democratic Rule, 1999-2003*, 2, Ibadan: University Press.

Aibinu, A. A., and Jagboro, G. O. (2012). The Effect of Construction Delays on Project Delivery in the Nigerian Construction Industry. *International Journal of Project and Management,* 20(8), 593-599. https://doi.org/10.1016/50263(02)00028-5.

Al-Hazim, N., and Abusalem, Z. (2015). Delay and Cost Overrun in Road Construction Projects in Jordan. *International Journal of Engineering and Technology* 4(2), 288-293. https://doi.org/10.14419/ijet.V4124409.

Ashwin, A. S., and Rahul, S. P. (2014). Identification of Critical Construction Delay Factors, *International Journal of Latest Trends in Engineering and Technology* (IJLTET), 3(4), 256-261.

Asish, R., and Pratheeba, P. (2015). Study on Construction Sequence Delay for Road Infrastructure Projects, *Journal of Mechanical and Civil Engineering* 12(2), 15-21. https://doi.org/10.9790/1684.12261521.

Aysha, S., Hussain, A., Naveed, A., Muhammed, N., and Nouman, A. (2015). Analysis of Key Performance Factors Affecting Residential Commercial Projects in Pakistan Arabian. *Journal of Business and Management Review*, 3(10), 9-14.

Awodele, O. A., Ogunsemi, D. R., and Adeniyi, O. O. (2012). An Appraisal of Private Sector Participation in Infrastructure Development in the Nigeria Construction Industry: Lagos State as a case study. *Journal of the Nigerian Institute of Quantity Surveyors,* 1(1), 20-32.

Aziz, R. F., and Abdel-Hakam, A. A. (2016). Exploring Delay Causes of Road Construction Projects in Egypt. *Alexandria Engineering Journal*, 55, 1515-1539. https://doi.org/10.1016/j.aej.2016.03.006.

Benon, C. B., and Milton T. (2012). Measuring the Performance of Contractors in Government Construction Projects in Developing Countries: Uganda's Context, *African Journal of Business Management* 6(32), 9210-9217.

Bromilow, F. J. (1974). Measurement and Scheduling of Construction Time and Cost Performance in the Building Industry, *Chartered Builder,* 10(9), 57.

Choudhury, I., and Rajan, S. S. (2003). Time-Cost Relationship for Residential Construction in Texas. Amor R. (ed.) *Proceeding of CIB W78's 20*TH *International Conference on Construction IT, Bridging the Distance, CIB Report 284. New Zealand,* 23-25 April 2003, 73-80. Accessed 15/6/2019.

Desai, M., and Desale, S. (2013). Study Factors Affecting of Delay in Residential Construction Project for Nashik City in India. *International Journal of Latest Trends in Engineering and Technology (IJLTET)*, 2(3),115-124.

Divya, R., and Ramya, S. (2015). Causes, Effects, and Minimization of Delays in Construction Projects. *Proceedings of National Conference on Research Advance in Communication, Computation, Electrical Science, and Structures (NCRACCESS)*, 47-53.

EnasFathi, T., and Pandey, R. (2013). Study of Delay in Project Planning and Design Stages of Civil Engineering Projects. *International Journal of Engineering and Advanced Technology (IJEAT)*, 2(3), 456-461.

Enshassi, A., Mohamed, S., and Madi, I. (2005). Factors Affecting Accuracy of Cost Estimation of Building Contracts in Gaza Strip. *Journal of Financial Management of Property and Construction*, 10(2), 115–125. https://doi.org/10.1108/1366438058000/069

Ekanem, S. F. (2019). Impact of Delay on the Performance of Road Projects Procured by Niger Delta Development Commission, Nigeria. Unpublished PhD Thesis in the Department of Quantity Surveying, Faculty of Environmental Design and Management, Obafemi Awolowo University, Ile-Ife, Nigeria.

Gebrehiwet, T., and Luo, H. (2017). Analysis of Delay Impact on Construction Project Based on RII and Correlation Coefficient: Empirical Study, Creative Construction Conference Premoisten, Croatia. *Procedia Engineering* 196, 366-374. https://doi.org/10.1016/j-preng.2017.07.212.

Ghana Statistics Service (2019). http://www.Government Data/.erte.com.accessed; 3/7/2020.

Harrell, F. E. (2011). Regression Modelling Strategies-with Application to Linear Models, Logistic Regression and Survival Analysis, New York: Springer-Verlag Inc, 215-221.

Haseeb, M., Xinhai-Lu, A., Bibi, A., Maloof-ud, D., and Rabbani, W. (2011). Problems of Projects and Effects of Delays in the Construction Industry of Pakistan. *Australian Journal of Business and Management Research*, 1(5), 41-50.

Hoffman, G. J, Jr. Thal, E. A., Webb, S. T., and Weir, D. J. (2007). Estimating Performance Time for Construction Projects. *Journal of Management in Engineering* 23(4),193-199. https://doi.org/10.1061/(ASCE)0742-597.

Imonikebe, U. G. (2013). Constraints to Pig Farmers' Participation in Food Production as Occasioned by the Devastating Flood in Isoko North Local Government Area of Delta State, Nigeria. *Scottish Journal of Arts, Social Sciences and Scientific Studies,* 17(1), 13- 19.

Isidiho, A. O., and Sabran, S. M. (2015). Socio-Economic Impact of Niger Delta Development Commission (NDDC) Infrastructure Projects in Selected Communities in Imo State, Nigeria. *Asian Journal of Human and Social Science (AJHSS),* 3(2), 109-113.

Jhawar, A., and Bajpai, P (2014). Applying FMEA and ISM Technique to Identify Factors Causing Delay in Road Construction Projects. *International Journal of Applied Engineering Research,* 9(5), 517-524.

Jike, V. (2005). The Political Sociology of Resource Control in the Niger Delta, A. Hassan Saliu (ed), *Nigeria under Democratic Rule, 1999-2003*, 2, Ibadan: University Press.

Kaka, P. P., and Price, A. D. (1991). Relationship Between Value and Duration of Construction Projects. *Construction Management and Economics*, 9(4), 383-400. https://doi.org/10.1080/01446199100000030

Khair, K., Farouk, H.., Mohamed, Z., and Mohammad, R. (2016). Causes and Effects of Delay Factors in Road Construction Projects in Sudan. *International Journal of Applied Engineering Research*, 11(18), 9526-9533.

Kulemeka, P. J., Kululanga, G., and Morton, D. (2015). Critical Factors Inhibiting Performance of Small- and Medium-Scale Contractors in Sub-Saharan Region: A Case for Malawi. *Journal of Construction Engineering*, (2015), 1-17. https://doi.org/10.1155/2015/927614

Larsen, J., Shen, G., Lindhard, S., and Brunoe, T. (2016). Factors Affecting Schedule Delay, Cost Overrun, and Quality Level in Public Construction Projects. *Journal of Management and Engineering*, 32(1), 04015032-1 – 04015032-10. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000391

Mahamid, I. (2011). Risk Matrix for Factors Affecting Cost Delay in Road Construction Projects Owners' Perspective. *Engineering Construction and Architectural Management*, 18(6), 609-619. https://doi.org/10.1108/09699981111180917

Mahamid, 1. Bruland, A., and Dmaidi, N. (2012). Causes of Delay in Road Construction Projects. *Journal of Management in Engineering* 28(3), 300-310. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000096

Mansfield, N., Ugwu, O., and Doran, T. (1994). Causes of Delay and Cost Overruns in Nigerian Construction Projects. *International Journal of Project Management* 12(4), 254-260.https://doi.org/10.1016/0263-7863(94)90050-7

Mohammed, K. A., and Isah, A. D. (2012). Causes of Delay in Nigeria Construction Industry. *Interdisciplinary Journal of Contemporary Research in Business,* 4(2), 785-795.

Mojekeh, M. O., and Eze, P. A. (2011). The Environmental Impact of Production and Sales of Sachet Water in Nigeria. *African Research Review: An International Multidisciplinary Journal, Ethiopia,* 5(4), 479-492. https://doi.org/10.4314/afrrev.v5i4.69298

Mulla, S. S., and Waghmare, A. P. (2015). A Study of Factors Caused for Time and Cost Overruns in Construction Project and their Remedial Measures. *Journal of Engineering Research and Applications,* 5(1), 48-53.

Ogunsemi, D. R., and Jagboro, G. O. (2006). Time-Cost Model for Building Projects in Nigeria. *Construction Management and Economics*, 24, 253-258. https://doi.org/10.1080/01446190500521041

Olawale, Y., and Sun, M. (2010). Cost and Time Control of Construction Projects Inhibiting Factors and Mitigating Measures in Practice. *Construction Management Economics* 28(5), 509-526. https://doi.org/10.1080/0144619/003674519.

Opawole, A. (2015). Assignments of Parties Obligation in Concession-Based Infrastructural Projects in South-Western, Nigeria. PhD Thesis in the Department of Quantity Surveying, Faculty of Environmental Design and Management, Obafemi Awolowo University, Ile-Ife, Nigeria.

Otali, M., and Adewuyi, T. O. (2015). Project Duration Prediction Models Using Time - Cost Relationship in Public Building Projects in North Central, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 11(1), 137-144.

Pallant, J. (2007). SPSS *Survival Manual* - A Step by Step Guide to Data Analysis using SPSS for Windows, 3rd ed., England McGraw Hill, Open University Press, 1- 311.

Ramabodu, M., and Verster, J. (2010). Factors Contributing to Cost Overrun of Construction Projects. P*roceeding of ASOCSA, 5th Built Environment Conference Durban South Africa.*

Patil, K. S., Gupta, A., Desai, D., and Sajane, A. (2013). Causes of Delay in Indian Transportation Infrastructure Projects. *International Journal of Research in Engineering and Technology* (IJRET), 2(11), 71-80. https://doi.org/10.15623/ijet2013021/013.

Rawat, D. S., and Sharmai, S. (2016). The Development of a Road Network and Its Impact on the Growth of Infrastructure: A Study of Almora District in the Central Himalaya. *Journal of Mountain Research and Development*, 17(2), 117-126. https://doi.org/10.2307/3673826.

Shahid, A., Ahmad, H., Ahmad, N., Shafique, M. N., and Amjad, N. (2015). Analysis of Key Performance Factors Affecting Residential Construction Projects in Pakistan. *Arabian Journal of Business and Management Review* 3(10), 9-14.

Shahsavand, P., Marefat, A., and Parchamijalal, M. (2018),."Causes of Delays in Construction Industry and Comparative Delay Analysis Techniques with SCL Protocol", *Engineering, Construction and Architectural Management*, 25(4), 497-533. https://doi.org/10.1108/ECAM-10-2016-0220.

Tabachnick, B. G., and Fidell, L. S. (2007). Using *Multivariate Statistics*. Third Edition., Harper Collins, New York.

Towhid, P., and Amiruddin, I. (2012). Causes and Effects of Delay in Iranian Construction Projects. *International Journal of Engineering and Technology*, 4(5), 598-601. https://doi.org/10.7763/ijet2012V4.441.

Ujene, A. O. (2014). Integrating Environmental Priority Concerns in Building Planning and Production in Niger Delta, Nigeria. *Journal of Architecture, Planning, and Construction Management*, 4(2), 37-56.

Umoren, O. (2014). Site Analysis and Report, A Basic Requirement in Planning for Construction. A Paper Delivered on October 9 – 11. *The Nigerian Institute Quantity Surveyors National Training Workshop*, Uyo, Akwa Ibom State, Nigeria.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

APPRAISING THE FACTORS INFLUENCING THE USE OF E-PROCUREMENT IN NIGERIAN CONSTRUCTION INDUSTRY

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ABSTRACT

Purpose: The fragmentation in the Nigerian construction industry is often seen as one out of many contributors to low productivity in construction and has led to well-documented problems with both communication and information processing. In Nigeria, Procurement over the years has been carried out manually and it has been distinguishingly characterized by large paperwork, high cost, corruption, and delay in procurement process. For this reason, this paper x-ray the factors influencing the use of E-procurement in the Nigerian construction industry.

Design/methodology/approach: Quantitative data were collected from construction professionals. The data were analysed using Mean Item Score (MIS) and Kruskal-Wallis H Test.

Findings: The most important risk factors influencing e-procurement in the Nigerian construction industry are safety and insecurity issues, the unreliability of technology, reduced level of personal contact, resistance to change among others. It is established from the study that E-procurement implementation can be expensive among construction firms in Nigeria. The factors influencing the use of E-procurement in the Nigerian construction industry the ease of transitioning from paper to electronic systems as the most important factor influencing the adoption of e-procurement followed by availability of policies to promote e-procurement, and then by the cost of e-procurement technology.

Practical implication: The paper provides procurement managers with relevant factors that influence the adoption decision. This highlights the importance of maximizing the benefits of e-procurement system for potential users to facilitate the adoption process.

Originality/value: The paper complements the existing literature review about the use of e-procurement in the construction industry.

Keywords: E-Procurement; technology; construction industry; firms; professionals.

1. INTRODUCTION

The construction industry is an industry, well fragmented as a result of stakeholders as well as the phases involved in construction projects Quangdung, Liu, & Hossain

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(2011). This fragmentation is often seen as one out of many contributors to low productivity in construction and has led to well-documented problems with both communication and information processing. Pollaphat and Miroslaw (2014) opined that these problems caused by fragmentation are now reduced through the routine use of the internet, a form of information technology that improves coordination and collaboration between firms participating in a project, resulting in better communication practice. It opined further that this is because the level of technology valid in the marketplace today, is extraordinary and massive and it encourages business and collaboration solutions.

The internet, specifically, the World Wide Web has been a key leading to a change in the construction business globally (Esben, 2012). Waziri, Ali, and Ghali (2015) corroborated that its use as a medium for communication, transfer information faster, effectively, and generate opportunities for developing distributed systems that can pass through organization boundaries, provide workflow automation and platforms for teamwork uniquely. Skibniewski and Abduh (2004) reported the merits of web technologies in construction in three areas; communication between project participants, important information services and management and engineering computing. It was widely said that the use of proper information and communication technology (ICT) coupled with communication interfaces and defined structures in the manufacturing industry has been demonstrated to be a tool with efficiency that helps the desegregation of processes for materials supply, product development, production, communication and maintenance procedure (Esben, 2012; Clifford & Alexandru, 2012; Waziri et al, 2015). Due to this, ICT has been applied across sectors widely to cut costs and increase competitiveness which is perceived today as a vehicle for gaining competitive advantage (Bowden, 2005; Esben, 2012).

Procurement is done in virtually all professions. To simply put, procurement is the process of obtaining services, goods, or works from an external source. It is a management act of acquiring and attaining supplies and services. Procurement over the years has been carried out manually and it has been distinguishingly characterized by large paperwork, high cost, corruption, and delay in the procurement process e.t.c (Nimbadia, 2013). However, the approach and arrival of the internet have brought about the commencement and adoption of e-procurement process in the area of procurement and supply chain management (Baily, Farmer, Crocker, Jessop, & Jones, 2008).

E-procurement is the use of electronic channels in buying goods and services. Starting from the identification of the goods or materials, through payment and to contract management, all these can be carried out with e-procurement (Davila, Gupta & Palmer, 2003). Aberdeen group (2008) opined that companies have been motivated by opportunities proffered by global markets to go global which as caused e-procurement to be irreplaceable. Angappa (2009) viewed the emergence of e-procurement as an influencing vehicle for attaining a reduction in cost and productivity improvement. Two main phases of e-procurement were stated in the UN Procurement Practitioner's Handbook (2006). These are the pre-award phase consisting of E-Notification, E-Submission, E-Evaluation, and E-Awarding; and also the post-award phase E-Ordering, E-Invoicing and E-payment. And every activity in these phases can be executed using a communication media and/or e-procurement technologies and tools (UN Procurement Practitioner's Handbook, 2006).

Though still at its early stage in Nigeria, Studies (Olusegun, 2017; Ibem et al, 2012; Agboyi & Ackah, 2012) have discovered that the use of e-procurement in different industrial zones has kept on increasing since mid-1990s when email and web services of internet became famous because it makes information easily acquirable and

increasing the scope for selection of products. The adoption of e-procurement in Nigeria has also increased too because Nigeria is the fastest growing telecom market in Africa has over 155 million mobile lines(active) and a growth of 9% yearly (NCC, 2014). Moreover, what we know as "computer age" has been characterized by changes in the traditional economy to a computerized one (Achuora, Arasa & Ochriri, 2012). Thus, this exploration paper intends to assess the factors influencing the use of E-procurement in the Nigerian construction industry. y area

The South-South of Nigeria comprises of Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and the River States selected from the nine States and is geographical located within the Niger Delta region, Nigeria. The study focused on this area due to familiarity with the environment for the sake of data collection and also due to numerous on-going road construction. Niger Delta region is rich in oil and gas, it remains the primary source of income for the country, accounting for about 97% of the total export item generating revenues (Agbu, 2005 and Jike 2005). They further explained that, this mineral became well-known in the region in 1958, and since then, the resources accruing from the exploration of crude oil has dominated the country's economy. The indigenes of the area depend on their land, water, and forest as farmers, fishermen, and hunters, for their survival before the discovery of mineral resources. These economic activities were devastated as a result of the operation of exploration by oil companies. As a result of the exploration activities, the region becomes unproductive and undeveloped for survival, thus necessitating the establishment of NDDC to implement developmental projects as a means of compensating the inhabitants of the area. The lack of completed desired and impacting development demands this study.

2. REVIEW OF RELATED LITERATURE

2.1. Nigerian Construction Industry

The structure of Nigerian construction industry is very complicated in that it has a wide range of different types of clients and contractors which are public and private, main contractors and subcontractors, one-man firms and international companies, low technology firms and sophisticated specialists, builders and civil engineers and a whole range of construction professionals connected within the industry (Oladapo, 2006). It further corroborated that the major divisions in the industry are building construction division and civil engineering division and heavy engineering construction, division. Although, the activities in the industry are being carried out on a project basis and could be within an organization or part of a construction program (Esben, 2012).

According to Oyediran & Akintola (2011), Nigeria as a nation is still at the infancy stage of infrastructural development where lots of construction activities are being carried out across the nation by the federal, state and local governments as the major clients in Nigeria. All these construction works are carried out by construction companies which are either indigenous or multinationals whose structure occasionally affects the level of construction output in the construction industry (Oladapo, 2006). But, most of these construction works are being executed by foreign construction firms. However, changes in government, transformation agenda and local content policy in the infrastructural sector have created opportunities for Nigerian indigenous contracting firms to grow and take part in the developmental processes (Oyediran & Akintola, 2011).

The federal government of Nigeria often seems to be involved in most complex projects such as road, sea, and airport projects and some heavy engineering projects. This is followed by the state government which is responsible for about 22.7% of the projects in the industry, although there are still some forms of partnering with different groups of investors in the industry (Olusegun, 2017). The professionals in the industry are a group of individuals often assembled into temporary and functional teams which include; architects, engineers, estate surveyors, project managers, quantity surveyors. This group of professionals is expected to possess the relevant skills, knowledge, tools and techniques to achieve the project goals (Oyediran & Akintola, 2012).

Basically in Nigeria, the construction companies are classified on the scope of operation, ownership and management control (Olusegun, 2017). Like other nations of the world, construction companies could be classified as small, medium, and large. In Nigeria, large companies are majorly governed by the multinationals with very few indigenous that could be classified as a medium while most are classified as small size firms (Olusegun, 2017). Conceptual evidence disclosed that Julius Berger Nigeria Plc is the leader in the Nigerian construction industry, as it controls a large part of public sector construction work in the industry (Aduwo *et al*, 2016). The Nigerian construction industry continues to be a major stimulant in the country's economic growth and development (Ibem *et al*, 2016). This strong interrelationship between the economy and the construction industry further strengthens the need to ensure that project planning and management are cost-effective (Olusegun, 2017).

2.2. Factors Influencing the Use of E-procurement

In a look at Malaysian SME's environment, Eadie (2012) observed the relevant factors influencing the uptake of e-Procurement like external factors such as technology, infrastructure and legislation; and internal factors such as resource constraints and management characteristics. Croom and Johnson (2003), E-procurement implementation can be expensive, particularly, in instances when a process based on disagreeing platforms is to be incorporated at a later date. The more distinct the technical platforms, the more prohibitive it becomes. Aduwo (2016) explained the lack of critical mass uptake of e-Procurement and its non-adoption in the Nigerian Building Industry (NBI) to be principally due to; internal factors within the organizations, external factors outside the organizations and the perception of the risks associated with the use of e-Procurement by people in the industry. Also, it was argued by Lou (2010) that the perceived benefits of e-procurement can be achieved if a construction firm is in a state of readiness to effectively absorb technology-enabled innovation into its practice in advance for investment.

According to Norzaidi *et al* (2013), the two key factors influencing the intended use of e-procurement are perceived ease of use (PEOU) and the perceived usefulness (PU). Perceived ease of use is the extent to which a person believes that the usage of a thing will influence his or her performance (Esben, 2012). It showed that the PEOU is an attitude and it suggested that the level of user's perceived ease of use can be studied by researching the end-user to know if he or she perceives that using a system is effort-free. Yusliza and Ramayah (2011) defined attitude as the response of an individual towards a system. Existing studies proposed that the PEOU is majorly an attribute of technology applications such as internet commerce, online banking, and mobile commerce (Luarn & Lin, 2005; Guriting & Ndubisi, 2006). The perceived ease of browsing, performing transactions and applying information should enhance favourable and coercing individual experience (Chen,

2002; Cheung & Liao, 2003). So, there is an important relationship between perceived ease of use and attitude towards the use of e-procurement.

The perception of PU varies between the type of e-procurement system and the users. It was argued that workers in performance-oriented firms with e-procurement are reinforced for benefits and good performance generally (Lai & Yang, 2009). This means that the usefulness of e-procurement in the improvement of performance will have a positive impact on attitude towards the application. Hence, there is a significant relationship between attitude and perceived usefulness towards the use of e-procurement. Although, the technology acceptance model (TAM), proposed that the perceived ease of use is thought to influence the perceived usefulness of the technology i.e the easier the usage of technology, the higher the benefit derived from the technology concerning performance enhancement Yusliza and Ramayah (2011). Thus, there is a relevant connection between perceived ease of use and perceived usefulness.

2.3. Factors Influencing the Use of E-procurement

The internal barriers influencing e-procurement are age, size, category of organization, number of office, poor financial base, unavailability of technical expertise, lack of top management support, amongst others. For factors related to the perception of the risks in e-procurement, the following are the influencing factors: safety and insecurity issues, lack of confidentiality and flexibility, resistance to change, fear for loss of jobs and end to corruption, unreliability of the technology, reduction in the level of personal contacts, illegality of e-procurement contracts. The external barriers are poor ICT and internet infrastructure, unreliable power supply, lack of a national ICT policy, cost of e-procurement technology, inadequate government support, lack of uniform standards, unavailability of e-procurement software applications and tools, amongst others.

Also according to the result of a research conducted by Ibem *et al*., (2016), the results showed the three most important factors influencing the adoption of e-Procurement amongst the participants in order of importance were: the benefits of e-Procurement in enhancing efficiency in project delivery; eliminating geographic barriers and effective communication among project team members. 29 factors were also investigated in seven different dimensions and the three emerged most significant predictors of e-Procurement adoption in the survey. According to Asian Development Bank (2013) the factors such as Government direction, policy & legal framework, agencies change, awareness & capacity building, technology etc. added to the successful adoption and implementation of e-procurement operations.

Azanlerigu and Akay (2015), also divided the factors influencing e-Procurement into various independent variables, which are: lack of employee competency, the inadequacy of legal framework, inadequate technological infrastructure, the security of procurement transaction data etc.

3. RESEARCH METHODOLOGY

3.1. Survey

The survey examines the conclusions of a sample of Nigerian construction professionals towards the point of the study. According to Kothari (2004), the Research

design is the investigation with the scheme of identifying variables and their relationship to one another. Quantitative research focuses on finding statistical relationships within numerical data. Quantitative research design was adopted for the study and it was based on the set objectives of the study through the administration of well-structured questionnaires with both open-ended questions and close-ended questions so that respondents can express their view based on their experience. The sample size for this study is 84 numbers of practicing construction firms. Census method was used in selecting the firms, in which office locations of 70 firms were visited for data collection. Data was collected from construction professionals in the firm, such as; Architects, Quantity surveyors, Builders and Engineers in the study area. The professionals were chosen from client organization, contracting, and consulting firms. The respondents were asked to express their level of assessment on a 5-point Likert. Adequate questionnaires were administered to construction firms in Ondo on a 5-point Likert-type scale with focuses 1 and 5 representing strongly disagree and strongly agree, respectively. Other parts of the questionnaire are intended to assemble demographical data about the respondents.

3.2. Data Collection

Adequate questionnaires were administered to construction firms in Ondo. This research work employed the use of primary data. The procedure for data collection for this research work as stated earlier was through the use of a well-structured questionnaire administered to construction firms. Out of 70 copies of the administered questionnaire, 53 were completed and returned. This represents 63.1% response rate which is far above the usual response rate of 20-30% for questionnaire surveys in construction management studies, as suggested by Akintoye (2000). Most firms have their existence between 6-10 years with 43.4% followed by 11-20 years with 28.3% followed by 0-5 years with 15.1% and 20-40 years with 13.2%. The average year of existence of these organizations is 12.3 years. The most type of respondents is the Architects with 28.3% followed by the Quantity surveyors with 26.4% followed by the Engineers (Civil, Structural, Mechanical and Electrical) with 24.5% and lastly, the builders with 20.8%. Most firms sampled 11-20 numbers of staff with 43.4% followed by 6-10 numbers of staff with a percentage of 26.4 followed by 20-50 numbers of staff with 20.8% and 0-5 numbers of staff with 9.4%. 64.2% of these firms have ICT departments while 35.8% of construction firms do not have ICT departments. 58.5% of the firms have 0-5 ICT related officials (highest) followed by firms with no ICT related official with a percentage of 20.8% followed by firms having 6-10 ICT related officials with 11.3% followed by 7.5% having 11-20 ICT related officials and 1.9% having 11-20 ICT related officials.

3.3. Data Analysis

An appropriate technique of analysing data is very important to be able to process the data collected accurately. Relative importance index/mean score was also used to analyze the questionnaire. Data processing was carried out with the aid of computer-based statistical software known as a statistical package for social sciences (SPSS). The basis for making ranking decisions is that the factor with the highest Mean Item Score (MIS) is ranked as the 1st and the others follow in subsequent descending order.

Since a Likert scale of 5-point was employed for the collection of the data, the formula for Mean Item Score can be written as:

$$MIS = \frac{(5F5 + 4F4 + 3F3 + 2F2 + 1F1)}{F5 + F4 + F3 + F2 + F1}$$

Where, F is the frequency of each ranking. The basis of ranking the utilization, success or the significance of factors using Mean Item Score is based on this premise:

1.00 ≤ MIS ≤ 1.50: Not important (or significant, or satisfactory, or effective)

1.50 ≤ MIS ≤ 2.50: Low importance (or significance, or satisfaction, or effectiveness)

2.50 ≤ MIS ≤ 3.50: Moderate importance (or significance, or satisfaction, or effectiveness)

3.50 ≤ MIS ≤ 4.50: High importance (or significance, or satisfaction, or effectiveness)

4.50≤ MIS ≤ 5.00: Very High importance (or significance, or satisfaction, or effectiveness)

Moreover, The Kruskal-Wallis test (sometimes referred to as the Kruskal-Wallis H Test) is the non-parametric alternative to a one-way between-between groups analysis of variance which allows the comparison of the scores on some continuous variable for three or more groups. It is similar in nature to the Mann-Whitney test which allows comparison for not more than two groups. Kruskal-Wallis test was conducted to determine whether the main significance of each factor was equal across the small size firms, medium size firms and large size firms. Where small size firms represent firms having 0-5 numbers of staffs, medium size firms represent firms having 6-10 numbers of staffs and large size firms represents firms having above 11 numbers of staffs.

4. Data Analysis, Results and Discussion of Findings

4.1. External Factors Influencing the Adoption of E-procurement

From the table, it is evident that from the Small size firms the most important factor influencing e-procurement is the unreliable power supply, followed by the cost of e-procurement technology, the unreliability of e-procurement software/tools and poor ICT/Internet infrastructure. For the Medium size firms, cost of e-procurement technology ranked the highest factor influencing e-procurement, followed by the unreliable power supply, poor ICT/Internet infrastructure and unreliability of e-procurement software/tools. For the Large size firms, cost of e-procurement technology ranked the highest factor influencing e-procurement, followed by the unreliable power supply, poor ICT/Internet infrastructure and unreliability of e-procurement software/tools. For all firms, the Cost of e-procurement technology ranked the highest factor influencing e-procurement, followed by the unreliable power supply, poor ICT/Internet infrastructure and unreliability of e-procurement software/tools. The result is presented in Table 1.

Kruskal-Wallis test showed that all external factors influencing e-procurement's adoption have a significant p-value of above 0.05 (ranging from 0.141-0.835). Since the p-value of each factor is greater than 0.05, this implies that there is no significant difference in the view of these 3 categories of respondents as to the importance of these 4 external factors influencing e-procurement in Ondo state.

Table 1: External Factors Influencing the Adoption E-procurement

External Factor	Small Size Firms		Medium Size Firms		Large Size Firms		Overall		Kruskal Wallis
	RII	RK	RII	RK	RII	RK	RII	RK	Sig.
Cost of e-procurement technology	0.88	2	0.9	1	0.91	1	0.91	1	0.835
Unreliable power supply	0.92	1	0.86	2	0.87	2	0.87	2	0.675
Poor ICT/Internet infrastructure	0.76	4	0.79	3	0.87	2	0.84	3	0.162
Unreliability of e-procurement software/tools	0.8	3	0.7	4	0.79	4	0.77	4	0.141

4.2. Internal Factors Influencing the Adoption of E-procurement

From Table 2, it is evident that from the Small size firms the most important factor influencing e-procurement is the unavailability of technical expertise, followed by the poor financial base, age, size and category of firms and lack of top management support. For the Medium size firms unavailability of technical expertise ranked the highest factor influencing e-procurement, followed by age, size, and category of firms, poor financial base and lack of top management support. For the Large size firms, poor financial base ranked the highest factor influencing e-procurement, followed by age, size and category of firms, lack of top management support, and unavailability of technical expertise. For overall firms, age, size, and category of firms and poor financial base ranked the highest factor influencing e-procurement, followed by unavailability of technical expertise and lack of top management support.

Table 2: Internal Factors Influencing the Adoption of E-procurement

Internal Factor	Small Size Firms		Medium Size Firms		Large Size Firms		Overall		Kruskal Wallis
	RII	RK	RII	RK	RII	RK	RII	RK	Sig.
Age, size and category of firm	0.84	3	0.79	2	0.87	2	0.85	1	0.311
Poor financial base	0.88	2	0.77	3	0.88	1	0.85	1	0.192
Unavailability of technical expertise	0.92	1	0.83	1	0.81	4	0.83	2	0.539
Lack of top management support	0.80	4	0.73	4	0.87	2	0.83	2	0.106

Kruskal-Wallis test showed that all internal factors influencing e-procurement's adoption have a significant p-value of above 0.05 (ranging from 0.106-0.539). Since the p-value of each factor is greater than 0.05, this implies that there is no significant difference in the view of these 3 categories of respondents as to the importance of these 4 internal factors influencing e-procurement in Ondo state.

4.3. Perception of Risk Influencing the Adoption of E-procurement

From Table 3, it is evident that from the Small size firms the most important risk factor influencing e-procurement is safety and insecurity issues, the unreliability of technology, followed by resistance to change, reduced level of personal contact, loss of job fears and end to corruption, lack of confidentiality and flexibility followed by Illegality of e-procurement contract. For the Medium size firms, safety and insecurity issues ranked the highest factor influencing e-procurement, followed by a reduced level of personal contact, followed by loss of job fear and end to corruption and unreliability of technology followed by resistance to change, followed by lack of confidentiality and flexibility, followed by the illegality of e-procurement contract. For the Large size firms, safety and insecurity issues and unreliability of technology ranked the highest factor influencing e-procurement, followed by a reduced level of personal contact followed by resistance to change followed by loss of job and end to corruption, followed by lack of confidentiality and flexibility and lastly, the illegality of e-procurement contract. For overall firms, safety and insecurity issues, the unreliability of technology, reduced level of personal contact, resistance to change, loss of job fear and end to corruption, lack of confidentiality and flexibility, and illegality of e-procurement contract.

Kruskal-Wallis test showed that all risk factors of e-procurement's adoption have a significant p-value of above 0.05 (ranging from 0.075-0.994). Since the p-value of each factor is greater than 0.05, this implies that there is no significant difference in the view of these 3 categories of respondents as to the perception of risk of these 6 factors influencing e-procurement in Ondo state.

Table 3: The Perception of Risk in the Adoption of E-procurement

Perception of risk	Small Size Firms		Medium Size Firms		Large Size Firms		Overall		Kruskal Wallis
	RII	RK	RII	RK	RII	RK	RII	RK	Sig.
Safety and insecurity issues	0.84	1	0.80	1	0.89	1	0.86	1	0.075
Unreliability of technology	0.84	1	0.77	3	0.89	1	0.85	2	0.115
Reduced level of personal contact	0.76	3	0.79	2	0.87	2	0.84	3	0.286
Resistance to change	0.80	2	0.76	4	0.77	3	0.77	4	0.99
Loss of job fear and end to corruption	0.76	3	0.77	3	0.75	4	0.76	5	0.994
Lack of confidentiality and flexibility	0.76	3	0.74	5	0.61	5	0.66	6	0.176
Illegality of e-procurement contract	0.40	4	0.41	6	0.34	6	0.37	7	0.552

4.4. General Factors Influencing the Adoption of E-procurement

From the table, the Small size firms have factors such ease of engagement between parties, availability of policies to promote e-procurement, security and data protection challenges and Ease of transitioning from paper to electronic system as the most important factors influencing the adoption of e-procurement, followed by lower cost of the

transaction, availability of technological infrastructure, reliability of e-procurement systems/tools, compatibility of e-procurement systems/tools, availability of infrastructure to promote e-procurement followed by speed of transaction and ease of integration of systems with existing processes. For the Medium size firms, availability of infrastructure to promote e-procurement and ease of transitioning from paper to electronic systems are the most important factors influencing the adoption of e-procurement, followed by the compatibility of e-procurement tools/system and availability of policies to promote e-procurement, followed by security and data protection challenges, followed by lower cost of the transaction, availability of technological infrastructure, reliability of e-procurement systems/tools, followed by the ease to respond electronically, ease of integration of e-procurement systems with existing processes, followed by the speed in transaction and ease of engagement between parties.

Table 4: General Factors Influencing E-procurement's Adoption

	Small Size Firms		Medium Size		Large Size Firms		Overall		Kruskal Wallis
General Factor	**RII**	**RK**	**RII**	**RK**	**RII**	**RK**	**RII**	**RK**	**Sig.**
Ease of transitioning from paper to electronic systems	0.96	1	0.94	1	0.94	1	0.94	1	0.041*
Availability of policies to promote e-procurement	0.96	1	0.91	2	0.93	2	0.93	2	0.552
Availability of infrastructure to promote e-procurement	0.92	2	0.94	1	0.89	5	0.91	3	0.388
Lower cost of transaction	0.92	2	0.89	4	0.92	3	0.91	3	0.862
Ease to respond electronically	0.96	1	0.87	5	0.92	3	0.91	3	0.275
Speed in transaction	0.88	3	0.84	6	0.92	3	0.90	4	0.190
Availability of technological infrastructure	0.92	2	0.89	4	0.91	4	0.90	4	0.960
Security and data protection challenges	0.96	1	0.90	3	0.89	5	0.90	4	0.160
Compatibility of e-procurement systems/tools	0.92	2	0.91	2	0.88	6	0.89	5	0.731
Reliability of e-procurement systems/tools	0.92	2	0.89	4	0.88	6	0.87	6	0.780
Ease of integration of systems with existing processes	0.88	3	0.87	5	0.89	5	0.87	6	0.759
Ease of engagement between parties	0.96	1	0.84	6	0.89	5	0.87	6	0.230

For the Large size firms, ease of transitioning from paper to electronic system is most important, followed by availability of policies to promote e-procurement, followed by the speed in the transaction, lower cost of the transaction, ease to respond electronically, followed by availability of technological infrastructure, ease of integration of systems with existing processes, availability of infrastructure to promote e-procurement, ease of engagement between parties, security and data protection challenge, followed by the reliability of e-procurement systems/tools and compatibility of e-procurement systems/tools. For overall firms, ease of transitioning from paper to electronic systems is the most important factor influencing e-procurement, followed by availability of policies to promote e-procurement followed by lower cost of the transaction, ease to respond electronically, availability of infrastructure to promote e-procurement, followed by the speed in the transaction, availability of technological infrastructure, security and data protection challenges, followed by the compatibility of e-procurement systems/tools, followed reliability of e-procurement systems/tools, ease of integration of systems with existing processes, ease of engagement between parties.

Kruskal-Wallis test showed that all factors influencing e-procurement's adoption have a significant p-value of above 0.05 (ranging from 0.160-0.960) except one (ease of transitioning from paper to electronic systems) which has a significant p-value of 0.041. Since the p-value of each factor is greater than 0.05, this implies that there is no significant difference in the view of these 3 categories of respondents as to the importance of these 12 general factors influencing e-procurement in Ondo state. However, there is a significant difference in the view of the respondents as regards the ease of transitioning from paper to electronic systems in construction firms in Ondo state.

4.5. Summary of all Factors Influencing the Adoption of E-procurement

Following a similar approach, some factors influencing e-procurement in construction firms were identified from the view of related literature and respondents were asked to rate them according to the level of use by each firm using a Likert scale of 1 to 5 with 1 being "very low" and 5 being "very high".

The results of the analysis show the ease of transitioning from paper to electronic systems is the most important factor influencing the adoption of e-procurement followed by availability of policies to promote e-procurement, followed by cost of e-procurement technology, lower cost of technology, ease to respond electronically, availability of infrastructure to promote e-procurement, followed by speed in transaction, availability of technological infrastructure, security and data protection challenges, followed by reliability of e-procurement systems/tools, compatibility of e-procurement system/tools, ease of integration of systems with existing processes and ease of engagement between parties, followed by unreliable power supply, followed by safety and insecurity issues, followed by age, size and category of firm, poor financial base, unreliability of technology, followed by poor ICT/Internet infrastructure, reduced level of personal contact, followed by unavailability of technical expertise, lack of top management support, followed by unreliability of e-procurement softwares/tools, resistance to change, followed by loss of job fear and end to corruption, followed by lack of confidentiality and flexibility, followed by illegality of e-procurement contract.

Kruskal-Wallis test showed that all factors influencing e-procurement's adoption have a significant p-value of above 0.05 (ranging from 0.075-0.994) except one (ease of transitioning from paper to electronic systems) which has a significant p-value of 0.041.

Since the p-value of each factor is greater than 0.05, this implies that there is no significant difference in the view of these 3 categories of respondents as to the importance of 11 general factors influencing e-procurement in Ondo state. However, there is a significant difference in the view of the respondents as regards the ease of transitioning from paper to electronic systems in construction firms in Ondo state.

Table 5: Summary of Factors Influencing the Adoption of E-procurement

Factor	Overall		Kruskal Wallis
	RII	RK	Sig.
Ease of transitioning from paper to electronic systems	0.94	1	0.041*
Availability of policies to promote e-procurement	0.93	2	0.552
Lower cost of transaction	0.91	3	0.862
Speed in transaction	0.91	3	0.275
Availability of infrastructure to promote e-procurement	0.91	3	0.388
Ease to respond electronically	0.91	3	0.835
Security and data protection challenges	0.90	4	0.160
Reduced level of personal contact	0.90	4	0.190
Availability of technological infrastructure	0.90	4	0.960
Reliability of e-procurement systems/tools	0.89	5	0.780
Compatibility of e-procurement systems/tools	0.89	5	0.731
Ease of integration of systems with existing processes	0.89	5	0.759
Ease of engagement between parties	0.89	5	0.230
Cost of e-procurement technology	0.87	6	0.675
Lack of top management support	0.86	7	0.075
Unreliability of e-procurement softwares/tools	0.85	8	0.311
Loss of job fear and end to corruption	0.85	8	0.115
Age, size and category of firm	0.85	8	0.192
Illegality of e-procurement contract	0.84	9	0.286
Poor ICT/Internet infrastructure	0.84	9	0.162
Poor financial base	0.83	10	0.539
Unavailability of technical expertise	0.83	10	0.106
Unreliable power supply	0.77	11	0.141
Lack of confidentiality and flexibility	0.77	11	0.990
Resistance to change	0.76	12	0.994
Safety and insecurity issues	0.66	13	0.176
Unreliability of technology	0.37	14	0.286

4.6. Discussion of Findings

Croom and Johnson (2003) corroborated that E-procurement implementation can be expensive, particularly, in instances when a process based on disagreeing platforms is to be incorporated at a later date. The more distinct the technical platforms, the more prohibitive it becomes. Findings from this research show that the cost of e-procurement technology is high. The cost of e-procurement technology has high MIS among other factors as ranked by construction firms in Ondo state, Nigeria. The findings of the result slightly affirm that of Azanlerigu and Akay (2015), which presented the factors influencing its adoption to be: lack of technical expertise, the inadequacy of legal framework, inadequate technological infrastructure, and security of procurement transaction data. The quantitative result strongly correlates with the findings made by Ibem and Laryea (2015) which have ease of transitioning from paper to electronic system in e-Procurement as the most influential factor

influencing the decision to use e-Procurement. Moreover, both results also slightly corroborate that of Asian Development Bank (2013) which have the most important factors influencing the adoption of e-Procurement to be; government direction, policy & legal framework, agencies change, awareness & capacity building, technology etc.

Aduwo (2016) explained the lack of critical mass uptake of e-Procurement and its non-adoption in the Nigerian Building Industry (NBI) to be principally due to; internal factors within the organizations, external factors outside the organizations and the perception of the risks associated with the use of e-Procurement by people in the industry as it was established in this research that the influential of overall construction firm in a descending manner is ease of transitioning from paper to electronic form; availability of policies to promote the use of e-procurement; cost of e-procurement technology; lower cost of technology; ease to respond electronically; availability of infrastructure to promote e-procurement; speed in transaction; availability of technological infrastructure; security and data protection challenges; reliability of e-procurement systems/tools; compatibility of e-procurement system/tools; ease of integration of systems with existing processes; ease of engagement between parties; unreliable power supply; safety and insecurity issues; age, size and category of firm; poor financial base; unreliability of technology; poor ICT/Internet infrastructure; reduced level of personal contact; unavailability of technical expertise; lack of top management support; unreliability of e-procurement software/tools; resistance to change; loss of job fear and end to corruption; lack of confidentiality and flexibility and illegality of e-procurement contract.

4.7. Implications of the Study

E-Procurement technology and its implementations in the construction industry are currently in their infancy and are going through growth pains not unique to emerging innovations and evolving initiatives. Companies that use e-procurement will attract value propositions for greater organizational efficiency and reduced costs and cycle times. This cost reduction is related to reduced paperwork, which translates into fewer errors and a more effective procurement process. Simplifying the procurement process that e-procurement systems are credited with also has a positive effect on the procurement cycle period. While not directly quantifiable into Naira, faster cycle time provides increased flexibility and more up-to-date information. E-Procurement and its adoption in the construction industry is still a subject of much discussion and great expectation. Therefore, there is much potential for research work to be carried out within the context of the Nigerian construction industry.

5. CONCLUSION AND RECOMMENDATIONS

This study was carried out to assess e-procurement adopted by construction firms in Ondo state, Nigeria. The research has contributed to the body of knowledge by assessing the general factors influencing the adoption of E-procurement in the Nigerian construction industry. It is evident that from the Small size construction firms in Nigeria that the most important factor influencing e-procurement is the unavailability of technical expertise, followed by the poor financial base, age, size and category of firms and lack of top management support. For the Medium size firms' unavailability of technical expertise ranked the highest factor influencing e-procurement, followed by age, size, and category of firms, poor financial base and lack of top management support. For the Large size firms,

poor financial base ranked the highest factor influencing e-procurement, followed by age, size and category of firms, lack of top management support, and unavailability of technical expertise It is conspicuous from all indications that the construction firms have ease of transitioning from paper to electronic systems as the most important factor influencing the adoption of e-procurement followed by availability of policies to promote e-procurement, followed by cost of e-procurement technology, lower cost of technology, ease to respond electronically, availability of infrastructure to promote e-procurement, followed by the speed in the transaction, availability of technological infrastructure, security and data protection challenges.

It is established from the study that E-procurement implementation can be expensive among construction firms in Nigeria, particularly, in instances when a process based on disagreeing platforms is to be incorporated at a later date. The more distinct the technical platforms, the more prohibitive it becomes. This research shows that the cost of e-procurement technology is high. The cost of e-procurement technology has high MIS among other factors as ranked by construction firms in the research area. To the limitation of the study, the procedure utilized in this investigation can be imitated in different areas for additionally thinks about. Moreover, additional studies may use more strategies in gathering more reliable data on E-procurement implementation. For this study, the questionnaire was well utilized, using several methods will make the results more flexible and precise Method such as interview, comparing data and many more should be adopted. The limitation is inherent in the population of the study.

It is recommended from the study that rampant adoption requires the government to provide adequate solutions to the external factors influencing the adoption of e-Procurement such as; unreliable power supply, unavailability of technical expertise and legal recognition etc. Nigerian government should develop keen interest in e-Procurement and adopts its use in the majority of their projects. Practitioners should examine the perceived benefits and embrace its use, irrespective of the cost and technicality. Construction firms should be encouraged through educational trainings on e-procurement systems and facilities.

REFERENCES

Aberdeen Group. (2002). Best Practices in e-Procurement. The Abridged Report, Aberdeen Group Inc, Boston, Massachusetts, 65.

Aberdeen Group. (2008). Global Supply Management (GSM): the 2008–2009 Aberdeen Agenda. (2017, May 28). Retrieved from http://www.aberdeen.com

Aberdeen Group. (2009). Global Supply Management (GSM): the 2009–2010 Aberdeen Agenda. (2017, May 28). Retrieved from http://www.aberdeen.com

Aduwo, E.B., Ibem, E.O., Uwakonye O.U., Olayeni, P.T., & Ayo-Vuaghan, E.K., (2016). Barriers to the uptake of e-Procurement in the Nigerian building industry. *Journal of Theoretical and Applied Information Technology*. ISSN: 1992-8645. (2017, May 15). Retrieved from http://www.jatit.org

Aduwo, E.B., Ibem, E.O., Tunji-Olayeni, P., Uwakonye; O.U., & Ayo-Vaughan, E.K. (2016). Barriers to the Uptake of e-Procurement in the Nigerian Building Industry. *International Journal of Applied Theoretical and Applied Information Technology* IJATAIT, 89.

Achuora, J., Arasa, R., & Ochriri, G. (2012). *Precursors to effectiveness of public procurement audits for Constituency Development Funds (CDF) in Kenya*. European Scientific Journal, ESJ, **8**(25).

Afolabi, O.A. (n.d). *E-maturity of stakeholders for web based procurement platform in the construction industry*

Agboyi, M. R., & Ackah, D. (2012). *The impact of E-procurement on the improvement of an Organization.*

Angappa, G., Ronald, E., Eric, W.T., Bharantendra, K. (2009). E-procurement adoption in the southcoast S.M.Es. Production Economics 122, 161-175.

Asian Development Bank. (2013). E-Government Procurement Handbook. Mandaluyong City, Philippines. (2017, May 28). Retrieved from http://www.adb.org/egovernment-procurement-handbook

Aslani, M. P., Laios, L. G., & Moschuris, S. J. (2008). The perceived impact of e-procurement in EU enterprises. *International Journal of Value Chain Management*, **2**(2), 168-187.

Azanlerigu, J. A., & Akay, E. (2015). *Prospects and Challenges of E-Procurement in Some Selected Public Institutions in Ghana.* Prospects, **7**(29).

Baily, P., Farmer, D., Crocker, B., Jessop, D., & Jones, D. (2008). *Procurement principles and management*. Pearson Education. England: Prentice Hall

Bikshapathi, K. (2006). Implementation of e-procurement in the Government of Andhra Pradesh: A Case Study. E-Governance: Case Studies, 270-285.

Bowden, S. (2005) *Application of mobile IT in construction*. Dissertation, University of Loughborough, Department of Civil & Building Engineering

Callender, G., Sajeev, A. S. M. & Kishor, V. (n.d). *Critical factors that influence E-procurement Implementation success in the Public Sector.*

Chomchaiya, S. (2014). *Consolidated Performance Measurement framework for government e-procurement focusing on internal stakeholders*. Accessed July 18, 2017, from https://www.deepdyve.com/lp/emerald-publishing

Clifford, M. & Alexandru V. (2012). *E-procurement; A myth or reality?* Volume 12, issue 2, 212-258, summer.

COBRA. (2009). The Construction and Building Research Conference of the Royal Institution of Chartered Surveyors Held at the University of Cape Town, 10-11 September 2009

Creswell, J. W. (2003) Research design: Qualitative, quantitative, and mixed method approaches I by John W. Creswell 1.-2nded.

Croom, S., & Brandon-Jones, A. (2007). Impact of e-procurement: experiences from implementation in the UK public sector. *Journal of Purchasing and Supply Management*,
13(4), 294-303.

Croom, S., & Johnston, R. (2003). E-service: enhancing internal customer service through eprocurement. *International Journal of Service Industry Management*, **14**(5), 539-555.

Davila, A., Gupta, M., & Palmer, R. (2003). Moving procurement systems to the internet: The adoption and use of e-procurement technology models. *European management journal*, 21(1), 11-23.

De-Boer, L., Harink, J., & Heijboer, G. (2002). A conceptual model for assessing the impact of electronic procurement. *European Journal of Purchasing & Supply Management*, **8**(1), 25-33.

Desmond, A. (2016). *Implementation and adoption of E-Procurement in Ghana Public Sector: the way forward.* PhD Thesis, from the Department of Building Technology, College of Art and Built Environment, Ghana.

E-Business W@tch. (2005). Sector Report No. 08-I (July 2005) ICT and Electronic Business in the Construction Industry, Key issues and case studies.

Eadie, K. S., Hussain, W., & Mustaffa, N. (2012). Survey on benefits and barriers of e-procurement: Malaysian SMEs perspective. *International Journal on Advanced Science, Engineering and Information Technology*, **2**(6), 424-429.

Eadie, R., Perera, S., Heaney, G., & Carlisle, J. (2007). Drivers and barriers to public sector eprocurement within Northern Ireland's construction industry. *Journal of Information Technology in Construction*, **12**(2), 103-120.

Eakin, D. (2003). Measuring e-Procurement benefits. Summit: *Canada's magazine on public sector purchasing, United Kingdom*.

Eric, K. A. & Bingunath, I. (2011). Exploring e-bussiness technology to support improvement in the infrastructure procurement process in Ghanaian Construction Industry.

Esben, A. S. (2012). Promoting the use of ICT in the construction industry; Assessing the factors hindering usage by building contractors in Ghana. September, 2012.

Fahad U. (2013). Types of Procurement Contract used in project Management. Retrieved July 18, 2017, from https://pmstudycircle.com/2013/12/types-of-procurement-contracts-usedin-project-management/

Fernandes, T., & Vieira, V. (2015). Public e-procurement impacts in small and medium enterprises. *International Journal of Procurement Management*, **8**(5), 587-607.

Ferreira, J. & Spinola R. (2013). The Potential of e-Tendering Data to Improve Post-Award Contract Management. *Journal of Suppliers*, **9**(5), 43–46.

Fischer, M. and J. Kunz (2004). "The Scope and Role of Information Technology in Construction." CIFE Technical Report 156, Stanford University.

Fleming, E. D., Kuo, C. C., & White, R. E. (2010). Funding e-procurement initiatives in US Government agencies: challenges, models, and trends. *International Journal of Procurement Management*, **3**(3), 231-246.

Gupta, M., & Narain, R. (2012). Investigation into barriers to adoption of e-procurement and measures of performance. *International Journal of Procurement Management*, **5**(5), 567- 607.

Harris, F. and MacCaffer, R. (2001): "Modern Construction Management." London: Blackwell Science -5 th edition.

Hassan, T. M. and McCaffer R. (2002) Vision of the large scale engineering construction industry in Europe, *Automation in Construction*, Vol.11, No.4, 421- 437.

Hore, A.V. (2006): Use of it in managing information and data on construction projects – a perspective for the Irish construction industry. Information Technology in Construction Project Management Engineers Ireland Project Management Society Talk: 21st March 2006

Hore, A.V and West, R.P. (2005). "Attitudes towards Electronic Purchasing in the Irish Construction Industry", 2005 CIB W92/T23/W107 International Symposium on Procurement Systems, Las Vegas, USA.

Ibem, E. O., Aduwo, E. B., Tunji-Olayeni, P., Ayo-Vaughan, E. A., & Uwakonye, U. O. (2016). Factors influencing e-Procurement adoption in the Nigerian building industry. *Construction Economics and Building,* **16**(4), 54-67.

Ibem, E. O., & Laryea, S. (2015). E-Procurement use in the South African construction industry. *Journal of Information Technology in Construction* (ITCon), **20**(23), 364-384.

Isikdag, U., Underwood J., Kuruoglu M. & Acikalin U. (2007) The Strategic Role of ICT within the Turkish AEC Industry. *Proceedings of CIB W89: International Conference on Building Education and Research -Building Resilience-.* (Haigh R. and Amaratunga D., editors), Kandalama, Sri Lanka.

Issa, R. R. A., Flood, I., & Caglasin, G. (2003). A survey of e-business implementation in the US construction industry. *Journal of Information Technology in Construction (ITcon),* **8(**2), 15-28.

Johnson, M. (2011). Public sector e-procurement: a study of benefits from e-markets in the local government sector. *International Journal of Services Technology and Management*, **16**(1), 1-27.

Kidd, A. (2013). The Definition of Procurement. Chartered Institute of Purchasing Supply: Australia Pty Ltd. (2017, July 18). Retrieved from https://www.cipsa.com.au/

Kothari, C. R. (2004). Research Methodology Methods and Techniques (Second Edition). An Imprint of New Age International Limited.

Löfgren, A.(2007) . ICT Investment Evaluation and Mobile Computing Business Support for Construction Site Operations. Royal Institute of Technology, Sweden

Lou, E. C. W., & Alshawi, M. (2010). Critical success factors for e-tendering implementation in construction collaborative environments: people and process issues. *Journal of Information Technology in Construction (ITcon),* **14**(10), 98-109.

Love, P.E.D., Li, H. and Mandal, P., (1999), Rework: a symptom of a dysfunctional supply-chain, European Journal of Purchasing and Supply Management, 5, 1-11.

MacManus, S. A. (2002). Understanding the incremental nature of e-procurement implementation at the state and local levels. *Journal of Public Procurement*, **2**(1), 5.

Maia, S. & Tavares, L. V. (2013). Public procurement re-examined. *Journal of Public Procurement*. **1**(1), 9–50.

Mathonsi, M. D., & Thwala, W. D. (2012). Factors influencing the selection of procurement systems in the South African construction industry. *African Journal of Business Management*, **6**(10), 3583.

Moon, M. J. (2005). E-procurement management in state governments: diffusion of eprocurement practices and its determinants. *Journal of Public Procurement*, **5**(1), 54. Naoum, S, G (2002). Dissertation research and writing for construction students, Butterworth Heinemann.

Murray M., Nkado R. & Lai A. (2001). The integrated use of information technology in the construction industry. Proceedings of the CIB 78 Conference: IT in Construction in Africa,Pretoria, South Africa, 39-1 to 39-13.

NCC. (2017). Nigeria's Fastest Growing Telecommunication Company. (2017, May 28). Retrieved from https://www.pressreader.com/canada/torontostar/20170216/282071981659100

Neef, D. (2001). E-Procurement: From strategy to implementation. FT press.

Neupane, A., Soar, J., Vaidya, K., & Yong, J. (2012, August). Role of public e-procurement technology to reduce corruption in government procurement. In Proceedings of the 5th International Public Procurement Conference (IPPC5) (pp. 304-334). Public Procurement Research Centre.

Norzaid,i M., Nurliyana, M., Arlina, E. & Intan, S. (2013). Factors influencing the usage of E-procurement among contractor companies in Malaysia. University Teknologi MARA, Malaysia

Ofori, G. (2000) Challenges of Construction Industries in Developing Countries, 2nd International Conference on construction in Developing Countries: Challenges facing theconstruction industry in developing countries, 15 –17 November, Gabarone, Botswana.

Oladapo, A.A. (2006). The impact of ICT on professional practise in the Nigerian in the Nigerian Construction Industry. *The Electronic Journal of Information Systems in Developing Countries,* 24.

Olusegun, B. S. (2017). Investigating Factors Affecting E-Government Procurement (E-GP) Acceptance Decision Among Nigerian Small And Medium Enterprises.

Oyediran, O. S., & Akintola, A. A. (2011). A Survey of the State of the Art of E-Tendering in Nigeria. *Journal of Information Technology in Construction ITcon*, **16**(32), 557-576.

Panda, P., & Sahu, G. P. (2012). E-Procurement implementation: critical analysis of success factors' impact on project outcome.

Parida, U., & Parida, V. (2005). E-procurement: an Indian and Swedish perspective. (2017, May 6). Retrieved from http://www.epubl.ltu.se/1404-5508/

Peansupap, V. & Walker D. (2005). Factors enabling information and communication technology diffusion and actual implementation in construction organizations. *Journal of Information Technology in Construction (ITcon),* Vol. 10, No. 14, 193-218.

Perreira, C.S. & Saores, AL. 2007. Improving the quality of collaboration requirements for information management through social networks analysis. International Journal of InformationManagement, 27: 86-103.

Pollaphat, N., Skibniewski, M. (2004). Web based construction project management systems: How to make them successful. Automation in construction, 491-506.

Price Water House Coopers. (2007). E-Procurement the golden book for good practice procurement. (2007, May 6). Retrieved from http://pwcglobal.com/eprocgoldenbook.

Quangdung, T., Dechun, H., Liu, B. & Hossain, E. (2011). A construction enterprise's readiness level in implementing E-procurement: A system engineering assessment model.

Rankin, J. H., Chen, Y., & Christian, A. J. (2006). E-procurement in the Atlantic Canadian AEC industry. *Journal of Information Technology in Construction* (ITcon), **11**(6), 75-87.

Samuelson, O. (2008). The IT-barometer – A decade's development of IT use in the Swedish construction sector. *Journal of Information Technology in Construction (ITcon),* **13**(1), 1-19.

Skibniewski, M. J. and Nitithamyong, P. (2004). Web-based Construction Project Management Systems: Practical Advantages and Disadvantages. Proceedings of the 4th International Conference on Construction Project Management (ICCPM), Singapore, Nanyang Technological University.

Subramaniam, C., & Shaw, M. J. (2002). A study on the value of B2B e-commerce: The case of Web-based procurement. E-Business Management, 439-461.

Tatsis, V., Mena, C., Van Wassenhove, L. N., & Whicker, L. (2006). E-procurement in the Greek food and drink industry: drivers and impediments. *Journal of Purchasing and Supply management*, **12**(2), 63-74.

Tavares, L. V. (2012). Management of public purchasing: guidelines for the application of the new Public Procurement Code - Decree-Law 18/2008. Lisbon.

Tenah, K. A. (1986). Information needs of construction personnel. Construction Engineering and Management 112.

Teo, T. S. H., Srivastava, S. C. & L. Jiang. (2009). Trust and electronic government success: An empirical study. *Journal of Management Information Systems*, **25**(3), 99-131.

UN Procurement Practitioner's Handbook. (2012). The Glossary of Terms, Interagency Procurement Working Group. 5th edition. Pp 80.

Vadhavkar, S.; Pena-Mora, F. (2000) Geographically Distributed Team Interaction Space. Computing in Civil & Building Engineering, Proceedings of the Eighth International Conference, ASCE, Virginia.

Vconnect. (2018).

Waziri, A., Ali N., Ghali, A., & Zaimi, (2015). Environment variables on IT adoption: A case of Nigerian construction organizations. April (2015).

Weele, Van, J. A (2010). *Procurement and supply chain management*, 5th Edition, Thomson International, London, England, 147.

Woksepp, Stefan Woksepp, & Olofsson, T. (2006)."Using Virtual Reality in a Large-Scale Industry Project", ITcon Vol. 11 (2006), Woksepp and Olafsson, pg. 627

World Bank. (2003). Procurement for Projects and Programs, E-procurement, *Journal of bank procurement*. **5**(6), 38-45

World Bank. (2006). Procurement guideline: procurement of Goods, Works, and NonConsulting Services under IBRD Loans and IDA Credits & Grants. 1818 H Street N.W. Washington, D.C. 20433.

Wyld, D. (2006). Constraints to Effective Implementation of E-Procurement in the Public. Management Research News. 5, 45.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

RISK MANAGEMENT EFFECTIVENESS IN HOUSING PROJECTS: A COMPARATIVE EVALUATION IN SELECTED PROCUREMENT METHODS IN AKWA IBOM STATE

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ABSTRACT

Purpose: The knowledge and understanding of risk management is critical in achieving project objectives in terms of time, cost, quality and safety. The study aimed at providing insight into how procurement methods could influence the effectiveness of risk management practices of housing projects in Akwa Ibom State. The objectives of the study were to evaluate the effectiveness of risk management methods of traditional, direct labour, and labour only procurement methods with a view to enhancing construction projects delivery in Akwa Ibom state and Nigeria in general.
Design/methodology/approach: A cross-sectional survey approach was used for the study. Ninety-nine (99) questionnaires were retrieved from purposively selected contractors operating in the study area. Data collected were analysed using mean item score and Kruskal Wallis was used to test the hypotheses.
Findings: The results indicate that Consulting with experts, past experience and brainstorming were the most moderate effective risk identification techniques employed by the respondents across the three procurement methods while risk analysis was rarely done. Risk response techniques shows 93.75% moderate effectiveness, with avoidance/prevention, transfer and mitigation were mostly employed, while risk retention was never used. Risk assessment was ineffective, while risk monitoring was of moderate effectiveness. Furthermore, the findings of the study revealed that there is no significant variation in the level of effectiveness of risk management methods among risk identification, response, monitoring among the delivery systems, but a significant variation in risk assessment. The study concluded that there is a general lack of knowledge of structured risk management practice by the respondents in housing projects.
Research limitations/implications: The limitations include the use of only perception of contractors purposively selected from companies in Akwa Ibom state and only selected procurement methods. The contribution to knowledge is that this study has established the current level of effectiveness of risk management in some procurement methods in the study area.
Practical implications: It is recommended that there is need for advanced formal and informal training in the characteristics and fundamentals of various procurement methods for adequate

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assessment of their inherent risks in the study area. There should be an iterative and systematic risk management approach that consider the specific risk factors and their assessment in the procurement practices.

Originality/value: The study revealed the effectiveness level of sub processes of risk management among risk identification, assessment, response and monitoring, as well as the variation among the procurement methods.

Keywords: Contractors; comparative evaluation; housing project; procurement methods; risk management.

1. INTRODUCTION

Man's major desire has been that of comfortable housing system to serve as shelter, this need occupies a unique place in the life of human beings (Alabi, 2018). Housing being one of the most basic needs of mankind after food is a very important consumer item that affects welfare, health and productivity of individuals and households and consequently, the economic growth of a country (Babalola, Ibem, Olotuah and Fulani, 2016).

According to the National Bureau of Statistics (NBS, 2015), the Nigerian construction industry which has the development of residential and commercial real estate and their maintenance as one of its functions, needs to accommodate social and demographic changes that happen overtime, such as migration and urbanization, demands for better living conditions. The growth of the industry over the years as a result of demands for real estate and housing, the provision of infrastructure to support an increasing population size and the need to open up communities to foster inter-state and inter-regional trade and movement has also opened up the market for construction and services within the industry (NBS, 2015).

It was reported that the Nigerian construction Industry is one active sector of the Nigerian economy which takes the largest part of government spending on capital projects and it's the major source of economic growth and development of the country (Waziri and Bala 2014).The provision of infrastructure is mostly undertaken and financed by the government through either the conventional traditional method or other procurement methods in Nigerian construction industry (Iboh, Adindu and Oyoh, 2013).Procurement method which is the management of the total process involved in construction project delivery, are of several types used in the construction industry, they range from the traditional system to the several variations of 'fast track' systems such as Design and Build, Management Contracting, Build operate and transfer, and so on (Babatunde, Opawole and Ujaddughe, 2010; Kadiri and Ogukola, 2014).Ogunsami (2012)reported that the client's choice for a procurement method is dictated primarily by the inherent risk and other derivable prospects in the method. Chattered Institute of Building (CIOB, 2010) stated that the selection of an absolute optimal procurement method is difficult, because even the most experienced client or contractor does not know all the potential benefits or risk for each method. Procurement is, therefore a succession of calculated risk. Hence, taking effective risk management techniques to manage the procurement risk associated with construction activities is very important for the successful delivery of a project.

According to Sanda, Anigbogu, Nuhu and Olumide (2020), risk refers to any factor, event or influence that threatens the successful completion of a project, although the influence could be negative or positive. Risk Management helps the key project

participants – clients, contractor or developer, consultant, and suppliers to meet their commitments and minimize negative impacts on construction project performance in relation to cost, time and quality objectives (Odimabo and Oduoza, 2013).The construction industry has become so complex, that the nature of the structured risk management systems can be the difference between failure and success of a project (CIOB, 2010; Agerbern and Ågren, 2012).

The procurement system selected determines the control and power the various parties may exercise and the risk to which they are exposed to. It is in line with the problems associated with the difficulty of managing the risks inherent in projects delivered with different procurement methods that informs the present comparison of the risk management among traditional, labour only and direct labour procurement methods in housing projects in AkwaIbom State. Studies like Akobi (2012); Ogunsami (2012); Babatunde, Opawole and Ujaddughe (2010); Ojo, Adeyemi and Fagbenle, (2006); Aladeniyi (2013), have established the prevalence of the use of these three procurement systems in housing projects delivery in the country hence the reason for choosing them for the study. Akwa Ibom State is one of the 36 states of the Federal Republic of Nigeria, with Uyo as the state capital. Since her creation in 1987, the provision of decent housing for its citizens has been a major socio-economic problem of great concern to the successive government. As observed by James, Akpan, Essien and Ekpo (2012), the state is currently undergoing major infrastructure and economic renaissance. This is evident in the construction of more infrastructures, for instance: Ibom Tropicana Entertainment Centre, the Uyo International Olympic Stadium and many urban roads, rural-urban migration intensifies, which makes the population of the urban area to become so dense that the existing houses are not enough to accommodate the growing population (Udoh, 2014).The governments, organisations and private individuals have made concerted efforts at meeting the needs of the growing population through provision of affordable houses but the achievement of this objective is still far away from reality. The focus of this study is therefore to compare the effectiveness of risk management in selected procurement methods adopted in housing projects with a view of enhancing effective housing delivery in the study area.

This study is aimed at providing an insight into how the effectiveness of risk management can be influenced by selected procurement methods used in housing projects delivery with a view to enhancing project delivery in Akwa Ibom State. The first objective is to determine the level of effectiveness of risk management practice applied in traditional procurement method in housing project in Akwa Ibom State. The second is to evaluate the level of effectiveness of risk management practice employed in direct labour procurement method, while the third is to determine the level of effectiveness of risk management practice applied in labour only procurement method in housing projects in Akwa Ibom State.

The study will help in advancing the knowledge and importance of procurement methods and risk management in enhancing project delivery in the study area. The evaluation of the effectiveness of risk management method in traditional, direct labour and labour only procurement method will provide the stakeholders of housing projects in the study area with the knowledge of selecting and prioritizing different risk management methods inherent in the various procurement methods for sustainable project performance. The study in general will help the client to appreciate the importance of risk management in housing projects thereby allocating funds for the exercise; it will also assist the consultants and contractors to have a knowledge base on

the processes of risk management; proceeding to analysis after identification, responding and monitoring risk appropriately to achieve project objectives.

1.1 Hypotheses of the Study

Four hypotheses were postulated for the study;

The first states that there is no significant variation in the effectiveness of the risk identification methods among the procurement systems.

The second states that there is no significant variation in the effectiveness of the risk monitoring methods among the procurement systems.

The third states that there is no significant variation in the effectiveness of the risk assessment methods among the procurement systems.

While, the fourth states that there is no significant variation in the effectiveness of the risk response methods among the procurement systems

2. REVIEW OF RELATED LITERATURE

Literature were reviewed in related areas covering, risk management and its processes, risk identification, risk assessment, risk response, risk monitoring and selected procurement methods.

2.1 Risk Management

Risk management is seen as integrated process aimed at addressing events that would have adverse effect on project objectives if they occur (Sanda, Anigbogu, Nuhu and Olumide, 2020). Risk management research has grown considerably in the construction industry given that construction projects are exposed to risk at the time of their coming into existence and are perceived to have more inherent risk due to the involvement of many contracting parties such as owners, contractors and designers, among others (Serpellaa, Ferradaa, Howarda and Rubio, 2014). Risks are associated with every project and should be identified in order to avoid negative impacts on the overall performance. Many problems which are faced in later phases of the project result from unmanaged risks from the earlier stage (Ropel and Gajewska, 2011). Banaitiene and Banaitis (2012) has it that risk management in the construction project management context is a comprehensive and systematic way of identifying, analysing and responding to risks to achieve the project objectives.

In this study, risk management is considered as the whole activities geared towards spotting risky situations, along with developing the strategies to reduce the probability of occurrence and impacts of risks (Pereraa, Rameezdeen, Chilesheb and Hosseini, 2014), with various management process.

2.2 Risk Management Process

The risk management process involves the systematic application of management policies, processes and procedures to the tasks of establishing the context, identifying, analysing, assessing, treating, monitoring and communicating risks (Ozcan, 2008; Ropel and Gajewska 2011). Identification and analysis of project risks are required for effective

risk management. One of the most important steps in Project Risk Management is the identification of the various risks. After identification of these risks, the focuses changes to the risk analysis and assessment, and then to selection of mitigation methods that will minimise, transfer, avoids, and control the risks (Ozcan, 2008). Klemetti (2006) believed that risk management process should be implemented at the early project phases, when there is still a possibility for fundamental changes. The project should be carefully analysed as to which kind of methods to use at which project phases, and a process needs to be customised according to all project characteristics.

2.2.1 Risk Identification

It is quite obvious that if we are unaware of the risks, it is difficult to manage them, though this view is limited to the event-type scope of risk management (Klemetti, 2006). According to Agerberg and Agren (2012), the risk identification process should be a set of on-going activities during the whole lifetime of a project. As a construction project makes progress, it will be harder to make changes as these will be associated with high costs. Therefore, it will be crucial to identify project risks in an early stage while it still can be governed. Risks and other threats can be hard to eliminate, but when they have been identified, it is easier to take actions and have control over them. If the causes of the risks have been identified and allocated before any problems occur, the risk management will be more effective (Ropel and Gajewska 2011).

2.2.2 Risk Assessment

Risk assessment is the second stage in the Risk Management Process where collected data about the potential risk are analysed. It can be described as short listing risks with the highest impact on the project, out of all threats mentioned in the identification phase (Ropel and Gajewska, 2011). Many risks can be quantified by measuring their impacts on the project objectives (Ozcan, 2008). An understanding of the possible effects on project objectives is needed: since most projects have only a limited amount of resources to use for risk management, concentration on only the major risks is essential. Reliable estimates of likelihoods and consequences are needed for prioritisation (Klemetti, 2006). Risk analysis involves the integration of information from numerous sources through quantitative and/or qualitative modelling, while preserving the uncertainty and the complex relationships between the elements of information (Ozcan, 2008). Ropel and Gajewska (2011) penned that in the analysis of the identified risk, two categories of methods – qualitative and quantitative – have been developed. The qualitative methods are most applicable when risks can be placed somewhere on a descriptive scale from high to low level. The quantitative methods are used to determine the probability and impact of the risks identified based on numeric estimations.

2.2.3 Quantitative methods

Quantitative methods need a lot of work for the analysis to be performed. The effort should be weighed against the benefits and outcomes from the chosen method, for example smaller projects may sometimes require only identification and taking action on the identified risks, while larger projects require more in depth analysis. The quantitative methods estimate the impact of a risk in a project, Project Management Institute (PMI, 2004). They are more suitable for medium and large projects due to the number of required resources (Ropel and Gajewska, 2011).

Scenario technique - Monte Carlo simulation- This method is based on statistics which are used in a simulation to assess the risks. The simulation is used for forecasting, estimations and risk analysis by generating different scenarios.

Modelling technique - Sensitivity analysis - The purpose of a sensitivity analysis is to establish the risk events which have the greatest impact or value.

Diagramming technique - Decision tree analyses are commonly used when certain risks have an exceptionally high impact on the two main project objectives: time and cost

2.2.4 Qualitative methods

Qualitative methods for risk assessment are based on descriptive scales, and are used for describing the likelihood and impact of a risk. These relatively simple techniques apply when quick assessment is required in small and medium size projects, (Cooper, Grey, Raymond and Walker, 2005). (PMI) (2004) identifies four qualitative methods for risk assessment;

i. Risk probability and impact assessment: In this method the likelihood of a specific risk to occur is evaluated. Furthermore, risk impact on a project's objectives is assessed regarding its positive effects for opportunities, as well as negative effects which result from threats.
ii. Probability/impact risk rating matrix: these is concerned with assessing risks in relation to other risks, since these relations may cause minor risks to become more relevant to the risk management process if they are significant sources for other risks.
iii. Risk Categorisation: This is a way of systematizing project threats according to their sources, in order to identify areas of the project that are most exposed to those risks. Tools which can be used in this method are work break down structure (WBS) or risk breakdown structure (RBS), and their role is to develop effective risk response.
iv. Risk Urgency Assessment: Is to prioritize risks according to how quick response they require.

2.2.5 Risk Response

This third step of the Risk Management Process indicates what action should be taken towards the identified risks and threats. The response strategy and approach chosen depend on the kind of risks concerned (Ropel and Gajewska, 2011). Other requirements are that the risk needs to have a supervisor to monitor the development of the response, which will be agreed by the actors involved in this risk management process (PMI, 2004). The strategies for risk response include;

i. Avoidance/Prevention: If the risk is classified as bringing negative consequences to the whole project, it is of importance to review the project's aim. In other words, if the risk has significant impact on the project, the best solution is to avoid it by changing the scope of the project or, worst scenario, cancel it. There are many potential risks that a project can be exposed to, and which can impact its success (Ropel and Gajewska, 2011). This is why risk management is required in the early stages of a project instead of dealing with the damage after the occurrence of the risk (PMI, 2004). The avoidance means that by looking at alternatives in the project, many risks can be eliminated. If major changes are required in the project in order to avoid risks. Cooper, Grey, Raymond and Walker (2005), list some activities that can help to avoid potential risk. These includes: More detailed

planning, Alternative approaches, Protection and safety systems, Operation reviews, Regular inspections, Training and skills enhancement, permits to work, Procedural changes, Preventive maintenance.

ii. Reduction/Mitigation: Mitigation seeks ways to reduce the probability and/or impact of risk (Klemetti 2006). Kajsa (2006) also affirms that risk reduction is about decreasing the probability, the consequences or a combination thereof for a risk to breakout. This could be done in several ways, of which sharing with other parties or taking some action where the probabilities or consequences become reduced is common. Mitigation strategies can, according to Cooper, Grey, Raymond, and Walker (2005), include: Contingency planning**,** Quality assurance**,** Separation or relocation of activities and resources**,** Contract terms and conditions**,** Crisis management and disaster recovery plans

iii. Transfer: Risk is transferred from the client to the contractor through the agreements in the contract, or from the contractor to the sub-contractor (Kajsa, 2006). Ropel and Gajewska (2011), states that the risk should be transferred to those who knows how to manage it. The actors that the risks can be transferred to are, for example, the client, contractor, subcontractor or designer depending on the risk's character. As a result, this could lead to higher costs and additional work, usually called risk premium. It must be recognized that the risk is not eliminated; it is only transferred to the party that is best able to manage it (PMI, 2004).

iv. Retention: When a risk cannot be transferred or avoided, the best solution is to retain the risk. The reasons for retaining the risk could be that the estimated probability, consequence or the combination of the two is low and at an acceptable level (Kajsa, 2006). In this case the risk must be controlled, in order to minimise the impact of its occurrence. Retention can also be an option when other solutions are uneconomical (Ropel and Gajewska, 2011).

2.2.6 Monitoring and Control

This is a method of creating a risk register where all risks and their management can be allocated in order to facilitate future projects (PMI, 2004). The continuous supervision over the Risk Management Process helps to discover new risks, keep track of identified risks and eliminate past risks from the risk assessment in the project (Ropel and Gajewska, 2011).

Tools and techniques used to monitor and control risk includes; Risk reassessment-identification of new potential risks: This is a constantly repeated process throughout the whole project. Monitoring of the overall project status – are there any changes in the project that can effect and cause new possible risks? Status meetings: discussions with risk's owner, share experience and helping managing the risks, and Risk register updates (PMI, 2004).

2.3 Procurement Methods

Three procurement methods have been selected for assessment in this study. These are the traditional, labour only and direct labour procurement methods. This is because many studies as earlier identified have established the prevalence of the use of these three procurement systems in housing projects delivery in the country hence adopting them in this study.

2.3.1 Traditional Method of Procurement

The traditional method of project procurement is a system whereby the client commissions an architect to take a brief, produce design and construction information, and invite tenders and administer the project during the construction period and settle the final account (Akobi, 2012). In the traditional approach, the employer accepts that design work will generally separate from construction, consultants are appointed for design and cost control, and the contractor is responsible for carrying out the works. This responsibility extends to all workmanship and materials, and includes all work by subcontractors and suppliers. The contractor is usually appointed by competitive tendering on complete information, but may if necessary be appointed earlier by negotiation on the basis of partial or notional information (Davis, Love and Baccarini, 2008). Traditional procurement has been in use in Nigeria for a long time and has dominated the construction scene for which majority of the projects in the country were procured. Studies of Ogunsanmi (2013), Ogunsamni (2012), Ojo, Adeyemi and Fagbenle, (2006), Babatunde, Opawole and Ujadduge (2010) all documented the dominancy of the Traditional method in housing constructions in Nigeria. However, Ogunsanmi (2013) explains that this situation is brought about because clients can easily understand the operations of the method as well as their financial commitments towards their projects long before the design documentation are made. In the views of Ogunsamni (2012), the traditional procurement method is not a suitable method for fast tracking projects because of its sequential nature that projects are designed before being constructed.

2.3.2 Labour Only Procurement Method

The downturn in the Nigeria economy from 1985 to 1999 had created recession in the construction industry that makes clients and consultants to think of cheaper ways of achieving constructions; this led to modifications of existing project execution systems in favour of labour-only system (Aladeniyi, 2013). Labour-only procurement is a method of acquiring new units of housing in which the client selects an Architect and other consultants, or no consultants at all are used, but a main contractor or sub-contractor is employed on "Labour-only" basis. Labour-only procurement system is adopted by clients who seek to have control of their building process and desires to save cost (Akinkunmi, Aghimien and Awodele, 2018).

The client purchases all the necessary building materials for the use of the building contractor to execute the project to completion (Ogunsamni, 2012). As stated by Ogunsanmi (2013), this method is now believed to offer cheaper, better and produce quality projects than Traditional method. Babatunde, Opawole and Ujaddughe (2010) asserts that in the Nigerian construction industry Labour-only procurement has recently been accepted by stakeholders for use in their various construction projects as many private individual projects of different constructions types ranging from residential, religious, social and other specialized buildings had been procured through the use of Labour-only method. As opined by Akobi (2012), this method has now been developed to suit the present economic condition of the country. The downturn in the economy he claimed, with the resultant lean economic resources has forced employers/promoters to expand the scope of its usage to include construction of new projects, primarily as a means of saving cost and yet realizing their set objectives.

The benefits of using labour-only according to Ogunsamni (2012), includes; It takes shorter time to achieve the design preparation processes as well as the building time, It is also used by clients for better control of their building process as well as strategy for saving money on project. It is versed with minor alteration/modification works involving repairs,

maintenance and refurbishments. The disadvantage of the use of this method by clients as observed by (Akobi, 2012) includes: liabilityto poor standard of workmanship, likelihood of offering poor working conditions for its labour force and possibility of leading to conflicts, as contractors are always not satisfied with the materials purchased by the clients.

2.3.3 Direct Labour Procurement

Adenuga (2013) defined it as a process by which a project is executed by the workers of an organisation instead of the project being contracted out. It can simply be described as a do it yourself' approach to project procurement. Akobi (2012) Asserts that direct labour method of project procurement is a system of project execution where technical civil servants are allowed to be involved fully in the physical execution of government projects. This method of project implementation is not new in the country as it has been used for executing minor jobs like filling of pot holes of road, repair of broken down machinery and so on. The new things about the method now are the emphasis and the call for direct labour method implementation in both state and federal governments' capital projects, such as buildings, consultancy services, roads and others major capital projects which has always been done by traditional system.

Aladeniyi (2013), observed that direct labour method is very pronounced in government or public sector projects and that the option has greater economy over contract methods. The author also describes direct labour as a method whereby a developer plans and organizes the project delivery process, carries out the design, the planning and procurement of resources and the construction of a project using client-employed supervisory staff and labour. They regard the method as an in-house arrangement because client's staffs as different from contractor's staff carry out the project delivery process and activities. They also observe that the arrangement may involve both design and construction otherwise regarded as in-house design and construction or a mixed system involving in-house design and contract construction or contract design and in-house construction. The direct labour delivery system is particularly used where: smaller projects are involved and 'in-house' resources have the required capacity, direct control with extra flexibility is required where the work cannot be accurately defined for a contract; uncertain and complex interface works between contracts are involved, where it is inappropriate to use another contract, the required speed of implementation and coordination with other dependent activities prohibits using a single contract or other work packages, there is a potential for the rapid development of technology or other change in a work/trade/special equipment area that must be addressed independently of other concurrent work, more time is required for design and to confirmed details, requiring some work areas to be addressed earlier and separately; and the work in a trade/equipment/other area is an experiment or a trial for new processes or technologies.

Akobi (2012) posited that increasing attention concern with the direct labour method by government and all personnel from all work of life is also new to the implementation of this method in Nigeria. The use of direct labour on government project at federal state and local government level is now well established nationwide. For reasons of cost, time, quality and training, it is being used increasingly. In fact, the situation has now led to renewed calls for the elimination of traditional system at all level of government (Akobi, 2012). The core benefits of using this method are; Generation of employment, Promotion of professional competency, Elimination of middlemen and cost saving, while the disadvantages of the direct labour are: lack of contractual obligation which oftentimes lead to projects abandoned due to lack of funds; lack of standard labour, as would have been the

case with established construction firms; and there may be inadequate incentives for workers involved in direct labour procurement.

3. RESEARCH METHODOLOGY

Statistical analysis of the data from the questionnaire was done using statistical package for social sciences (SPSS). The procurement and risk management methods adopted by 99 purposively selected contractors were examined using descriptive statistical tools. The tools that were used for the data analysis were: mean item score and Kruskall Wallis test. Mean item score was used in the data analysis to get the straight-forward totals of the respondents' perception of effectiveness of risk management on the understudied procurement methods. The formula is given as:

$$\text{Mean Score (MS)} = \frac{\Sigma (f) \times s)}{N}$$

where; f = frequency of response to each rating (5 to 1)

s = the score given to each factor by the respondents (ranging from 5 to 1)

N = the total number of responses concerning that factor.

Using the mean scores, the variables are classified as "Effective" (significant) variables that have mean score higher than 4.0, those with 4.0-3.0 mean scores were considered as "moderately effective", while variable with mean score less than 3.0, were considered as "ineffective" as adapted from Ejohwomu, Oshodi, and Onifade (2016).During analysis the variations in the perceptions of the effectiveness of risk management in projects procured with the delivery methods as captured in hypotheses were analysed using Kruskal Wallis test.

4. DATA ANALYSIS, RESULTS AND DISCUSSION OF FINDINGS

The results and findings are presented in this section.

4.1 Respondents Characteristics

The characteristics of the respondents that supplied the data used for the study were analysed for an understanding of the perception of the effectiveness of risk management in the three procurement methods. From the findings 88.9% represents the male while 11.1% represents the female. The highest academic qualification of the respondents are 1% had SSCE, 8% had OND, and 56% had HND OR B.Sc while 35% had M.Sc or PhD, also 14% of the respondents were consultants, 65% were contractors while 21% were clients. The professional affiliation of the respondents, 25% were Architects, 30% Builders, 29% Engineers, 10% Quantity Surveyors and 5% Estate Surveyors. The response on the sub-characteristics of membership status in their professional body, result revealed that corporate members were 21% and graduate members 37% while associate members were 29%. The results also show that 16% of the respondents have been in practice between 1-5yrs, 42% have practiced between 6-10yrs, 12% between 11-15yrs, 8% between 16-20yrs and 21% have been practicing for over 20yrs. The respondents were asked to state the client for the housing project they took part in. The result shows that 29% were public housing projects while 70% were private housing projects. The study also reveals that 54% of the

respondents were from Uyo senatorial district while Ikot Ekpene and Eket senatorial district had 26% and 20% respectively. The respondents were requested to indicate the size of their firm if they are consultants or contractors. The results show that 93% of respondents are working in a small firm (from 0-50 permanent employees) and 7% in a large firm (from 50-250 permanent employees). The results from the type of firm operated by the respondents shows that 82% operate contracting firms while 18% operate consultancy firm. The result gives a good and dependable characteristic of respondents used for the study.

4.2 Effectiveness of Risk Management Process in Traditional Procurement Method

The study achieved the first objective by collecting data on the perception of the internal stakeholders of housing projects in the study area on the level of effectiveness of 14 risk identification methods, 7 risk assessment methods, 16 risk response methods and 4 risk monitoring and control methods identified in the literature as applied in traditional procurement method. The method of analysis was done as described in the method of study and result presented in Table 1.

The result in Table 1 shows that in risk identification the stakeholders perceived that Consulting with experts ranked 1st with a mean score of 3.74, Past experience ranked 2nd with a mean score of 3.66, Brainstorming ranked 3rd with a mean score of 3.52. The result shows 64.3% moderate effectiveness of risk identification. The result of the assessment of risk shows that, Risk urgency assessment ranked 1st with a mean score of 2.92, Risk breakdown structure ranked 2nd with a mean score of 2.75 all showing ineffective performance. The response to risk in traditional procurement method; operation reviews ranked 1st with a mean score of 3.66, regular inspection ranked 2nd with a mean score of 3.60 and risk transfer ranked 3rd with a mean score of 3.56. This criterion shows 93.75% moderate effectiveness. The result of risk monitoring methods as applied in traditional procurement method shows that, Monitoring the overall project status ranked 1stwith a mean score of 3.70, Risk reassessment ranked 2nd with a mean score of 3.63 and Risk register updates ranked 3rd with a mean score of 3.42, all of moderate effectiveness. Generally, the findings support the observation by Osipova (2008) that Traditional design-bid-build contracts do not create opportunities for open discussion of project risks and joint risk management, hence, weakness in current procurement practices in Sweden.

Table 1: Effectiveness of risk management in Traditional procurement method

Risk Identification	1	2	3	4	5	Sum	Mean	Rank	Rmk
Consulting Experts	3	11	26	27	32	371	3.74	1	ME
Past Experience	4	7	35	25	28	363	3.66	2	ME
Brainstorming	4	7	41	27	20	349	3.52	3	ME
Stakeholder Analysis	3	12	32	38	14	345	3.48	4	ME
Interview	1	13	47	25	13	333	3.36	5	ME
Study Specialist Literature	5	19	42	25	8	309	3.12	6	ME
Checklist	7	23	32	30	7	304	3.07	7	ME
Database	14	18	23	36	8	303	3.06	8	ME
Questionnaire	7	27	29	26	10	302	3.05	9	ME
Delphi Technique	5	39	15	36	4	292	2.94	10	IE
Templates	10	24	37	24	4	285	2.87	11	IE
Risk Breakdown Structure	7	31	31	27	3	285	2.87	12	IE

Research Assumptions	9	29	36	18	7	282	2.84	13	IE
Research Interface	14	32	26	22	5	269	2.71	14	IE
Risk Assessment									
Risk urgency assessment	21	21	22	15	20	289	2.92	1	IE
Risk breakdown structure	18	31	13	32	5	272	2.75	2	IE
Decision Tree analysis	18	33	13	32	3	266	2.69	3	IE
Modelling Technique	16	35	31	12	5	252	2.55	4	IE
Probability & impact assessment	17	39	26	11	6	247	2.49	5	IE
Probability matrix	25	30	32	11	1	230	2.32	6	IE
Monte Carlo Simulation	35	37	18	7	2	201	2.03	7	IE
Risk Response									
Operation reviews	7	7	21	42	22	362	3.66	1	ME
Regular inspection	2	15	25	36	21	356	3.60	2	ME
Risk transfer	2	10	32	41	14	352	3.56	3	ME
Alternative approaches	2	12	30	41	14	350	3.54	4	ME
Crisis management	7	12	22	39	19	348	3.52	5	ME
Permits to work	3	14	39	18	25	345	3.48	6	ME
Retention	1	17	29	45	7	337	3.40	7	ME
Preventive maintenance	2	20	30	32	15	335	3.38	8	ME
Training and skills enhancement	5	11	38	36	9	330	3.33	9	ME
More detailed planning	7	21	30	15	26	329	3.32	10	ME
Contract terms and conditions	3	12	51	19	14	326	3.29	11	ME
Contingency planning	1	28	38	11	21	320	3.23	12	ME
Procedural changes	4	11	48	32	4	318	3.21	13	ME
Quality assurance	2	27	32	25	13	317	3.20	14	ME
Protection and safety systems	8	14	41	28	8	311	3.14	15	ME
Relocation of activities & resources	2	29	42	22	4	294	2.97	16	IE
Risk Monitoring & Control									
Monitoring overall project status	2	10	24	43	20	366	3.70	1	ME
Risk reassessment	4	12	27	30	26	359	3.63	2	ME
Risk register updates	4	14	24	50	7	339	3.42	3	ME
Status meeting	7	8	42	34	8	325	3.28	4	ME

ME-Moderately Effective; IE-Ineffective, RMK- Remarks

4.3 Effectiveness of Risk Management Methods in Direct-Labour Procurement Method

The study achieved the second objective by collecting data on the perception of the internal stakeholders of housing projects as was done in the first objective, for the direct labour procurement method. The result is presented in Table 2.

The result in Table 2 shows that past experience ranked the 1st (MS= 3.60), brainstorming ranked 2nd (MS=3.47), consulting experts ranked 3rd (MS=3.45). The result shows that identifying risk has 57.14% moderate effectiveness. The result suggests that past experience is a major source of managing risk, the risk encountered and managed in previous projects will serve as a benchmark to managing or preventing the risk from future occurrence. Brainstorming is a situation where the stakeholders in the

projects meet to discuss the way out of a potential risk; Experience from previous projects can be used to facilitate such discussions. Moreover, such discourse will be used as a tool to alert other participants about potential risks and by prioritize those risks which had the biggest impact on the project. This corresponds to the findings by Ropel and Gajewska (2011), past experience and discussions were the most commonly used techniques to identify and manage potential risks.

For risk assessment, Risk urgency assessment ranked first (MS= 2.540, decision tree analysis ranked 2nd (MS=2.51) and probability matrix ranked 3rd (MS= 2.49). All mean score less than 3.0 indicated ineffective performance. A critical examination of the risk methods with the least mean scores shows that they are either never or rarely being used by the internal stakeholders of housing projects in the study area, this is similar to the findings by Ropel and Gajewska (2011) that many construction practitioners who execute housing projects are not familiar with these structured methods used to analyse potential risk.

In risk response the results indicate that risk transfer ranked 1st (MS= 3.66), regular inspection ranked 2nd (MS= 3.60) and quality assurance ranked 3rd (MS = 3.56). The result also shows about 93.75% moderate performance. In direct labour procurement, where the client bears most of the risk, transferring the risk to a specialty sub-contractor when the expected loss is higher is a relief to the client. Although, it is generally recognized that risk should be transferred to the party in the best position to deal with the situation. Where a contractor tries to transfer all risks in a project may point towards lack of innovation, leading to low productivity. This corroborates inference by Banaitiene and Banaitis (2012) that risk transference to another project party were risk response techniques frequently used in construction projects.

Table 2: Effectiveness of risk management in Direct Labour Procurement

Risk Identification	**1**	**2**	**3**	**4**	**5**	**Sum**	**Mean**	**Rank**	**Rmks**
Past Experience	4	16	26	23	30	356	3.60	1	ME
Brainstorming	8	8	24	47	12	344	3.47	2	ME
Consulting Experts	9	13	25	28	24	342	3.45	3	ME
Interview	4	17	28	33	17	339	3.42	4	ME
Stakeholder Analysis	4	23	32	28	11	313	3.19	5	ME
Questionnaire	15	16	31	22	14	298	3.04	6	ME
Study Specialist Literature	8	17	47	18	9	300	3.03	7	ME
Database	11	15	45	19	9	297	3.00	8	ME
Delphi Technique	18	19	24	24	14	294	2.97	9	IE
Checklist	12	27	29	25	6	283	2.86	10	IE
Research Assumptions	11	30	29	22	7	281	2.84	11	IE
Risk Breakdown Structure	14	30	32	15	8	270	2.73	12	IE
Research Interface	16	28	30	18	6	264	2.69	13	IE
Templates	16	28	32	19	4	264	2.67	14	IE
Risk Assessment									
Risk urgency assessment	27	21	26	18	6	249	2.54	1	IE
Decision Tree analysis	24	28	21	19	5	244	2.51	2	IE
Probability matrix	29	23	22	19	6	247	2.49	3	IE
Probability & impact assessment	21	33	27	13	5	245	2.47	4	IE
Risk breakdown structure	29	25	26	14	5	238	2.40	5	IE
Modelling Technique	27	25	32	13	2	235	2.37	6	IE
Monte Carlo Simulation	38	30	18	7	6	210	2.12	7	IE

Risk Response									
Transfer	7	7	21	42	22	362	3.66	1	ME
Regular inspection	2	15	25	36	21	356	3.60	2	ME
Quality assurance	2	10	32	41	14	352	3.56	3	ME
Alternative approaches	2	12	30	41	14	350	3.54	4	ME
Crisis management	7	12	22	39	19	348	3.52	5	ME
Permits to work	3	14	39	18	25	345	3.48	6	ME
Retention	1	17	29	45	7	337	3.40	7	ME
Preventive maintenance	2	20	30	32	15	335	3.38	8	ME
Operation reviews	5	11	38	36	9	330	3.33	9	ME
More detailed planning	7	21	30	15	26	329	3.32	10	ME
Contract terms and conditions	3	12	51	19	14	326	3.29	11	ME
Contingency planning	1	28	38	11	21	320	3.23	12	ME
Procedural changes	4	11	48	32	4	318	3.21	13	ME
Training and skills enhancement	2	27	32	25	13	317	3.20	14	ME
Protection and safety systems	8	14	41	28	8	311	3.14	15	ME
Relocation of activities & resources	2	29	42	22	4	294	2.97	16	IE
Risk Monitoring & Control									
Monitoring overall project status	3	11	33	39	13	345	3.48	1	ME
Status meeting	2	13	37	36	11	338	3.41	2	ME
Risk register updates	2	4	54	29	10	338	3.41	3	ME
Risk reassessment	5	14	43	29	8	318	3.21	4	ME

ME-Moderately Effective; IE-Ineffective, Rmks- Remarks

In risk monitoring the result shows that monitoring the overall project status ranked 1st with a mean score of 3.48, status meeting ranked 2nd with a mean score of 3.41 and risk register updates ranked 3rd with a mean score of 3.4. The result shows moderate effectiveness of risk monitoring and control and suggests that in status meetings discussions with risks owner and sharing experiences helps monitor the risks.

4.4 Effectiveness of Risk Management Methods in Labour-Only Procurement Method

To evaluate the level of effectiveness of risk management methods applied in Labour Only procurement method, the previous approach was used, with result presented in Table3.

The result in Table 3 shows that past experience ranked the 1st (MS= 3.69), consulting with experts ranked 2nd (MS=3.49) and brainstorming ranked 3rd (MS= 3.19), with about 28.57% moderate effectiveness. This may be attributable to the fact that, the risk encountered within a labour only project may not be identified in the early stages of the project life cycle until it exceeds the capability of the stakeholder to manage. When an expert in risk management is not consulted those risk will not be identified early and managed throughout the life cycle of the project thereby meeting project objectives, this corresponds with the findings by Ropel and Gajewska (2011), that consulting experts in the field of risk management within the project will help in systemising and mapping out the techniques needed in handling these risks.

In risk assessment the result shows that risk urgency assessment ranked first with a mean score of 2.23, risk breakdown structure ranked second with a mean score of 2.16 and probability impact assessment ranked third with a mean score of 2.07.The mean scores less

than 3.0 shows ineffectiveness, suggesting that the respondents are not familiar with risk management techniques, also the degree of sophistication involved in the techniques is unwarranted if compared with project size, hence, their ineffectiveness.

Table 3: Effectiveness of risk management in Labour-only Procurement Method

Risk Identification	**1**	**2**	**3**	**4**	**5**	**Sum**	**Mean**	**Rank**	**Rmks**
Past Experience	2	11	28	33	25	365	3.69	1	ME
Consulting Experts	4	12	34	29	20	346	3.49	2	ME
Brainstorming	2	29	28	28	12	316	3.19	3	ME
Interview	3	17	46	25	8	315	3.18	4	ME
Stakeholder Analysis	13	20	38	17	11	290	2.93	5	IE
Risk Breakdown Structure	11	26	33	24	5	283	2.86	6	IE
Checklist	13	29	31	17	9	277	2.80	7	IE
Questionnaire	24	12	35	17	11	276	2.79	8	IE
Study Specialist Literature	19	27	20	25	8	273	2.76	9	IE
Database	17	25	29	23	5	271	2.74	10	IE
Delphi Technique	22	23	30	18	6	260	2.63	11	IE
Templates	26	26	27	18	2	241	2.43	12	IE
Research Assumptions	28	21	35	11	4	239	2.41	13	IE
Research Interface	30	21	33	10	5	236	2.38	14	IE
Risk Assessment									
Risk urgency assessment	40	33	12	9	4	221	2.23	1	IE
Risk breakdown structure	32	31	25	10	1	214	2.16	2	IE
Probability & impact assessment	42	20	21	14	2	205	2.07	3	IE
Modelling Technique	36	36	16	10	1	201	2.03	4	IE
Probability matrix	44	28	14	12	1	195	1.97	5	IE
Decision Tree analysis	36	40	14	8	1	194	1.96	6	IE
Monte Carlo Simulation	46	36	12	4	1	175	1.77	7	IE
Risk Response									
Transfer	6	7	25	39	22	361	3.64	1	ME
Contingency planning	4	12	28	39	16	348	3.51	2	ME
Regular inspection	2	16	32	29	20	346	3.49	3	ME
Crisis management	4	10	38	34	13	339	3.42	4	ME
Protection and safety systems	6	14	29	37	13	334	3.37	5	ME
Training and skills enhancement	8	17	29	23	22	331	3.34	6	ME
Quality assurance	11	14	30	23	21	326	3.29	7	ME
Relocation of activities & resources	3	17	38	32	9	324	3.27	8	ME
Contract terms and conditions	7	20	26	36	10	319	3.22	9	ME
Preventive maintenance	7	18	33	29	12	318	3.21	10	ME
Alternative approaches	7	16	40	28	8	311	3.14	11	ME
Retention	12	18	23	38	8	309	3.12	12	ME
Procedural changes	6	16	45	25	7	308	3.11	13	ME
More detailed planning	9	28	22	24	16	307	3.10	14	ME
Permits to work	6	23	38	26	6	300	3.03	15	ME
Operation reviews	8	32	22	28	9	295	2.98	16	IE
Risk Monitoring & Control									
Status meeting	5	9	31	28	26	358	3.62	1	ME
Risk register updates	4	13	29	26	27	356	3.60	2	ME
Monitoring overall project status	3	19	30	28	19	338	3.41	3	ME
Risk reassessment	10	5	48	25	11	319	3.22	4	ME

The result of risk response shows that risk transfer ranked 1st (MS=) 3.64, contingency planning ranked 2nd (MS=3.51) and regular inspection ranked 3rd (MS= 3.49), with 93.75% moderate effectiveness. The result suggests that most common contingency plan is to set aside extra money, a contingency fund, to draw on in the event of unforeseen cost overruns. Hence, contingency plans can be looked on as a kind of insurance. The moderate effectiveness may be attributable to the observation by Osipova (2008) that a lack of an iterative approach and absence of systematic risk management in the procurement practices, create a weakness in effectiveness.

The result in risk monitoring shows that status meeting ranked first (MS= 3.62), risk register updates ranked 2nd (MS= 3.60) and monitoring the overall project status ranked 3rd (MS= 3.41), with 100% moderate effectiveness.

4.5 Comparison of Effectiveness of Risk management among Procurement Methods

To further compare respondent's perception of risk management process applied in the different procurement methods, the four hypotheses earlier postulated were tested.

In order to test this hypothesis Kruskal-Wallis test was used at $p \leq 0.05$ to provide confidence of views and generalization of opinions of the three procurement methods, with regards to risk identification, assessment, response and monitoring. The decision rule is that if p-value > 0.050, the hypothesis is accepted, but if p-value ≤ 0.050 the hypothesis is rejected. The results are presented in Table 4.

Table 4: Kruskal Wallis test for comparing risk management in procurement methods

Items compared among respondents	No of variables	Traditional Mean Rank	Direct Labour Mean	Labour only Mean rank	H-value	p-value	sig. level	Decision
Risk Identification	14	26.39	22.11	16.00	5.077	0.079	0.050	Accept
Risk Assessment	7	15.29	12.93	4.79	11.051	0.004	0.050	Reject
Risk Response	16	27.03	27.03	19.44	3.142	0.208	0.50	Accept
Risk Monitoring	4	8.25	4.75	6.60	1.911	0.385	0.05	Accept

The result in Table 4 shows that the p-value for risk identification is 0.079> 0.05 hence the null hypothesis is accepted, implying that there is no significant variation in the perception of effectiveness of risk identification among the procurement methods. The result indicates that the stakeholder identifies risk the same way among the procurement methods.

In risk assessment the p-value is 0.004> 0.050 hence the null hypothesis is rejected, implying that there is a significant variation in the perception of effectiveness of risk assessment among the procurement methods. The result may be attributable to the fact that the stakeholders assesses risk differently in the procurement methods or does not carry out risk assessment at all, owing to their lack of knowledge in risk assessment practice or lack of funds allocated for the risk exercise.

In risk response the p-value is 0.208> 0.050 hence the null hypothesis is accepted, implying that there is no significant variation in the perception of effectiveness of risk

response among the procurement methods. The result indicates that the stakeholders respond to risk the same way, probably due to similarity in past experience, consulting experts, brainstorming and interview which mainly comprised risk identification.

In risk monitoring the p-value is 0.385> 0.05 hence the null hypothesis is accepted, implying that there is no significant variation in the perception of effectiveness of risk monitoring methods among the procurement methods. The result indicates that the respondents perceive that stakeholders of housing projects in the study area carry out the process of risk monitoring the same way.

5. CONCLUSION AND RECOMMENDATIONS

Risk management has become an important part of the management process for any project. In spite of the general awareness of the risk management process, implementing risk management systematically in the project is still limited in practice. From the results obtained, risk identification is of moderate effectiveness. This may be because, the analysis of the risk to ascertain its likely impact on the project is not performed by the respondents in housing projects. Response techniques of avoidance, transfer and mitigation were carried out but the risk operation review was hardly done. Monitoring was also done. The level of perception of effectiveness of risk management method among the procurement systems was established to be of moderate level in all except risk assessment which is ineffective. The study concludes that risk management has not been very effective in the procurement options probably due to a general lack of knowledge of the likely influence of procurement methods, a lack of an iterative approach and absence of systematic risk management in the procurement practices as noted by Osipova (2008). It shows that there is a no significant variation in the level of effectiveness of risk management methods in identification, response and monitoring among the delivery systems, except in risk assessment which shows significant variation. The study concluded that this might be due to the fact that most procurement methods do not provide opportunity for adequate risk assessment by the stakeholders, or the lack of time/funds in the project reserved for risk management and this may make risks handling difficult at the time of occurrence.

Based on the conclusion of this study, it is recommended that there is need for advanced formal and informal training in the characteristics and fundamentals of various procurement methods for adequate assessment of their inherent risks in the study area. Formal education could be graduate studies in construction project management or informal education and training could take the form of career development programs (like risk management awareness program) organized by academic institutions or professional organizations such as the Nigerian Society of Engineers (NSE), the Nigerian Institute of Building (NIOB) amongst others. There should be an iterative and systematic risk management approach that consider the specific risk assessment in the procurement practices. It is also recommended that the factors affecting the effectiveness of the risk management methods should be evaluated and ample assessment of risk should be encouraged irrespective of the procurement method used.

REFERENCES

Adenuga, O.A. (2013). Comparison of the performance of traditional and direct labour methods of project procurement: A case study of some selected projects of the Nigerian Army. *Ethiopian Journal of Environmental Studies and Management*, 6(1), 21-30.

Agerberg, J. and Agren J. (2012), Risk Management in the Tendering Process: A Survey of Risk Management Practices within Infrastructural Construction. An unpublished M. Sc. Thesis in the Department of Technology Management and Economics Chalmers University of Technology, Sweden.

Akinkumi, O. G., Aghimien, D. O. and Awodele, O.A. (2018). Appraising the use of Labour-Only Procurement System for Building Construction in Nigeria. *Organization, Technology and Management in Construction.* 10, 1719-1726.

Akobi, G., (2012). The Comparison of Performance of Traditional and Direct Labour Procurement Methods Adopted by the Nigerian army. An M.Sc. thesis in the Department of Building, Faculty of Environmental Design, A. B. U. Zaria.

Aladeniyi, B. (2013). Comparison of the Performance of Direct Labour and Labour Only Procurement Methods in Lagos State. An unpublished M.Sc. thesis in the Department of Building, University of Lagos.

Alabi, A.O. (2018). Assessment of Risk involved in Housing Projects Procured Using Public Private Partnership System in Nigeria, International Journal of Economic, Commerce and Management, 6(12), 443-455.

Babalola, O. D., Ibem, E. O., Olotuah, A. O. and Fulani, O. A. (2016), Residents' Perception of Quality of Public Housing in Lagos, Nigeria, International *Journal of Applied Environmental Sciences*, 11(2), 583-598.

Babatunde, S. O., Opawole, A. and Ujaddughe, I. C. (2010). An Appraisal of Project Procurement Methods in the Nigerian Construction Industry. *Civil Engineering Dimension*. 12(1), 1-7.

Banaitiene, N. and Banaitis, A. (2012). Risk Management in Construction projects (http://creativecommons.org/licenses/by3.0) http://dx.doi.org/10.5772/51460, accessed 23rd September, 2015.

Chartered Institute of Building (CIOB) (2010), A Report on Exploring Procurement in the Construction Industry. Englemere, Kings Ride, Ascot Berkshire SL5 7TB, United Kingdom.

Cooper, D., Grey B. Raymond., and Walker, P. (2005). *Project Risk Management Guidelines: Managing Risk in Large Projects and Complex Procurements*. Chiclester: John Wiley and Sons ltd.

Davis, P. Love, P. Barccarini, D. (2008), Construction Innovation Report on Building Procurement Methods. Curtin university of Technology.

Ejohwomu, O. A., Oshodi, O. S. and Onifade, M. K. (2016). Identifying the critical causes of conflict in construction projects in Nigeria, *Nigerian Journal of Technology (NIJOTECH),* 35 (2), 290 – 296.

Iboh, A. A., Adindu, C. C. and Oyoh, A. J. (2013). Public Private Partnership Construction Project Disputes in Nigeria. *Journal of Research in National Development*, 11(1), 6-11.

James, E. E., Akpan, P. A., Essien, A. U. and Ekpo, K. J. (2012). The Pattern of Housing-Health Status among Residential Zones in Uyo Metropolis, AkwaIbom State, Nigeria. *Journal of Environmental Issues and Agriculture in Developing Countries,* 4(3), 29-35.

Kadiri, D. S. Ogunkola, O. M. (2014), Assessment of Procurement Methods Based on Clients Selection Criteria in Ogun State, Nigeria, *Covenant Journal of Research in the Built Environment.* 2(1), 31-41.

Kajsa, S., (2006). Risk Management in Small construction projects; An Unpublished M.Sc. Thesis in the Department of Civil, Mining and Environmental Engineering, Luleå University of Technology, Sweden.

Klemetti, A. (2006). Risk Management in Construction Project Networks. Helsinki University of Technology. Laboratory of Industrial Management Report. Available on http://www.tuta.hut.fi, accessed 20th December 2015.

National Bureau of Statistics (NBS) (2015). Nigerian Construction Sector: Summary of Report 2010-2012.

Odimabo, O. and Oduoza C.F. (2013). Risk Assessment Framework for Building Construction Projects in Developing countries*, International Journal of Construction Engineering and Management*, 2(5), 143-154.

Ogunsami, E. (2013), Comparisons of Performance of Traditional and Labour Only Procurement in Construction Projects in Nigeria*, DBA Africa Management Review*, 3 (2), 1-15.

Ogunsanmi, O. (2012), Comparison of Procurement Characteristics of Traditional and Labour-Only Procurement in Housing Projects in Nigeria*, Civil and Environmental Research,*2(8), 1-10.

Ojo, O. S., Adeyemi, A. Y. and Fagbenle, O. I. (2006). The Performance of Traditional Contract Procurement on Housing Projects in Nigeria. *Civil Engineering Dimension*, 8(2), 81-86.

Osipova, E. (2008). Risk management in construction projects: a comparative study of the different procurement options in Sweden, Unpublished Licentiate Thesis, Department of Civil, Mining and Environmental Engineering, Luleå University of Technology.

Ozcan, G. (2008). A Generic Risk and Vulnerability Assessment Framework for International Construction Projects. An Unpublished M. Sc. Thesis in the Department of Civil Engineering Middle East Technical University.

Perera, B. A. K. S., Rameeddeen, R. Chileshe, N. and Hosseinin, M. R. (2014). Enhancing the Effectiveness of Risk Management Practices in Sri Lankan Construction Projects: A Delphi Approach. *International Journal of Construction Management*, 14(1), 1-19.

Project Management Institute (PMI) (2004), a Guide to the Project Management Body of Knowledge: PMBOX 3rd Edition, Pennsylvania: Project Management Institute.

Ropel, M. and Gajewska, E. (2011). Risk Management Practices in a Construction Project –A Case Study, An M.Sc. Thesis in the Department of Civil and Environmental Engineering, Division of Construction Management. Chalmers University of Technology, Sweden.

Sanda, Y. N., Anigbogu, N. A., Nuhu, Z. Y. and Olumide, O. S. (2020). A Life-Cycle Framework for Managing Risk in Public Private Partnership in Housing Project; Journal of Engineering, Project and Production Management. 10(1), 27-34.

Serpella, A. F., Ferrada, X. Howard, R., Rubio, L. (2014). Risk Management in Construction Projects: A Knowledge– Based Approach. *Journal of Social and Behavioural Sciences* (119), 653-663.

Udoh, N. (2014). The Determinants and Implications of Rural-Urban Migration in Nigeria. *African Journal of Social Sciences*, 4 (3), 133-143.

Waziri, B. S. and Bala, K. (2014). Actualizing Nigeria's vision 20:2020 Imperatives of the Construction sector, *Civil and Environmental Research*, 6 (6), 69-75.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

EVALUATING THE EFFECTS OF URBANIZATION ON VEGETATION IN MINNA METROPOLIS: GIS APPROACH

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ABSTRACT

Purpose: The growth of urban areas is one of the major factors that leads to cutback of vegetation. This paper is set to assess the effect of urbanization on vegetation cover in the Minna metropolis, Niger State, Nigeria.
Design/Methodology/Approach: The remote sensing Quick Bird satellite images of Minna for the year 2010, 2015 and 2020 were used to obtained land use information change. Remote Sensing Data Image (RSDI) was processed using GIS Arc Map 10.1 for digitization and calculation of built up areas and the land use change. Two neighborhoods were chosen for examination and analysis, Tayi village neighborhood and old Advanced Teachers' College (ATC) layout; presently called Zarumai New Extension Neighborhood, all in Minna, Nigeria**.**
Findings: It was found that study areas have grown double between 2010 and 2020, speedy urban development due to population increase led to massive de-vegetation, as at 2010 the built-up area in Tayi was 20%, but by 2020 built up area has increased to 46% while in old ATC in 2010 was 30.8% but as at 2020 the built-up area has grown to 82.8%.
Research limitation/implications: In evaluating the influence of urbanization on vegetation in the study areas, selected neighborhoods were examined by segmenting eleven years into two at the interval of six years and five years, that is, 2010 to 2015 and 2016 to 2020 respectively. Therefore, the gradual effect of urbanization on vegetation was examined from 2010 to 2020.
Originality and Value: The study revealed that, the method of land acquisition is through customary and informal purchase, less concentration was given to open space development and management and the relationship between built up areas and vegetation cover was opposite, as built-up areas enlarged, the vegetation covers decreased.

Keywords: GIS; remote sensing; satellite image; urbanisation; vegetation.

1. INTRODUCTION

Globally, people living in urban are more than people living in rural areas, according to 2014 World Record, about 54% of the population of the world are residing in urban

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areas. The world report stated that, (30%) of the world's population was urban, and 66% per cent of the population in the world is projected to be urban by 2050. According to World Urbanization Prospects (WUP, 2014) only three countries were identified- China, India, and Nigeria overall are predictable to explain for 37% of the expected growth of the world urban population, India it is projected to add 404 million urban dwellers between 2014and 2050, 292millinoin China while Nigeria is projected to add 212 million. The challenges of urban development have been doggedly faced by developing African countries and still fight with colossal financial resources, investing in urban infrastructure, urban governance transformation, management of the urban environment, social services provision and handling the adaptation of mitigating the urbanization threats.

According to World Bank (2005) the awful conditions of built environment can be attributed to rural urban migration, uncontrolled urbanization, urban infrastructure decay, continuous economic downturn and poor housing quality. In some under-developed nations, most especially in Nigeria, there is distorted urbanization process and this has led to a problem with respect to the provision of adequate houses, basic infrastructure and amenities (Osuide and Dimuna, 2005). This has therefore contributed to numerous urban environmental problems in Nigerian cities. Several studies have shown that the problem of vegetation destruction is prevalent, it is however more severe in developing countries with Nigeria inclusive (Eric*et al,* 2010; UN, 2005; 2006; 2014; World Bank, 2008; Lawanson 2015).

The challenge of vegetation degradation in under-developed nations is due to over population in an urban setting Lawason (2015). Mostly, urban poor is most crucial, however the colossal increase of the urban population is as a result of increase in population growth rate and uncontrolled incessant rural-urban migration which have contributed to the vegetation degraded condition. Nigeria, among other developing countries in the world has highest urban growth rate which is the reason for the prevalent vegetation degradation trends and this is making Nigeria to have been experiencing the challenges of fastest rates of urbanization in the world. (Benna, and Benna, 2017).

In most developing nations of the world, unrestrained urbanization and unplanned neighborhood have been acknowledged as major problem of sustainable vegetation and urban improvement. In the 1950s and rapid urbanization growth had been identified as an outbreak in terms of vegetation degradation (Eric*et al,* 2010). Okoye (2009) further observed that "speedy urbanization and reduced economic growth have compounded the problems of vegetation degradation in the environment of Nigeria (Akinbode & Ugbomeh, 2006), hence the need to study and investigate how the vegetation has been (especially in the selected neighborhoods of the study area) influenced by urbanization in Minna metropolis.

Owolabi (2017) pointed out that as "countries continue to urbanize, westernize and civilize, the vegetation especially those in the rainforest environment will be in turn altered and degraded over time leaving the environment bare, thereby prone to environmental hazards. The influence of human activities (such as bush-burning, construction of buildings, mining, lumbering and timbering) on the environment affects the vegetation of that area".

Rapid urbanization exerts strong impact on the vegetation. Urban problems are similar to the rural poor that lack access to clean water, sanitation and adequate housing. Urban situation is compounded by overcrowding, exposure to domestic waste and urban pollution. Because of the need to meet the increasing demand and aspiration of a rapidly growing population in terms of food production, improving human settlement and

associated element to enhance living conditions led to some notable negative impacts on the vegetation in particular and the environment in general.

For instance, world report of 1990 noted that the current de-vegetation trend due to urbanization put the lives of 50 million Nigerian's into jeopardy and this trend must be checked so as to ensure sustainable development. The rapid urbanization in under-developed countries in general and Nigeria in particular has been of immense interest in the past. It is of concern however in the past, urbanization has been seen as a process of urban growth only. This is however now being replaced by a concept, which sees it as a process of social change and development. One of the purely natural phenomena that actually reduce the amount of greenhouse gases in the atmosphere is vegetation. Through the process of photosynthesis, plants draw down more carbon dioxide than anything else.

Urbanization has significant impact on vegetation and the ecosystem. When people develop cities, forests are cut, shrubs are removed and much of the ground is paved. The only vegetation left standing afterward is typically the standard urban fare of grass, loosely scattered trees, and hedgerows. The soil, which tends to be some of the most productive in a given region, is often severely degraded. Consequently, once an area has been urbanized, it is very difficult to bring the land back to its natural state.

Over the next century, urbanization is predicted to rise at a very high rate. In fact, it was estimated that worldwide the migration towards the cities has been moving at three times the rate of population growth. Only a third of the planet's population lived in urban areas 10 years ago. Now it is up to 50 percent and researchers believe that in 10 more years it will be up to two third. When you consider that the human population will grow from six billion to 10 billion over the next 50years, an enormous amount of land is likely be urbanized in a relatively short time.

Consequently, Minna as an urban area is growing horizontally and the level of urbanization has much impact on most of the vegetal cover within Minna metropolis and environs. The uncontrolled growth of Minna metropolis in the last ten to eleven years culminated into massive removal of vegetation for developmental purposes. This has led to widespread environmental problems, such as increase in urban heat, pollution, soil erosion, flooding among others. Most of the unique vegetal cover in the (study) area has vanished and high-quality agricultural lands are acquired for development. The value of urban forest and woodlands (vegetation) lies in protecting watersheds. This augments urban water supplies, reduces urban heat and reduces flood hazards. Hence the need to study the extent of urbanization on vegetation. As such, the objective of the study is to assess the trends in urbanization on vegetation cover in the study area.

2. REVIEW OF RELATED LITERATURE

2.1 Urbanization

Urbanization or urban drift refers to the process by which rural areas take on urban characteristics. It is an index of transformation from traditional rural economy to modern industrial one and thus a progressive concentration of population in urban unit. (Davis, 1965)

Urbanization is also defined by the United Nations as movement of people from rural to urban areas with population growth equating to urban migration (United Nations, 2008).

The urbanization process is much more than simple population growth; it involves changes in the economic, social and political structures in a region. While the current pace of urbanization is not unique in human history, the sheer magnitude is unprecedented. Rapid urban growth is responsible for many environmental and social changes in the urban environment and its effects are strongly related to global change issues. The rapid growth of cities strains their capacities to provide essential services such as energy, education, health care, transportation, sanitation and physical security. Cities have become areas of massive sprawl, serious environmental problems and widespread poverty. The intense concentration of population, industry and energy use has led to severe local pollution and environmental degradation.

Urbanization can describe a specific condition at a set time, i.e. the proportion of total population or area in cities or towns, or the term can describe the increase of this proportion over time. The term urbanization can represent the level of urban relative to overall population, or it can represent the rate at which the urban proportion is increasing. Urbanization occurs naturally from individual and corporate efforts to reduce time and expense in commuting and transportation while improving opportunities for jobs, education, housing, and transportation (Slemp, 2012).

McDonald, Kareiva, & Forman (2008) emphasized that "Urbanization is the physical growth of urban areas as a result of rural-urban migration and even sub-urban concentration into cities, particularly, the very largest ones". Urbanization is not merely a modern phenomenon, but a rapid and historic scale, where predominantly village culture is being rapidly replaced by urban culture. Urbanization according to Varshney *et al.* (2013) can either be planned and/or referred as an organic urbanization.

Living in cities permits individuals and families to take advantage of the opportunities of nearness and accessibility, diversity and market place competition. People move into cities to seek economic opportunities. In rural areas, often on small family farms, it is difficult to improve one's standard of living beyond basic subsistence means of sustenance. Farm living is dependent on unpredictable environmental conditions, and in times of drought, flood or pestilence, survival becomes extremely problematic. In modern times, industrialization of agriculture has negatively affected the economy of small and middle-sized farms and strongly reduced the size of the rural labor market. The most adversely affected in this regard are the urban poor, who constitute the majority in the developing countries of Africa and Asia wherein, according to a UN Report, consists of cities which now account for over 90% of the world's urban population growth (UN –Habitat, 2007).

Existing studies have shown the rate at which urban growth are increasing in most African countries including Nigeria, and the major factors for these rapid increases is relative to large-scale migration into the urban centers for employment and wealth acquisition, natural increase of the population, and lopsided concentration of investments by both governments and private organizations (Jiboye & Omoniyi, 2010).

2.1.1 Trends in urbanization

Urbanization trend may best be appreciated by examining the degree of urbanization in terms of indices such as the "proportion urban," the rate of urbanization and rate of urban population growth over a specified period of time. Cities are currently absorbing two third of the total population increase in the developing world (McMichael 2000).

Conningham, (2001) opined that, close to two billion will populate the urban areas of developing countries by the years 2010, with some 600 million of this number being added during the current decade alone. Another two billion people are expected to be added to the urban population of the developing countries between 2000 and 2025: moreover, the

majority of these new urban residents will be living in large cities. Today half of the population is located in some 360 cities of over half a million inhabitants each. In 1950, the world total urban population was 734 million, of whom 448 million were in the developed countries and 286 million in the developing countries. The share between the two changed in1980 when the developing countries made up 985 million of the world's urban population of 1.8 billion, this proportion is expected to gallop to 2.3 billion and by the year 2025 the developing countries will have 4.4 billion of the world total urban population of 5.5 billion (Carle 1997).

Estimate and projections suggest that during the 75 years from 1950-2025 the proportion of the world's urban population will have doubled, while the absolute world population will have increased nearly seven folds. It is evident that the developing countries are urbanizing faster than the developed countries. This is as a result of the rapid population growth in developing countries, which triggers demographic forces responsible for rapid urbanization (Carle 1997).

During the period 1985-1990 the growth rate of the world's urban population was 3.1 percent per year (0.8% in the developed countries and 4.5% in the developing countries.

Currently, Africa exhibits the highest urban growth rates, projected to persist up to the year 2010 and beyond. The projected scenarios are higher, but declining growth rate in the developing regions, which will contrast sharply with the already declining growth rate (expected to plummet further) in the developed world. Yet it must be stressed that the projected declines in growth rate will be occurring in the context of much larger urban populations thereby compounding urban problems of the 23 countries with the highest rate of urbanization in the range of 3.0 and 7.9% per annum. Of these 18 are in Africa alone, the rest being in Asia. Conversely of the 25 countries with lowest urbanization rates (-0.9 - .03% per annum), 10 are in Europe, nine in Asia, two in north America, two in Asia and one each in Africa and Latin America. From this account, it is evident that urbanization of further will be an Africa phenomenon, given that African cities or agglomeration are yet to reach the sizes of their Asia or Latin American counterparts (Silitshena 1996).

2.1.2 Factors influencing urbanization

According to Conningham (2001) a variety of factors have combined to influence the rapid growth of urban population. However, the factors are numerous, complex and vary in their importance from one part of the world to another. Some of the main factors include agricultural improvements, industrialization, market potential, increased service activities, transport improvement, social and cultural attraction, increased education and natural population growth.

Agricultural Improvement: One of the fundamental factors that have influenced urbanization is agricultural improvement such as mechanization and the use of improved agricultural inputs. These increased food productions and released labor for work in industry thereby sustaining a larger percentage of non-agricultural population.

Industrialization: This implies the concentration of factories near the source of raw materials or power. Dependence of manufacturing on raw materials and power supplies (e.g. coal) leads to the clustering of factories in relatively few locations. The resulting agglomerations create external economies of scale and industries grow and multiple accordingly. Large-scale output requires large amount of labor and as output rises, the demand for labor rises also. Furthermore, with rising population, market-oriented industries are also located in such areas where labor for industries can also be found.

Tertiary Activities: Rising standard of living has led to increased demand for consumer goods and other personal services. These services are best co-ordinates in urban areas thereby leading to further population growth.

Market Potential: The development of light industry leads to an increase in the importance of market-oriented locations. Towns provided large, ready-made market for consumer goods and therefore attract new industries. These new industries bring with them new labour supplies which in turn increase the size of the potential market, the snow ball effect being set in motion and urban growth becoming self-sustaining.

Increased Service Activities: Tertiary and veterinary industries grow due to increased trade, higher standard of living and the need for greater economic and social organization. Many services, by their very nature, tend to be centralized in towns: retailing, entertainment, catering and administration.

Transport Improvement: Improved transport has led to the expansion of towns along major routes as well as encouraging mobility of population. People are able to move from countryside to towns more quickly and easily than before, so that net immigration into urban areas goes up. For example, rural urban migration is one of the major factors influencing urbanization in Africa.

Social and Cultural Attraction: Towns especially if they are large, old or cultural may act as magnets to their surrounding population because of their social facilities; cinemas theatres art galleries and so on. Many people simply enjoy being near the center of urban life.

Increased Education: As people become more knowledgeable, their ambition grows. Towns are seen as centers where opportunities abound and success is more attainable. The mass media have helped to distribute knowledge over a wide range of area and may have made some people more aware of the inadequacies or limitations of their lives.

2.2 Vegetation

Thus, vegetation can be defined as the plant life or the forms, structure, spatial extent or any other species botanical or geographic characteristics (Ossola, Hahs, Nash & Livesley, 2016). It is broader than the term flora which refers exclusively to species composition, but vegetation can and often does refer to a wider range of spatial scales than that term does, including scales at large as the global primeval redwood forest, coastal mangrove stands, sphagnum bogs desert soil crust roadside weed patches, wheat fields, cultivated gardens and lawns, all are encompassed by the term vegetation which literally means the earth's flora (Drillet, Fung, Leong, Sachidhanandam, Edwards, & Richards, 2020).

According to Monk-house (2004), "vegetation is defined as the living layer of flora which covers much of the land surface forming an important part of the physical environment. It is a major component of the Biosphere; the word vegetation is a broad term that is used to specify the floristic composition of the ecosystem. Vegetation is usually described by reference to its flora or floristic (species) composition and its structural characteristics. The most abundant species in any plant community which also exercises the greatest influence on the inhabitant is referred to as the dominant, while other species are secondary".

Various vegetation types provide contrasting suites of ecosystem services disservices (Delshammar, Östberg & Öxell 2015). For instance, "vegetation reduces air temperatures by up to 3.9 ◦C more than turf (Fung & Jim, 2019), furthermore, Ossola, Hahs, Nash & Livesley (2016) were of the view that vegetation types with a higher understory volume have higher soil decomposition rates. According to Lyytimäki, Petersen, Normander and

Bezák (2008) the balance of services and disservices provided by urban vegetation has a strong influence on how urban greenery is experienced, used, and valued by people".

2.3 Effect of Urbanization on Vegetation

Urbanization is increasingly homogenizing the vegetation of less developed countries. Even though urban sprawl is a worldwide problem, most studies on the effect of urbanization, and the conceptual model have focused on the developed countries. Most of the developing countries are experiencing rapid and uncontrolled growth. Pavements replace native ecosystems and buildings and what is left of the natural soil is covered with green areas dominated by non-native ornamental species. Wetland and other peri-urban ecosystems are rapidly being destroyed, fragmented or invaded by non-native species. It was found that from a study area of 32,000 hectares, there was a net loss to urbanization of 1734 hectare of wet lands (23% of original) and 1417 hectare (9%) of agricultural, forest and shrub land cover types between 1975 and 2000. (David, 2001).

The environmental associated with the clearance of native vegetation for the purpose of urbanization are significance and include:

- Loss of habitat for native plants and animals;
- Potential loss of plant species and reduction in population size of plant and animal species with an increased potential for local extinctions associated with single event such as urbanization;
- Increase salinity problems associated with the removal of deep-rooted perennial plants;
- Increase vulnerability of weed invasion;
- De-stabilization of soil, leading to wind and water erosion;
- Impact on the health of catchments;
- Changes in water flow patterns and hydrology;
- Increase greenhouse implications (removal or vegetation inhibits the absorption of carbon dioxide from the atmosphere. (Natural Management Ministerial Council 2001).

2.4 Importance of Urban Vegetation

One of the primary challenges to understanding the dynamics of the earth system is an accurate assessment of relationship between the human population and other component of the system. Recent estimate indicates that over 45% of the world's human population now lives in urban area with over 60% projected by 2030 (Beery 1983). The global rate of urbanization is expected to continue to accelerate in the near future with emergence of large urban agglomeration in developing counties (Berry, 1983).

The spatial temporal distribution of vegetation is a fundamental component of the urban/suburban environment. Vegetation influences urban environmental conditions and energy fluxes by selective reflection and absorption and by modulation of evapotranspiration (David, 993). The presence and abundance of vegetation in urban areas has long been recognized as a strong influence on energy demand and development of urban heat island (Christopher, 1997). Urban Vegetation abundance may also influence air quality and human health because trees provide abundant surface area for sequestration of particular matter and ozone.

Research has shown that properly placed trees and landscape planting can save 20 to 25 percent energy use in the home. In neighborhoods with large trees, there will be significant effect on temperature and energy use in buildings (Daine, 1996). Without the cooling and moderating effect of vegetation and green space in our urban environments, urban areas grow hotter and dryer – a heat island approximately five to ten percent of the current electric demand in cities is spent to cool buildings, just to compensate for the heat island effect. In Los Angeles, this translates to $150,000 per hour and in Washington DC, close to $40, 000 per hour during peak times. Nationally the hourly cost may be as high as $1 million (Jeremy 2006).

2.5 Conceptual Framework

The framework for this study is urbanization as the independent variable and vegetation is the dependent variable.

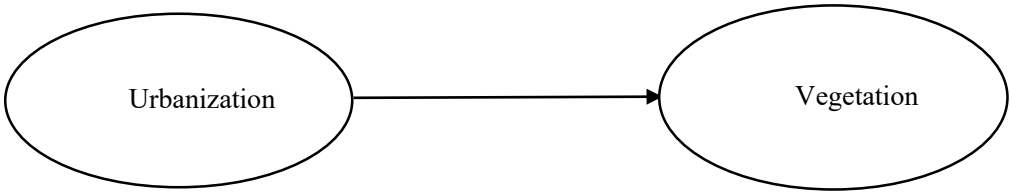

Figure 1: Framework

3. RESEARCH METHODOLOGY

3.1 Profile of the Study Area

Minna is the capital of Niger State in Nigeria. The study area lies between latitude $9^0$26'41N to $9^0$28'16N and longitude 6^0 40' 12E to 6^0 43' 37E on a geological base of undifferentiated basement complex of mainly gneiss and magnetite. At the North- east corridor of the town lays a continuous steep outcrop of granite, which form a limitation towards physical development in that axis. In the present political zoning system, it is within the North Central Zone, and occupies an area of about 884 hectares. It is about 145 kilometers by road from Abuja, the Federal Capital of Nigeria. The Minna metropolis has grown to engulf suburbs settlements such as Bosso, Maitunbi, Dutsen Kura, Kpakungu, Shango and Chanchaga. The city is presently widely disposed along the main spine road from Chanchaga in the south to Mainkunkele in the north, a distance of about 20 kilometers. Immediately to the north of rail tracks are the high density quarters, Sabon-Gari, and the Main market neighborhoods. Figure 2 shows a map of the study area.

3.1.1 Climatic Profile

The climate of Nigeria is characterized by distinct wet and dry season. The wet (rainy) season starts in April and ends in October, with a maximum rainfall occurring in August. Presently, Tayi and old ATC enjoys a climate typical of the middle belt zone, Guinea savannah with distinct wet and dry seasons. The rainy season starts around April and last till October; it has a mean annual rainfall of about 1334mm (52inches) with September

recording the highest rains of about 3 00mm. The mean monthly temperature is highest in March at 35°C and lowest in August at 22.3°C. The mean monthly relative humidity is highest in August at 60% and lowest in January at 19% respectively

3.1.2 Soil

The soil type is primarily the result of the interaction between climate, flora and fauna, parent materials and geomorphic factors over varying period of time. Soils are developed from Precambrian basement complex rock comprising granite, schist, genesis, and amphiboles. The soil belongs to the Minna association, which occurs on an undulating welling dissected plain, developed on deferential basement complex consisting mainly of granites rock, gneiss and schist. The surface soils are usually loamy sand to sandy loam. Most of these soils are gravely except the soils formed on colloidal materials. Drainage may be poor in areas with high clay or where the soil in shallow. The soils are moderately deep and well drained.

3.1.3 Vegetation

The vegetation of Minna consists of open savannah. The Fadamas of the larger rivers support savannah with occasional streams covered with dense riparian woodlands or forested area. The grasses are between 0.8 to 3.5m height. The trees are scattered, short brand with some up to 16.5meters height. The trees include shear butter (Bytyra Spemum Parki), locust bean (Tamarindus Indica), Baubles silk cotton and bleb palms that are common along valleys of rivers which are identified by dense growth of woodland. The composition of the vegetation and its character are often caused by variations in soil types, topography, groundwater situation and human interference.

3.1.4 Topography

The topography of Minna consists of hills and mountains especially towards eastern and western part of the area. Because of these gigantic rocks, development has been restricted towards the eastern and western parts. All developments follow the line of the rock, which was halted by flat rock out crop at the extreme north. The basic geology of the study area is a mixture of rock granites. In most of the areas, the surface is decomposed of laterite, erosion and small stream that cut deep gullies leaving the residual crops generally eaten away by natural forces, such as rain and wind

3.2 Research Methods

Field survey was conducted in this study, observation and measurement was carried out as noticed, data collected through this method include; identifying, Measurement, Mapping and calculation of built-up areas and open spaces (vegetation) on new developed areas, two neighborhoods faced with rapid development as a result of urbanization in Minna, Nigerian were considered for this study. Following Jenerette and Potere (2010) and Liu, Yang, Tian, Zhang, Bo and Gu (2014) remote sensing Quick Bird satellite images of Minna for the year 2010, 2015 and 2020 were used to obtained land use information change. Remote Sensing data image was processed using GIS Arc Map 10.1 for digitization and calculation of built up areas and the land use change. Digital processing of data was being done using MS Excel computer software for cross tabulation, simple correlation and plotting of chart to show the trends in the in urbanization and its negative impact on the environment.

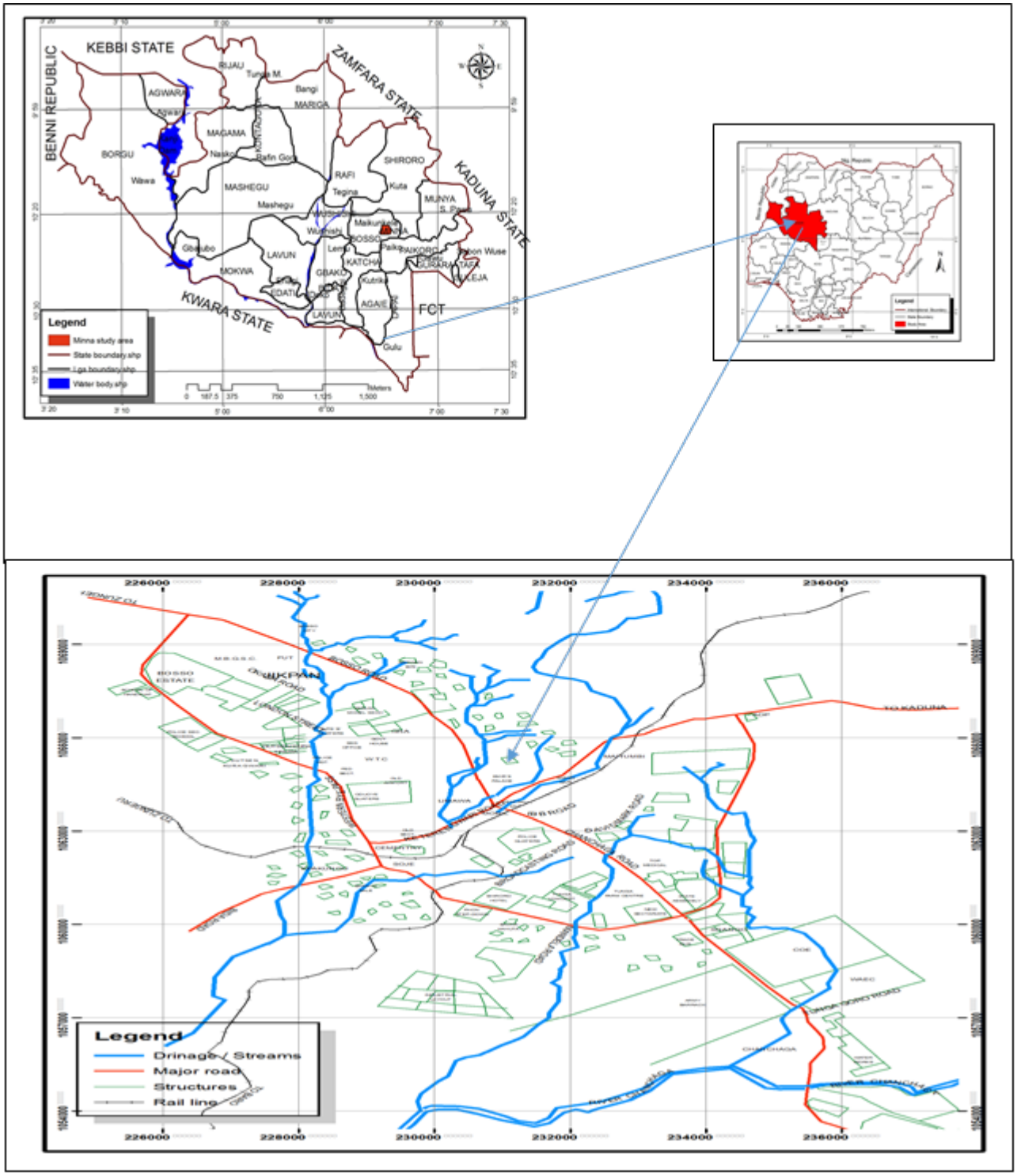

Figure 2: Minna Township Map
Source: DataNET Cartographic Consult Minna, 2019

4. Data Analysis, Results and Discussion of Findings

The data is obtained using the Quick Bird satellite image to identify the land use change as presented below:

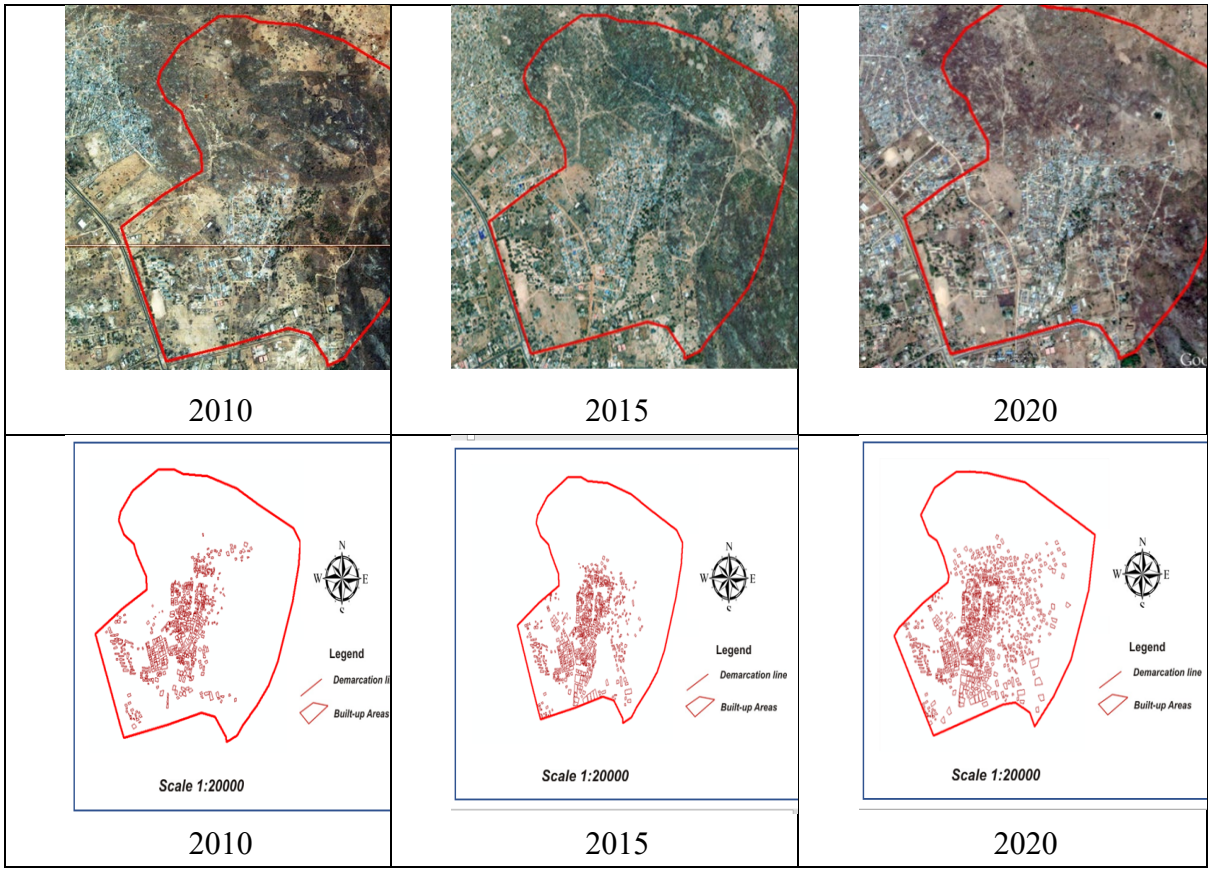

Figure 3: Satellite Image and Digitization of Built-up Areas in Tayi

Figure3 above shows the satellite imagery of Tayi neighborhood and digitization of built-up areas. It was discovered that, as at 2010 the development was not enormous but rapid development of built up areas started in 2015, and it was indicated selected neighborhoods experienced sporadic and high urbanization in 2020 and this led to massive destruction of the vegetation in the study area.

Figure 4 below is the satellite imagery and digitization of the effect of extent of urbanization on vegetation in the study area over the years under study. As at 2010 there were few developments, by 2015 the development was on the increase as a result of population and socio-economic activities. In 2020 virtually, the area was almost developed without considering vegetation.

Table 1: Trends (in percentage) of built-up Areas (urbanization) between 2010,2015 and 2020

YEAR	TAYI BUILT-UP AREA/HECTARE	PERCENTAGE (%)	OLD ATC BUILT - UP AREA /HECTARE	PERCENTAGE (%)
2010	50,749	20	14,695	30.8
2015	88,723	35	26,400	55.5
2020	116,395	46	39,400	82.7

Table 1 above shows the trend of built-up areas per hectare and percentage as at 2010, 2015 and 2020.

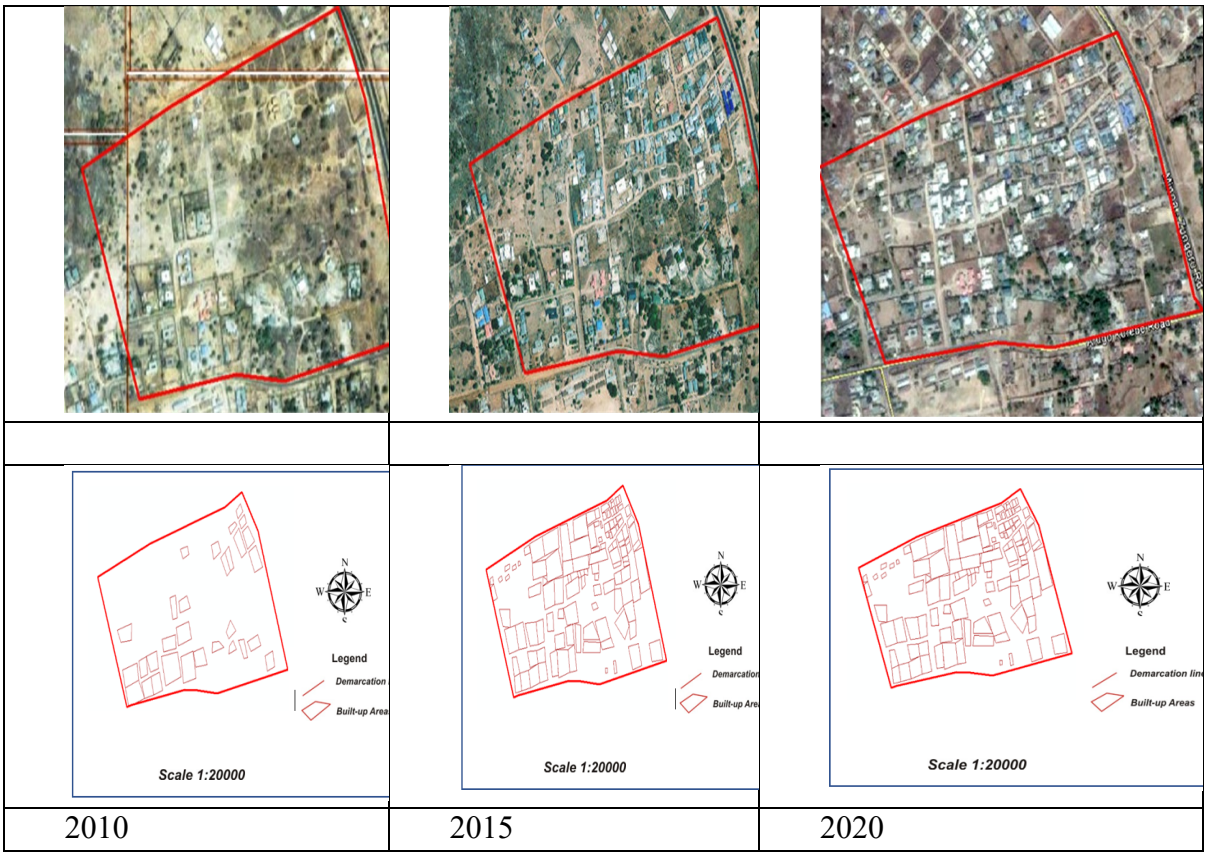

Figure 4: Satellite Imagery and Digitization of Built-up Areas at old ATC

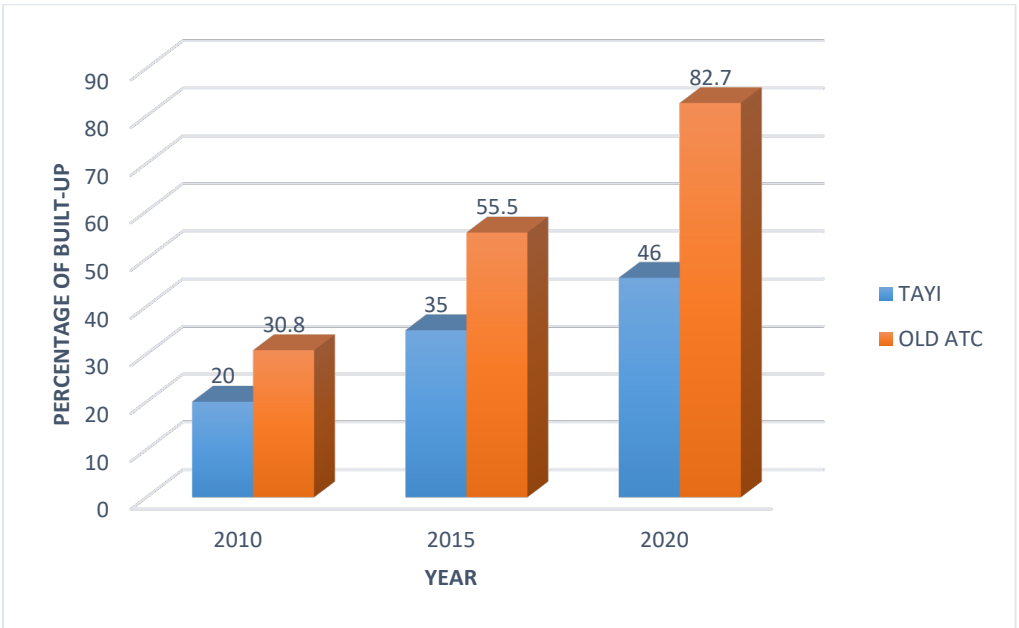

Figure 5: Chart showing the trend of built up areas.

Figure 5 above is a chart indicating the trend of urbanization in the selected areas of Minna metropolis. The study discovered it that, as the years go by, more areas are being developed and the natural vegetation is destroyed without consideration for re-vegetation.

4.1 Summary of Findings

The following findings are obvious from the study carried out: The study area has grown twice within eleven years under study, that is, between 2010 – 2020 and this indicates rapid urban development due to population increase and has led to massive de-vegetation in the study area.

It was also discovered that, mode and method of land acquisition in the selected neighborhoods of the study area are through customary and informal purchase. Also, adequate attention has not been given to open space development in the study area.

There is inadequate intervention by the communities and the government in arresting the de-vegetation problem, no adequate measure on replanting of trees, re-vegetating and creation of enabling environment for green area development. The effects of both the communities and government are not being felt on the above listed areas to the environment from de-vegetation.

The study found out that, urban expansion is responsible for vegetation change in the study area and there is inverse relationship between built up area and vegetation cover. As built-up area increases, the vegetation covers declines.

4.2 Discussion of Results and Findings

The growth of Minna has been rapid over the last two decades. This is reflected not only in population but also in built up area development, which affect vegetation changes over the years. These changes are better appreciated with in residential neighborhoods Hence two neighborhoods have been chosen for further examination and analysis. These are Tayi village and old ATC layout all in Minna, Niger State, Nigeria. Changes are observed between 2010- 2020. These neighborhoods were mapped out using Quick Bird satellite images, digitized and calculated the built up.

It was found that vegetation covers at Abattoir Tayi village by 2010, the neighborhood was small with only small built up areas, few roads and large open space (vegetation cover). The total land area of the neighborhood was 252,000 hectares then the built-up areas was only 50,749 hectares or 20%. But as shown in figure1 vegetation changes in abattoir Tayi village as at 2015, the built-up area was 88,723 hectares representing 35%. The area has been redefined and the growth of the area was high, residential and commercial layout was prepared, road network, the built-up area as of2020 became 116,395 hectares (46%) and the open space or vegetation in the neighborhood was destroyed as a result of urbanization this is consistent with the study of (Qiu, Song, & Li, (2017) and Chao & Zhang, (2014).

The study also revealed that old ATC layout as at 2010, the neighborhood was vegetated with few roads and scattered built up area. The total area demarcation was 47.600 hectares. The built-up area then was 14.695 hectares or 30.8%. But by 2015 the built-up area has been increased leading to a reduction in vegetal cover. As can be seen in figure2. By 2020 the built-up area was 39,400 hectares or 82.7.5%. More land has been developed without considered the conservation of urban open space, more areas were developed and more roads were constructed within the neighborhood the built-up area was 39,400 hectares or 82.7% living vegetation with only 8,200hectares or 17.3%. The study reveals that the extent of urbanization on vegetation is high this is in line with the study of Li,Chen,Yan and Yu (2014); Li, at el (2017) and Liu et al. 2015.

4.3 Research Implications

This research has made both theoretical and practical contributions. The theoretical implication of this study is that, the framework scrutinizes relative influences of urbanization on vegetation and it provides a direction for future studies and contribution to knowledge because it demonstrates an adequate understanding of the relevant literature in the field of urban development.

The practical implication of the study is that, it will help stakeholders in urban development and management (urban developers and urban managers) in appropriate policy and decisions making regarding the urbanization. This study will in the same way help the real estate investors and professionals in built environment to understand the implications of vegetation availability and its functionality on property investment returns.

5. CONCLUSION AND RECOMMENDATIONS

Series of research have been undertaken by contemporary urban geographers and environmentalists on the impact of urbanization on vegetation, and that the reduction of vegetal cover and high fertile agricultural land as a result of urbanization process, other factors such as land use, lack of political will of the government and the public at large only aggravate the problems. The negative impact of urbanization on vegetation are more than the positive effect, example of such effect are the environmental problems caused as a result of interference with nature by man without regard for sustainable development. Example of such environmental problems are: flood, urban heat island, pollution, soil erosion, drought, and desertification. These disasters have led to destruction of lives and properties.

The problems arise from the intensity of the variables as a result of urban de-vegetation, which varies with time, whether this is true of other environmental problems require further research. However other environmental problems that merit further research in the urban center include flood, soil erosion, waste disposal system, urban traffic problem which are beyond the scope of this study. It is convinced that, if all the recommendations are adhered to, the scores between urbanization and vegetation will effectively be settled.

Following the findings and conclusions from this research work, it is therefore recommended as follows: method of land acquisition should be properly checked and make it conform to the provision of the Land Use Act 1978. Recreational land use or open space development should be encouraged by both government and non-governmental organizations. Also, it is recommended that, adequate intervention measures should be put in place by the communities and government to arrest the problems, by replanting of trees and creation of green areas and development should be done considering the preservation and conservation of vegetation. Good management of parks and garden should be put in place and more green areas should be created and maintained properly especially by professional Estate Surveyor and Valuer or any qualified Facilities Manager. It is also recommended that, environmental education, awareness of good vegetative cover and enforcement of environmental legislation as a measure by both community, government and other relevant agencies in arresting the situation should be put in place.

REFERENCES

Aina, Y. (2004). Lagos Spends #10billion on Housing. The Punch Newspaper, Thursday September 9, 2004. pp 9.

Abotutu, A. A. (2014). Urbanization and poverty in the Third World: Measurement, patterns and policies in Warri Metropolis, Nigeria. *AFRREV STECH: An International Journal of Science and Technology*, *3*(1), 220-246.

Benna, U., &Benna, I. (Eds.). (2017). *Urbanization and Its Impact on Socio-Economic Growth in Developing Regions*. IGI Global.

Berry J.L (1983) *Land use, urban form of environmental quality.* Oxford University Press London

Connignham -Saigo (2001) *Environmental science*. A global concerned sixth edition Mc Graw-Hill company U.S.A

Chao, Z., & Zhang, P. (2014). Assessing the impact of urbanization on vegetation change and arable land resources change in Shandong province. In *Agro-Geoinfomatics (Agro-Geoinfomatics 2014), Third International Conference on* (pp. 1-5). IEEE.

Christopher Small& Roberta Miller (1997) *Monitoring the urban environment from the Space.* Colombia University Press N.Y U.S.A.

David Herring (2001) *Earth Observatory Study*. Urbanization Aftermath. Cambridge university press Cambridge UK.

Delshammar T., Östberg, J., Öxell, C. (2015). Urban trees and ecosystem disservices – A pilot study using complaints records from three Swedish cities. Arboric. Urban For. 41, 187–193.

Diane Relf (1996) *Plant actually clean air* Virginal State University Press.

Drillet, Z., Fung, T. K., Leong, R. A. T., Sachidhanandam, U., Edwards, P., & Richards, D. (2020). Urban vegetation types are not perceived equally in providing ecosystem services and disservices. *Sustainability*, *12*(5), 2076.

Eric, Misilu Mia Nsokimieno, Chen Shouyu, and Zhang li Qin. (2010) "Sustainable urbanization's challenge in Democratic Republic of Congo." *Journal of Sustainable Development* 3, no. 2: 242.

Fung, C.K.W., Jim, C.Y. (2019). Microclimatic resilience of sub-tropical woodland sand urban-forest benefits. Urban ForUrban Green. 42, 100–112.

Grant, M., Boyd, S., & Ye, Y. (2008). CVX: Matlab software for disciplined convex programming.

Habitat, U. N. (2006). State of the World's Cities. The Millennium Development Goals and Urban Sustainability.

Hopkins, A. L., Groom, C. R., & Alex, A. (2004). Ligand efficiency: a useful metric for lead selection. *Drug discovery today*, *9*(10), 430-431.

Jiboye, A. D., & Omoniyi, S. S. (2010). Environmental Sustainability and urban growth in Nigeria. In *Proceedings of International Conference on, Engineering Research and Development* (Vol. 1, No. 2).

Jiboye, A. D., & Makinde, O. O. (2015). Evaluating the determinants of residents' perception of neighborhood safety in gated communities in Ibadan, Nigeria.

Jenerette, G.D.; Potere, D. (2010). Global analysis and simulation of land-use change associated with urbanization. Landsc. Ecol. 2010, 25, 657–670.

Lawanson, S. (2015). The illegal rosewood boom in West Africa; How Chinese demand is driving conflict, corruption and human rights abuses. In *Presentation to Chatham House Illegal Logging Stakeholder Update Meeting, 25th June*.

Li, G. Y., Chen, S. S., Yan, Y., & Yu, C. (2014). Effects of urbanization on vegetation degradation in the Yangtze River Delta of China: Assessment based on SPOT-VGT NDVI. *Journal of Urban Planning and Development*, *141*(4), 05014026.

Li, X., Zhou, Y., Asrar, G. R., Mao, J., Li, X., & Li, W. (2017). Response of vegetation phenology to urbanization in the conterminous United States. *Global change biology*, *23*(7), 2818-2830.

Liu, Q.; Yang, Y.; Tian, H.; Zhang, Bo.; Gu, L. (2014). Assessment of human impacts on vegetation in built-up areas in China based on AVHRR, MODIS and DMSP_OLS nighttime light data, 1992–2010. Chin. Geogr. Sci. 2014, 24, 231–244.

Lyytimäki, J.; Petersen, L.K.; Normander, B.; Bezák, P. (2008). Nature as a nuisance? Ecosystem services and disservices to urban lifestyle. Environ. Sci. 5, 161–172.

McDonald, R. I., Kareiva, P., & Forman, R. T. (2008). The implications of current and future urbanization for global protected areas and biodiversity conservation. *Biological conservation*, *141*(6), 1695-1703.

Mexia, T., Vieira, J., Príncipe, A.; Anjos, A., Silva, P., Lopes, N., Freitas, C, Santos-Reis, M., Correia, O.and Branquinho, C. (2018). Ecosystem services: Urban parks under a magnifying glass. Environ. Res. 160, 469–478.

Natural Resources Management Ministerial Council (NRMMC 2001) "National framework monitoring of Australians native vegetation". Department of the environment and heritage Canberra.

Okoye, A. (2009). The rising corporate social responsibility as an essentially contested concept: is a definition necessary? *Journal of Business Ethics*, *89*(4), 613-627.

Qiu, T., Song, C., & Li, J. (2017). Impacts of Urbanization on Vegetation Phenology over the Past Three Decades in Shanghai, China. *Remote Sensing*, *9*(9), 970.

Ossola, A.; Hahs, A.K.; Nash, M.A.; Livesley, S.J. Habitat complexity enhances commination and decomposition processes in urban ecosystems. Ecosystems 2016, 19, 927–941.

Owolabi, A. (2017). Increasing population, urbanization and climatic factors in Lagos State, Nigeria: The nexus and implications on water demand and supply. *Journal of Global Initiatives: Policy, Pedagogy, Perspective*, *11*(2), 6.

Silitshesna R.M (1996) *Sustaining the future economic, social and environmental changes in sub-Sahara Africa.* United Nations University press New York.

Slemp, C.; Davenport, M.A.; Seekamp, E.; Brehm, J.M.; Schoonover, J.E.; Williard K.W. (2012). "Growing too fast," Local stakeholders speak out about growth and its consequences for community well-being in the urban–rural interface. Landsc. Urban Plan. 2012, 106, 139–148

United Nations, (2007). Achieving the Millennium Development Goals in Nigeria. How Far Now? UN-Habitat" United Nations Week. Abuja, Nigeria.

United Nations. Department of Economic. (2008) *The millennium development goals report 2008*. United Nations Publications.

UN-Habitat, (2007). Milestones in the evolution of human settlements policies.1976-2006. State of the world cities. Report 2006/2007. The MDGs and urban sustainability. 30years of shaping the Habitat Agenda. U.K. Earthscan.

Varshney, R. K., Song, C., Saxena, R. K., Azam, S., Yu, S., Sharpe, A. G.& Millan, T. (2013). Draft genome sequence of chickpea (Cicer arietinum) provides a resource for trait improvement. *Nature biotechnology*, *31*(3), 240-246.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

FACTORS INFLUENCING THE EFFECTIVENESS OF RISK MANAGEMENT IN HOUSING PROJECTS PROCURED WITH SELECTED METHODS IN AKWA IBOM STATE

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ABSTRACT

Purpose: The awareness and insight of the factors influencing risk management is essential in the effective management of projects delivered with any procurement method. The study aimed at providing insight into how several factors influence the effectiveness of risk management practices of housing projects procured by traditional, direct labour and, labour only methods with a view to enhancing construction projects delivery in Akwa Ibom State.
Design/methodology/approach: A cross-sectional survey approach was used for the study. Ninety-nine (99) copies of questionnaire were retrieved from purposively selected representatives of construction firms operating in the study area. Twenty-five factors were identified from literature and presented for respondents' assessment. Data collected were analysed using relative influence index, while Kruskal Wallis was used to test the hypothesis.
Findings: It has been established that the five most important factors influencing the effectiveness of risks management in traditional, direct labour and labour-only procurement methods are; timing, environmental factors, funds allocation for risk exercise, complexity and top management support. The result also shows that 4.0% of the whole factors has very high influence, 60% have high influence, while 36% of the evaluated factors have moderate influence on the effectiveness of the procurement methods, with all the methods exhibiting similar influence.
Research limitations/implications: The limitations include the use of only the perception of purposively selected representatives of construction firm in Akwa Ibom state and only selected procurement methods. The contribution to knowledge is that this study has established the current level of effectiveness of risk management in some procurement methods in the study area.
Practical implications: It is recommended that that advanced formal and informal training in risk management and prioritization of the control of the factors influencing their effectiveness should be regularly conducted among the stakeholders involved in the delivery of housing projects in the study area
Originality/value: The study revealed the level of influence which the identified risk factors have on the management of risks in of housing projects procured with different methods, as well as the variations among the factors in the procurement methods.

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Keywords: Contractors; housing project; influencing factors; procurement methods; risk management.

1. INTRODUCTION

The Nigerian construction Industry is one active sector of the Nigerian economy which takes the largest part of government spending on capital projects and it's the major source of economic growth and development of the country (Waziri and Bala, 2014). The industry has grown over the years as a result of demands for real estate and housing, the provision of infrastructure to support an increasing population size and the need to open up communities to foster inter-state and inter-regional trade and movement. This opened up the market for construction and services within the industry (NBS, 2015). The provision of these infrastructure is mostly undertaken and financed by the government through different procurement methods of construction in the country (Iboh, Adindu and Oyoh, 2013). According to Babatunde, Opawole and Ujaddughe (2010), procurement method is the management of the total process involved in construction project delivery. The variants of procurements methods available today metamorphosed from the need to improve construction project delivery, that is, project completion within budget and time, and the emphasis of procurement methods is optimizing all parameters involved in project delivery namely, time, cost and quality (Babatunde, Opawole and Ujaddughe, 2010; Alabi, 2018).

According to Chartered Institute of Building (CIOB) (2010), the difficulty and what sets construction industry procurement far apart from anything else, is the complexity of projects. Influences such as ground conditions, topography, logistics, weather, available technologies, finance, labour availability and services all affect the ability of a project to be completed on time, on budget and to a high quality.

There are a number of risks which can be identified in the construction industry and which can be faced in each construction project regardless of its size and scope. Changes in design and scope along with time frames for project completion are the most common risks for the construction sector (Ropel and Gajewska, 2011, Akinkumi, Aghimien and Awodele, 2018).

Risk management is a positive and proactive process intended to reduce the likelihood of unsatisfactory consequences to the project in its different stages, such as design, construction and operation. (Serpella, Ferrada, Rubio and Arauzoa, 2014.) Risk management is a planned form of identifying and evaluating risk and selecting, establishing and applying options for the handling of the risk (Aminu, 2013; Sanda, Anigbogu, Nuhu and Olumide, 2020). Ngundo (2014) opined that the effectiveness of the risk management process can be influenced by several internal and external factors. An understanding of the nature of influence of these factors has overall effect on the performance of a project delivered through any procurement method (Ujene and Adewuyi, 2016). This is consequent upon the fact that the further in the process, changes in scope or design are implemented, the more additional resources, time and cost, those changes require. Project completion ahead of time may be as troublesome as delays in a schedule. Too quick completion may be a result of insufficient planning or design problems which in fact shorten the completion time but on the other hand leads to a low quality of final product and increased overall cost (Ropel and Gajewska, 2011).

The problem of this study therefore concerns the inability of stakeholders to effectively determine and control the factors associated to the management of various

risks associated with different project delivery methods in the study area. Hence this study seeks to evaluate the factors affecting the effectiveness of risk management methods in traditional, direct-labour and labour only procurement in housing projects in Akwa Ibom State. The evaluation of the factors influencing the effectiveness of the risk management practice in the procurement methods will assist the stakeholders (clients, consultants and contractors) of housing projects in the study area to appreciate the impediments to effective risk management methods, and hence prioritize the provision of solutions to check the problems in the various procurement methods.

1.1 Aim and Objectives of the Study

The aim of this study is to provide reasonable insight and awareness of the factors affecting the effectiveness of risk management practice of selected procurement methods of housing projects, with a view to enhancing the delivery of building projects in Akwa Ibom State.

The three objectives of this study are to:

1. Evaluate the factors influencing the effectiveness of the risk management practice in traditional procurement method.
2. Assess the factors influencing the effectiveness of the risk management practice in direct labour procurement method.
3. Evaluate the factors influencing the effectiveness of the risk management practice in labour only procurement method.

One hypothesis was postulated based on the three objectives, which states that there is no significant variation in the influence of factors affecting risk management among the procurement systems.

2. REVIEW OF RELATED LITERATURE

Literature were reviewed in related areas covering, risk management processes, types of procurement methods and factors influencing the effectiveness of risk management.

2.1 The Risk Management Process

Banaitiene and Banaitis (2011) has it that risk management in the construction project management context is a comprehensive and systematic way of identifying, analysing and responding to risks to achieve the project objectives. Ozcan (2008) Considers Project Risk Management as “increasing the probability and impact of positive events, and decreasing the probability and impact of events adverse to the project”.

However, Pereraa, Rameezdeen, Chilesheb and Hosseini (2014) stated that risk management domain should not be confined to mitigating and controlling risks but should target avoiding the identified risk. According to Ropel and Gajewska (2011), risk management cannot be perceived as a tool to predict the future, since that is rather impossible. Instead, it is a tool to facilitate the project in order to make better decisions based on the information from the investment. In this way, decisions based on insufficient information can be avoided, and this will lead to better overall performance. For the purpose of this study, risk management is considered as the whole activities geared toward spotting risky situations, along with developing the strategies to reduce the probability of occurrence

and impacts of risks (Pereraa, Rameezdeen, Chilesheb and Hosseini, 2014). The major processes of Risk Management include risk identification, risk quantification, and risk response, development and control (Ozcan, 2008).

2.2 Methods of Procurement in Construction

Once a project has been found to be feasible and viable, the client's next step is to select the appropriate procurement method he intends to use for the project. This selection of a procurement method by the client is based on experience and or the advice of a construction professional either in-house or from a private practice (Akobi, 2012). A procurement method (or sometimes known as procurement system) "is an organizational system that assigns specific responsibilities and authorities to people and organizations, and defines the various elements in the construction of a project (Ei Agha, 2013). A procurement method can also be described as the process of the management of the design and construction of a building from inception to the completion stage (Kadiri and Ogunkola, 2014). The different procurement systems present have brought changes not only to the process and procedure of project delivery but also the aspects of management and organization (Rashid *et a*l., 2006). Variants of the procurement methods in use in construction projects in Nigeria include Traditional, Design and Build, Project Management, Construction management, Management Contracting, Labour-Only, Direct-Labour, and other Discretionary procurements such as Alliancing, Partnering, and Joint Ventures. Ogunsami (2012), however, came to the conclusion that more often than not, the traditional system of project procurement provides the datum for comparing the other methods. For the purpose of this research, much attention will be paid to traditional, direct labour and labour-only procurement methods.

2.3 Factors Affecting the Effectiveness of Risk Management Practice

Project risk management is an iterative process; the process is effective when it is implemented in a systematic manner throughout the lifecycle of a construction project, from the planning stage to completion. Some of the factors that influence effectiveness of risk management practice include; top management support, competence of project team, project funding and project risk planning.

2.3.1 Top Management Support

As penned by Ngundo (2014), top management support and commitment is a critical success factor in effectiveness of project risk management, the benefit of which is related to improving decision making in order to manage risk, commitment and support from top management plays a key role in influencing the success in almost any initiative within an organization, Critical top management support includes a broad range of activities in an organization. Rao and Mak (2001), outlines a number of key responsibilities for the executive to ensure project success, which include approving the project, confirming it is aligned to the strategic goal of the business, allocating resources such as human, time and financial resources to the implementation effort. Hence, top management should involve itself in resolving conflict by mediating between groups and promoting project acceptance, by building cooperation between various stakeholders and involving users in the project implementation process.

2.3.2 Competence of Project Team

The owners' project team consists of project managers, project executives and functional Members. In order to complete project successfully, it is critical that every project team member has a good understanding of the fundamental project requirements, which include project planning, organizing, motivating, directing and controlling (Cleland and Ireland, 2002) and has positive attitude. The problems of the incompetence of project team have been divided into two categories, individual incompetence and ineffective teamwork. The first issue concerns the ability of each individual in the project team in performing his/her job. Only a few people can perform their duties well with high productivity, on time and with high efficiency. The reasons for this poor performance often come from the lack of knowledge, skills and abilities of project team members (Kerzner, 2003).

In order to cope with the problem of the project team's incompetence, several critical strategies were proposed, namely; training and education, good staffing and effective teamwork (Ngundo, 2014). Ngundo (2014) further observed that formal risk management is rarely used, not only because of a lack of knowledge but also because of doubts in the suitability of risk management techniques for construction activities. From the findings, construction contractors also seldom employ formal risk management in their business practices and it may be because of a lack of knowledge and a lack of exposure to risk management. Although, local organizations sometimes apply risk management, the applied risk management method typically amounts to undocumented practices, which unfortunately fail to achieve the full benefits of formal risk management.

2.3.3 Project Funding

The critical risk factors affecting project time and cost identified in the work of Ngundo (2014), are; increased material cost and inaccurate material estimation were the factors most affecting project cost overrun, difficulty in obtaining monthly payments and material price escalation, change orders, disbursement schedule.

2.3.4 Project Risk planning

The first stage in the risk management process, risk planning, involves planning how to approach and perform risk management to ensure that the level, type and visibility of risk management are commensurate with both the size of the risk and the importance of the project. The project objectives are established and the responsibilities are assigned to the relevant parties in the risk planning stage (PMI, 2004). Here the risk management process is employed in the project risk planning.

2.4 Risks in Procurement

How risks are shared among the actors in a construction project is to a large extent governed by the choice of procurement option and the content of the related contract documents. As different procurement options imply different ranges of responsibilities and liabilities in the project, selecting an appropriate project procurement option is a key issue for project actors (Osipova, 2008). In the traditional procurement system, as the parties share the responsibilities for various phases of a project, the intention is having a balance of risk between parties whereas in design and build because the contractor accepts the responsibility for both design and construction, majority of the risks are placed on the contractor. In direct Labour the client bears all the risk whereas in labour-only the client and the contractor bears the risk in respect of their responsibilities in the project.

In management contracting and construction management procurement systems, the client accepts a considerable amount of risk since the contractor is mostly providing only the management expertise (Davis, Love and Baccarini, 2008). However, the type of the contract chosen for the project under any of the selected procurement systems would also determine the ratio of risk transferred to the involved parties. In fixed price contract since the contractor is responsible for majority of the tasks, the risks are mostly transferred to contractor than the client whereas in the reimbursable contract because the contractor is paid a percentage of the cost of the project, it is possible that contractor tries to maximize the cost of the project in order to earn more profit and therefore the client is dealing with majority of the risks (especially financial risks) in this contract.

In billed rates and also turnkey contracts, since the contractor is responsible for executing the majority of the phases of the project and client is only paying the contractor, responsibility of managing the majority of the risks is also by the contractor. Partnership contracts, however, would have a balance in sharing the risks between the parties based on the details of the contract. Therefore, it can be seen that the level of risk transferred to the parties varies in different procurement systems and contracts. However, no matter which party is responsible for the risks more than others, the risks should be managed systematically. The identification of the factor(s) that will constitute the greatest risk to the projects if they fail to be achieved will assist in the development of a weighted list of priorities and the overall procurement system to be considered. The following risk factors should be considered when evaluating the most appropriate procurement strategy as identified by Davis, Love and Baccarini (2008):

a. External factors – consideration should be given to the potential impact of economic, commercial, technological, political, social and legal factors which influence the client and their business, and the project team during project's lifecycle. For example, potential changes in interest rates, changes in legislation and so on.

b. Client resources – a client's knowledge, the experience of the organisation with procuring building projects and the environment within which it operates will influence the procurement strategy adopted. Client objectives are influenced by the nature and culture of the organisation. The degree of client involvement in the project is a major consideration.

c. Project characteristics – The size, complexity, location and uniqueness of the project should be considered as this will influence time, cost and risk.

d. Ability to make changes – Ideally the needs of the client should be identified in the early stages of the project. This is not always possible. Changes in technology may result in changes being introduced to a project. Changes in scope invariably result in increased costs and time, especially they occur during construction. It is important at the outset of the project to consider the extent to which design can be completed and the possibility of changes occurring.

e. Cost issues – An assessment for the need for price certainty by the client should be undertaken considering that there is a time delay from the initial estimate to when tenders are received. The extent to which design is complete will influence the cost at the time of tender. If price certainty is required, then design must be complete before construction commences and design changes avoided.

f. Timing – Most projects are required within a specific time frame. It is important that an adequate design time is allowed, particularly if design is required to be complete before construction. Assurances from the design team about the resources that are available for the project should be sought. Planning approvals can influence the progress of the project. If early completion is a critical factor, then design and construction activities can be overlapped so that construction can commence earlier on-site. Time and cost trade-offs

should be evaluated. Ogunsanmi, Salako, and Ajayi (2011) also identified 37 risks in design and build procurement which are:

Natural Phenomenon: The sub factors are; weather conditions (exceptional inclement weather) and catastrophes (fire, earthquake, windstorm and others).

Economics/finance: The sub factors are; Inflation, financial failure – any party (lack of payment), exchange rate fluctuation/devaluation and tax rate charge.

Politics/Government/Society: The sub factors are; government acts and regulations, and administrative bureaucracy.

Industrial Characteristics/Contract: The sub factors are; Labour disputes, third party litigation, contract and award method, indemnification and holding harmless.

Construction/Safety and Environment: The sub factors are; different sites conditions (unforeseen site conditions), unidentified utilities, construction defects (inadequate quality of works and need for correction), quality control and assurance, environmental risks, accidents, safety, delayed payment (delay progress payments), owner's experience, designer and builder selection and, charge order (change in scope of work/quality).

Designer/Contractor: The sub factors are; permits and approval, establishment of a project cost, constructability of design, redesign if over budget, errors or omissions, level of design completion, contract and award method, delay in Design, inadequate specifications, warranty of facility performance, contractor's experience and, permits and approval.

Job Site: The sub factors are; soil condition and site access.

3. RESEARCH METHODOLOGY

3.1 Study Area

The research was conducted in Akwa Ibom state. Akwa Ibom State is one of the thirty-six states that make up Nigeria and one of the nine oil and gas producing states of the Niger Delta region in Nigeria. The State is geographically located in the South-South Geo-Political zone of Nigeria with an estimated population of 3,902,051 people and has a total land mass of 6,187km2, which represents 0.67% of the total land mass of Nigeria (National Population Commission, 2007). The state which has three major languages of Ibibio, Annang and Oron is located between latitude 4^{o} 3' and 5^{o} 32' North of the equator and longitude 7^{o} 25' and 8^{o} 3' East of the Greenwich meridian (Akpan, 2014).

Politically, the state has three senatorial districts namely; Eket senatorial district, Ikot-Ekpene senatorial district and Uyo senatorial district, with ten federal constituencies and thirty-one Local Government Areas. According to Akpan and Usoro (2011), as at now, some urban areas like Ikot-Ekpene, Abak and especially Uyo capital city, which has other part of Uruan, Ibiono Ibom, Itu, Ibesikpo and Etinan Local Governemt Areas carved out and added to the former Uyo Township, have witnessed tremendous transformation. Their former natures of rural local government headquarters have metamorphosed into Municipalities with many modern roads which have completely changed the aesthetics of the places (Udoh, 2014). These transformations have also encouraged rural-urban migration and steady influx of people from neighbouring states, which has imposed several housing problems on the populace (James, Akpan, Essien and Ekpo, 2012; Udoh, 2014). This research focused on this area due to the on-going and completed housing project construction in the state, which is, attributed to the drive by the state government and the

private sector to provide accessible and affordable housing accommodation to its increasing population

3.2 Research Methods

The study adopted cross-sectional survey approach to assess the factors influencing the effectiveness of risk management in projects delivered using traditional, direct labour and labour only methods. The perceptions of 99 purposively selected representatives of construction firms practicing in Akwa Ibom were gathered using structured questionnaire. The purposive approach is due to the researchers' desire to reach out to willing and capable respondents who preferred to remain anonymous. Statistical analysis of the data from the questionnaire was done using statistical package for social sciences (SPSS). The tools employed for the data analysis were: relative influence index and Kruskall Wallis test.

The relative influence index (RII) method was used in this study to determine the influence of the Twenty-five selected factors from literature on risk management in the different procurement methods as stated in objectives 1-3. This approach was adopted from Ugwu and Haupt (2007) and Enshassi, Mohamed and Abushaban (2009) as shown in equation 1.

$$\text{RII} = \sum W/AxN \quad \ldots\ldots\ldots\ldots (1)$$

Where W is the weight given to each variable by the respondents and ranges from 1 to 5; A – The highest weight = 5; N – the total number of respondents.

For ease of explanation the RII were categorised as: 0-0.359 very low influence (VLI); 0.36-0.529 low influence (LI); 0.53-0.679 moderate influence (MI); 0.68-0.839 high influence (HI) and 0.84-1.0 very high influence (VHI) as adopted from Ujene and Adewuyi (2016), since there is no specific range of RII available in the literature for explanation (Alashwal and Al-Sabahi, 2018). Kruskal Wallis test was used for the variations in the perceptions of the factors influencing the effectiveness of risk management in projects procured with the different delivery methods as captured in the hypothesis of the study.

4. Data Analysis, Results and Discussion of Findings

The results and findings arising from the analysis are presented in this section.

4.1 Respondents Characteristics

The characteristics of the respondents that supplied the data used for the study were analysed for an understanding of the effect of risk management using the understudied procurement methods. From the findings 88.9% represents the male while 11.1% represents the female. The highest academic qualification of the respondents are 1% had SSCE, 8% had OND, and 56% had HND OR B.Sc while 35% had M.Sc or P.hD, also 14% of the respondents were consultants, 65% were contractors while 21% were clients. The

professional affiliation of the respondents, 25% were Architects, 30% Builders, 29% Engineers, 10% Quantity Surveyors and 5% Estate Surveyors.

The respondents were requested to indicate their membership status in their professional bodies. The study revealed that corporate members were 21%, graduate members 37%, while associate members were 29%. The results also show that 16% of the respondents have been in practice between 1-5yrs, 42% have practiced between 6-10yrs, 12% between 11-15yrs, 8% between 16-20yrs and 21% have been practicing for over 20yrs.

The respondents were asked to state the client for the housing project they took part in. The result shows that 29% were public housing projects while 70% were private housing projects. The study also reveals that 54% of the respondents were from Uyo senatorial district while Ikot Ekpene and Eket senatorial district had 26% and 20% respectively. The respondents were requested to indicate the size of their firms and- if they are consultants or contractors. The results show that 93% of the respondents are working in a small firm (from 0-50 permanent employees) and 7% in a large firm (from 50-250 permanent employees). The results from the type of firm operated by the respondents shows that 82% operates contracting firms while 18% operates consultancy firm.

4.2 Factors influencing the Effectiveness of the Risk Management Method in the different Procurement Methods

The three objectives of the study were formulated to evaluate the factors affecting the effectiveness of risk management methods in the different procurement methods. To achieve these objective 25 factors were identified from the literature and pilot study and presented to the respondents for subjective assessment as it applies to the three understudied procurement methods. The perception of the respondents was measured on a five point Likert scale as indicated in the methodology of the study. The sum and relative influence indices of the factors affecting effectiveness of the risk management methods were analysed and their corresponding ranks and level of influence were determined.

The result as presented in Table 1 shows that in traditional procurement the most significant factors are Complexity, Top Management Support and Timing. These ranked 1st, 2nd, 3rd with an RII of 0.836, 0.814 and 0.794 respectively. The results also showed that 76% the factors have high influences, while 24% have moderate influence on the effectiveness of risk management methods in traditional procurement.

In Direct-Labour the most significant factors are timing, environmental factors and funds allocation for the risk exercise with an RII of 0.857, 0.808 and 0.806 respectively. The result shows that 4% of the factors have very high influence, 68% have high influence, while 28% have moderate influence on the effectiveness of risk management methods in direct-labour procurement. In Labour-only, timing, funds allocation for the risk exercise and top management support were the most significant factor with RII of 0.869, 0.826 and 0.810 respectively. The result also shows that 4% of the identified factors have very high influence, 64% have high influence, while 32% of the factors have moderate influence on the effectiveness of risk management in the labour-only procurement method.

The study found out that lack of project timeliness affects effectiveness in risk management to a great extent. When a project takes longer to complete than was initially planned for, the delay triggers cost overruns which jeopardizes the success of the project in that these cost overruns were not planned for and the financiers may either not have the extra funding or are not willing to spend more on the project. This finding concurred with the result of the research by Cox, Morris, Rogerson and Jared (1999) that identified that

project time variations affect management of project risks. Environmental factors such as socio cultural, economic conditions affects risk management practice in housing projects in the study area. As each project is situated graphically within a specific environment the external environment has an important influence on the way any project risk is managed (Ghahramanzadeh, 2013). Funds allocation for the risk exercise as indicated by the respondents affects risk management in the understudied procurement methods in the study area. This usually may make the risk management process to stop at identification since analysis of the risk for its likely impact on the project will require funds that were not provided for. The findings correspond with the inference of the study by Ngundo (2014), that lack of commitment and low risk knowledge level makes the management not to allocate sufficient resources to risk management practice.

Table 1: Factors influencing the Effectiveness of the Risk Management in the Procurement Methods

Procurement methods	Traditional method			Direct labour method			Labour-only method		
Risk Factors	RII	Rank	Rmk	RII	Rank	Rmk	RII	Rank	Rmk
Timing	0.794	3	HI	0.857	1	VHI	0.869	1	VHI
Funds Allocation for the Risk Exercise	0.754	9	HI	0.806	3	HI	0.826	2	HI
Top management support	0.814	2	HI	0.742	11	HI	0.810	3	HI
Environmental factors	0.776	7	HI	0.808	2	HI	0.806	4	HI
Historical data of past projects	0.733	13	HI	0.766	7	HI	0.802	5	HI
Risk Management Policies	0.792	4	HI	0.782	5	HI	0.790	6	HI
project type	0.786	5	HI	0.752	8	HI	0.766	7	HI
Expected outcome of risk exercise	0.768	8	HI	0.669	21	MI	0.760	8	HI
Clients knowledge	0.648	22	MI	0.749	9	MI	0.760	8	HI
Complexity	0.836	1	HI	0.786	4	HI	0.758	10	HI
Project Size	0.782	6	HI	0.766	6	HI	0.741	11	HI
Documentation Reviews	0.737	12	HI	0.737	13	HI	0.741	11	HI
Level of skills of risk assessor	0.745	10	HI	0.703	18	HI	0.723	13	HI
Nature and culture of the organization	0.630	26	MI	0.625	25	MI	0.689	14	HI
Project budget	0.729	14	HI	0.747	10	HI	0.687	15	HI
Change in scope	0.703	18	HI	0.741	12	HI	0.683	16	HI
Level of occurrence of risk	0.705	17	HI	0.616	26	MI	0.681	17	HI
Risk Tolerance	0.717	15	HI	0.706	17	HI	0.673	18	MI
Risk perception	0.717	16	HI	0.640	24	MI	0.671	19	MI
Qualification of risk assessor	0.642	24	MI	0.715	14	HI	0.651	20	MI
Unforeseen site conditions	0.681	19	HI	0.712	15	HI	0.638	21	MI
Project requirement	0.644	23	MI	0.707	16	HI	0.634	22	MI
Incomplete design	0.741	11	HI	0.693	19	HI	0.632	23	MI
Degree of client involvement	0.636	25	MI	0.661	23	MI	0.630	24	MI
Government acts and regulations	0.673	20	MI	0.679	20	MI	0.566	25	MI

RII= Relative Influence Index, Rmks = Remarks

The complexities of projects arising from ambiguous and non-routine activities affects effectiveness of risk management practice as complex projects require more attention to the risk management process. Systems and procedures that are easy to handle are important drivers of more effective risk management, hence, the complexity of the systems makes them difficult to apply in practice (Osipova, 2008).

4.3 Variation in the Influence of Factors Affecting Effectiveness of Risk Management Methods in the different Procurement Methods

For the purpose of evaluating the variation in the influence of factors affecting effectiveness of risk management practice in the different procurement methods, one hypothesis was tested it states that there is no significant variation in the influence of factors affecting effectiveness of risk management methods among the procurement system. . In order to test this hypothesis Krukal-Wallis test was used at ≤0.05, to provide confidence of views and generalization of opinions of the three procurement methods. The decision rule is that if p-value > 0.050, the hypothesis is accepted, but if p-value ≤ 0.050 the hypothesis is rejected. In Table 2, the result shows a p-value of 0.918 > 0.050, this indicates that there is no significant variation in the factors affecting effectiveness of risk management in the study area. This implies that the perception of the respondents on the factors influencing risk management among the procurement methods is the same, which may be attributable to the current general level of awareness of the respondents.

Table 2: Variation in Influence of Factors affecting Effectiveness of Risk Management Methods in the different Procurement Methods

Procurement methods	N	Mean Rank	Chi-square	Df	Asymp. Sig.	Decision
Traditional	25	40.52	0.171	2	0.918	Accept
Direct Labour	25	39.94				
Labour Only	25	38.04				
Total	75					

The result is similar to the finding by Gyamfi, Boadaa and Adu-Fosu (2016), which established from the corroborative evidence of respondents that the risks influencing the various procurement options (Design and build, Management contracting, Design and manage and Private-public partnership) adopted by construction firm in the Ashanti Region of Ghana could be classified mainly into economic risks and technological risks.

4.4 Aggregated Influence of Factors Affecting Effectiveness of Risk Management Methods in all the Procurement Methods

Consequent upon the establishment that there is no significant variation in the factors affecting effectiveness of risk management in the study area, the study attempted to evaluate the aggregated influence of all the methods by computing the average influence of the three procurement methods as presented in Table 3. The result shows that the five most influencing factors are; timing, environmental factors, funds allocation for risk exercise, complexity and top management support. The result also shows that only one factor representing 4.0% of the whole factors has very high influence. Fifteen factors representing 60% have high influence, while nine factors representing 36% have moderate influence on the effectiveness of the procurement methods. The result is similar to the finding by Gyamfi, Boadaa and Adu-Fosu (2016), that several factors classified into economic and technology have influence on the performance of various procurement options.

Table 3: Combined Influence of Factors affecting Effectiveness of Risk Management Methods in all the Procurement Methods

Risk Factors	Procurement Methods												
	Traditional			Direct Labour			Labour Only			Combined			
	Sum	RII	Rank	Sum	RII	Rank	Sum	RII	Rank	Sum	RII	Rank	Rmks
Timing	393	0.794	3	424	0.857	1	430	0.869	1	1247	0.840	1	VHI
Environmental factors	384	0.776	7	400	0.808	2	399	0.806	4	1183	0.797	2	HI
Funds Allocation for Risk Exercise	373	0.754	9	399	0.806	3	409	0.826	2	1181	0.795	3	HI
Complexity	414	0.836	1	389	0.786	4	375	0.758	10	1178	0.793	4	HI
Top management support	403	0.814	2	360	0.742	11	401	0.810	3	1164	0.789	5	HI
Risk Management Policies	392	0.792	4	387	0.782	5	391	0.790	6	1170	0.788	6	HI
project type	389	0.786	5	372	0.752	8	379	0.766	7	1140	0.768	7	HI
Historical data of past projects	363	0.733	13	379	0.766	7	397	0.802	5	1139	0.767	8	HI
Project Size	387	0.782	6	379	0.766	6	367	0.741	11	1133	0.763	9	HI
Documentation Reviews	365	0.737	12	365	0.737	13	367	0.741	12	1097	0.739	10	HI
Expected outcome of risk exercise	380	0.768	8	331	0.669	21	376	0.760	8	1087	0.732	11	HI
Level of skills of risk assessor	369	0.745	10	348	0.703	18	358	0.723	13	1075	0.724	12	HI
Project budget	361	0.729	14	370	0.747	10	340	0.687	15	1071	0.721	13	HI
Clients knowledge	321	0.648	22	371	0.749	9	376	0.760	9	1068	0.719	14	HI
Change in scope	348	0.703	18	367	0.741	12	338	0.683	16	1053	0.709	15	HI
Risk Tolerance	355	0.717	15	346	0.706	17	333	0.673	18	1034	0.699	16	HI
Incomplete design	367	0.741	11	343	0.693	19	313	0.632	24	1023	0.689	17	MI
Unforeseen site conditions	337	0.681	19	349	0.712	15	316	0.638	22	1002	0.677	18	MI
Risk perception	355	0.717	16	317	0.640	24	332	0.671	19	1004	0.676	19	MI
Qualification of risk assessor	318	0.642	24	354	0.715	14	322	0.651	20	994	0.669	20	MI
Level of occurrence of risk	349	0.705	17	305	0.616	26	337	0.681	17	991	0.667	21	MI
Project requirement	319	0.644	23	350	0.707	16	314	0.634	23	983	0.662	22	MI
Nature & culture of the organization	312	0.630	26	303	0.625	25	341	0.689	14	956	0.648	23	MI
Degree of client involvement	315	0.636	25	327	0.661	23	312	0.630	25	954	0.642	24	MI
Government acts and regulations	333	0.673	20	336	0.679	20	280	0.566	26	949	0.639	25	MI

RII= Relative Influence Index, Rmks = Remarks

5. CONCLUSION AND RECOMMENDATIONS

Risk management has become an integral part of construction project management. In spite of the general awareness of the risk management process, implementing risk management systematically in the project is still limited in practice owing to some factors affecting its effective management. It has been established that the five most important factors influencing the effectiveness of risks management in traditional, direct labour and labour-only procurement methods are: timing, environmental factors, funds allocation for risk exercise, complexity and top management support. The result also shows that 4.0% of the whole factors have very high influence, 60% have high influence, while 36% of the evaluated factors have moderate influence on the effectiveness of the procurement methods. It was concluded that these factors impair effective risk management practice in the study

area and if not given adequate consideration, successful delivery of projects will be hindered using any of the procurement methods. It was also concluded that the perception of the respondents on the factors affecting risk management among the procurement system is the same, hence equal and similar risks management consideration can be applied to any adopted procurement method. It is recommended that advanced formal and informal training in risk management and prioritization of the control of the factors influencing their effectiveness should be regularly conducted among the stakeholders involved in the delivery of housing projects in the study area.

REFERENCES

Alashwal, A. M and Al-Sabahi, M. H. (2018). Risk Factors in Construction Projects during Unrest Period in Yemen. *Journal of Construction in Developing Countries*, 23(2), 43–62.

Akpan, G. A. and Usoro, E. B. (2011). Problems and strategies for private sector development in Akwa Ibom state, Nigeria. *Journal of Sustainable Development in Africa,* 13 (8), 129-141.

Akpan, P. U. (2014). Oil exploration and security challenges in the Niger -delta region: A case of Akwa Ibom state, Nigeria. *IOSR Journal of Research & Method in Education*, 4(2), 41-48.

Akinkumi, O. G., Aghimien, D. O. and Awodele, O.A. (2018). Appraising the use of Labour-Only Procurement System for Building Construction in Nigeria. *Organization, Technology and Management in Construction.* 10, 1719-1726.

Akobi, G., (2012). The Comparison of Performance of Traditional and Direct Labour Procurement Methods Adopted by the Nigerian army. An M.Sc thesis in the Department of Building, Faculty of Environmental Design, A. B. U. Zaria.

Alabi, A.O. (2018). Assessment of Risk involved in Housing Projects Procured Using Public Private Partnership System in Nigeria, International Journal of Economic, Commerce and Management, 6(12), 443-455.

Aminu, A. B. (2013). Risk Management in Nigerian Construction Industry. An M.Sc Thesis, Institute of Graduate Studies and Research, Eastern Mediterranean University, Gazimagusa, North Cyprus.

Babatunde, S. O., Opawole, A. and Ujaddughe, I. C. (2010). An Appraisal of Project Procurement Methods in the Nigerian Construction Industry. *Civil Engineering Dimension*. 12(1), 1-7.

Banaitiene, N. and Banaitis, A. (2012). Risk Management in Construction projects (http://creativecommons.org/licenses/by3.0) http://dx.doi.org/10.5772/51460, accessed 23rd September, 2015.

Chartered Institute of Building (2010), A Report on Exploring Procurement in the Construction Industry. Englemere, Kings Ride, Ascot Berkshire SL5 7TB, United Kingdom.

Cleland, D. I. and Ireland, R. L. (2002). *Project Management: Strategic Design and Implementation* (Forth Edition). New York: McGraw-Hill.

Cox, I. D., Morris, J. P., Rogerson, J. H. and Jared, G. E. (1999). A quantitative study of post contract award design changes in construction, *Construction Management and Economics*, 17(4), 427-39.

Davis, P. Love, P. Barccarini, D. (2008), Construction Innovation Report on Building Procurement Methods. Curtin university of Technology.

El-Agha, O.I. (2013). Factors Affecting the Selection of Procurement Methods in the Construction Projects in Gaza Strip, An M.Sc. Thesis in Civil Engineering - Construction Management, The Islamic University of Gaza.

Enshassi, A., Mohamed, S. and Abushaban, S. (2009). Factors affecting the performance of construction projects in the Gaza Strip, *Journal of Civil Engineering and Management,* 15(3), 269–280.

Ghahramanzadeh, M. (2013). *Managing risk of construction projects: A case study of Iran*. PhD Thesis, University of East London, UK. Retrieved December 20th, 2019 from: http://hdl.handle.net/10552/3502.

Gyamfi, T. A., Boadaa, R. and Adu-Fosu, B. (2016). Risk Analysis of Procurement Options: Implications for Construction Firms in Ghana. *International Journal of Sciences: Basic and Applied Research (IJSBAR),* 28(1), 90-102.

Iboh, A. A., Adindu, C. C. and Oyoh, A. J. (2013). Public Private Partnership Construction Project Disputes in Nigeria*. Journal of Research in National Development*, 11(1), 6-11.

James, E. E., Akpan, P. A., Essien, A. U. and Ekpo, K. J. (2012). The Pattern of Housing-Health Status among Residential Zones in Uyo Metropolis, AkwaIbom State, Nigeria. *Journal of Environmental Issues and Agriculture in Developing Countries,* 4(3), 29-35.

Kerzner, H. (2003). *Project Management: A System Approach to Planning, Scheduling and Controlling*. 8th Ed. New Jersey: John Wiley & Sons.

Kadiri, D. S. Ogunkola, O. M. (2014), Assessment of Procurement Methods Based on Clients Selection Criteria in Ogun State, Nigeria, *Covenant Journal of Research in the Built Environment.* 2(1), 31-41.

National Bureau of Statistics (2015). Nigerian Construction Sector: Summary of Report 2010-2012.

Ngundo, J. M. (2014). Factors Affecting Effectiveness of Risk Management in Public Housing Construction Projects In Kenya: A Case of Kibera Slum Upgrading Housing Scheme in Nairobi, A Master of Arts in Project Planning and Management of The University of Nairobi.

Ogunsanmi, O. (2012), Comparison of Procurement Characteristics of Traditional and Labour-Only Procurement in Housing Projects in Nigeria*, Civil and Environmental Research,* 2(8), 1-10.

Ogunsanmi1, O. E., Salako, O. A. and Ajayi, O. M. (2011). Risk Classification Model for Design and Build Projects, *Journal of Engineering, Project, and Production Management,* 1(1), 46-60.

Osipova, E. (2008). Risk management in construction projects: a comparative study of the different procurement options in Sweden, Unpublished Licentiate Thesis, Department of Civil, Mining and Environmental Engineering, Luleå University of Technology.

Ozcan, G. (2008). A Generic Risk and Vulnerability Assessment Framework for International Construction Projects. An Unpublished M. Sc. Thesis in the Department of Civil Engineering Middle East Technical University.

Perera, B. A. K. S., Rameeddeen, R. Chileshe, N. and Hosseinin, M. R. (2014).Enhancing the Effectiveness of Risk Management Practices in Sri Lankan Construction Projects: A Delphi Approach. *International Journal of Construction Management*, 14(1), 1-19.

PMI Project Management Institute, (2004), a Guide to the Project Management Body of Knowledge: PMBOX 3rd Edition, Pennsylvania: Project Management Institute.

Rao, T.V.M. and Mak, C.L. (2001). A risk management model for improving operation and maintenance activities in electricity transmission networks. *The Journal of the Operational Research Society,* 52(2), 125–134.

Rashid, A., Taib, M., Ahmad, W., Basiron, W., Nasid, M., Ali, W., and Zainordin, Z. (2006). Effect of procurement systems on the performance of construction projects. Symposium conducted at the meeting of the International Conference on Construction Industry 2006 (ICCI 2006), Padang, Indonesia.

Ropel, M. and Gajewska, E. (2011). Risk Management Practices in a Construction Project –A Case Study, An M,Sc Thesis in the Department of Civil and Environmental Engineering, Division of Construction Management. Chalmers University of Technology, Sweden.

Sanda, Y. N., Anigbogu, N. A., Nuhu, Z. Y. and Olumide, O. S. (2020). A Life-Cycle Framework for Managing Risk in Public Private Partnership in Housing Project; Journal of Engineering, Project and Production Management. 10(1), 27-34.

Serpella, A. F., Ferrada, X. Howard, R., Rubio, L. (2014). Risk Management in Construction Projects: A Knowledge– Based Approach. *Journal of Social and Behavioural Sciences* (119), 653-663.

Udoh, N. (2014). The Determinants and Implications of Rural-Urban Migration in Nigeria. *African Journal of Social Sciences*, 4 (3), 133-143.

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, 665–680.

Ujene, A. O. and Adewuyi, T. O. (2016). Residential buildings procurement with labour only method: performance evaluation among federal income earners in Akwa Ibom State. *Journal of Environmental Sciences*, 17(1&2), 39-53.

Waziri, B. S. and Bala, K. (2014). Actualizing Nigeria's vision 20:2020 Imperatives of the Construction sector, *Civil and Environmental Research*, 6 (6), 69-75.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

CITY CENTRE REDEVELOPMENT: SOCIO-ECONOMIC IMPLICATIONS IN IKOT EKPENE URBAN, AKWA IBOM STATE, NIGERIA

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ABSTRACT

Purpose: Redevelopment and relocation procedures in Nigerian cities frequently benefits the government and also helps in the proper control of positive development of a city. This study assesses the city centre redevelopment and its socio-economic implications in Ikot Ekpene urban. The study was restricted to the Central Business District of Ikot Ekpene urban.
Design/methodology/approach: To achieve this, the study was restricted to the Central Business District of Ikot Ekpene urban. This involves the core area of about 14,000 m^2 and expanded area of about 3 km^2 from the city centre. A sample size of 400 respondents was taken from the projected population of the study area by the application of Taro Yammane sample size technique. A total of 400 questionnaires was administered using both simple random and purposive sampling technique to respondents in the study area. Percentages and Relative Satisfaction Index (RSI) was used to analysed the level of satisfaction by the respondents.
Findings: The result revealed that there is positive relationship. The RSI indicated that 75.75% respondents were satisfied with the redevelopment project in the city centre, 17.17% partially satisfied and 7.08% were not satisfied with the redevelopment project. The study revealed the redevelopment of the city centre therefore represent a strong revitalization strategy in an overall land use planning.
Originality/value: The study recommends the introduction of the concept of pedestrianisation, disembarkation point and a lot more which will lead to a total transformation of the study area. The city centre redevelopment effort into a public square is a good thing to happen in the study area.

Keywords: Redevelopment; city centre; socio-economic; relative satisfaction index; implications.

1. INTRODUCTION

Redevelopment can be described as a focused attention in a city neighbourhood aimed at reversing deteriorating trends. Redevelopment has been identified as one of the most effective ways to foster private investments into run-down neighbourhoods or

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deteriorated areas of a city plagued by social, physical, environmental or economic conditions. Thus the injection of new ideas and capital into a run-down neighbourhood is a principal benefit of redevelopment (Koebel and Squires, 1990).

Also human activity on redevelopment attracts a variety of questions, answers to which throw much light on the process. The first two such questions have been given answers in our first two paragraphs above. This includes what is redevelopment and what benefit accrue from it?

In U.S. urban redevelopment and residential displacement by public action has occurred in four periods in 1945 – 1954, 1955-1963, 1964 – 1974 and 1975 – 1984. The prevailing emphasis in each of these periods was slum clearance, clearance for public housing, commerce and "market-rate" housing national promotion of social change and neighbourhood movements and redevelopment of central business district.

In Nigeria, the earliest known case of urban redevelopment took place at the eve of independence, when the German Town Planner Zimmermman was consulted by the colonial governor, to leave a legacy in his name, this was in 1958 (George, 2009). This led to the development of Tinibu Square and Tafewa Balewa Square – Lagos. This was done by government fiat, and it led to the development of the Surulere housing layout.

The first ever government planning efforts in independent Nigeria was again at Lagos as a metropolis. This time by the United Nations for Technical Assistance, Department of Economics and Social Affairs. The study group was led by Dr. Otto Koenigsborger a German (Tesco-Kotzi, 1974). The terms of reference of the study stated that all the development projects in metropolitan Lagos should be considered in the context of the overall needs of the area. A fully coordinated development scheme was proposed.

In 1970, the government of South Eastern State, did commission a firm of Romania Engineers and City planners to propose a Master Plan for the development and redevelopment of Calabar and other towns of the state including Ikot Ekpene. The groups came together under the name of Tesco- Kotzi Consulting Engineers under the leadership of Professor C. K. Polonyi (Tesco-Kotzi, 1974)

These neighbourhood effects or externalities can be positive or negative. To overcome these impediments government must actively promote redevelopment, either through public development or through public assistance of private redevelopment (Koebel, 1996). Physical decline and the necessity of redevelopment are never-ending challenges for built communities. The evidence of declines is numerous in Nigerian cities and is spreading to inner suburbs (Koebel, 1996). No matter how great the need, urban reinvestment aid redevelopment, is neither certain to occur nor certain to succeed. There are serious challenges and impediments to inner-city redevelopment.

Redevelopment according to California Redevelopment Association is a process created to assist city and country government to eliminate blight from a designated area and to achieve desired development, reconstruction and rehabilitation including but not limited to residential, commercial and industrial uses and retail. Redevelopment is one of the most effective ways to foster private investment into deteriorated area plagued by social, physical, environmental or economic conditions. Through redevelopment a project area will received focused attention and financial investment to reverse deteriorating trends, create jobs, revitalize the business climate, rehabilitate and add to the housing stock which would not otherwise occur.

It is imperative that the situation in the city centre has to be replaced through public action. This started earlier, the very investments cities need to attract development which can result in displacements. Such displacements can harm the residents forced them to relocate and would appear to be a legitimate matter of public concern.

Akwa Ibom State government under the maxim of providing public infrastructure to ease traffic congestion in Uyo, its capital did undertake the development of what has come to be known as Ibom Plaza (Uyo Master Plan, 1988). The Ikot Ekpene city centre redevelopment scheme, is the second of such public-sector driven proposals in the state. This study generally aims at assessing the socio-economic implications of city centre redevelopment in Ikot Ekpene urban in order to create a better city centre in the State.

1.1. Problem Statement

The post-civil war politics had down played the strategic importance of Ikot Ekpene. The seemingly indifference on the part of government to the injection of public funds into the development of infrastructure encouraged the departure of the big European companies in search of more vibrant locations. These are other less emphasized factors occasioned by the realignment of political, economic and social spheres encouraged a slump in the socio-economic activities in the system area.

The continuous political restructuring in the country beginning with the 1976 local government reforms, and the state creation exercise in 1987 has reformed the status of Ikot Ekpene. This has led to increased prosperity for workers which in turn have stimulated retail consumption. Ikot Ekpene is located at an intersection connecting the cities of Aba and Umuahia to Uyo, and Calabar as well as Abak and Itu. At the same time, physical deterioration has become apparent among the abandoned warehouses of the big European companies. The Federal prisons at the city centre was becoming a misnomer disturbing the psyche of the citizenry.

The tenement and working class cottages along Abak road and the prisons staff-quarters are all at various stages of dilapidation. The environmental infrastructure such as storm drains are all sited. Many of the buildings were constructed hastily, while some with poor quality materials have all become obsolete. Equally, the road network in the area is chaotic and too narrow for the volume of traffic thereby creating traffic bottlenecks in the city centre. The scenario is nothing short of a slum, but over 65% of all transportation activities are located within this area and bludgeoning percentage of retail trading takes place too.

2. Literature Review and Conceptual Framework

Physical decline and the necessity of redevelopment are never-ending challenges for built communities. The evidence of declines is numerous in Nigerian cities and is spreading to inner suburbs (Koebel, 1996). No matter how great the need urban reinvestment aid, redevelopment is certain to occur nor certain to succeed.

Redevelopment as defined by California Redevelopment Association is a process created to assist city and country governments to eliminate blight from a designated area and to achieve desire development, reconstruction and rehabilitation including but not limited to residential, commercial and industrial uses.

Redevelopment is one of the most effective ways to foster private investment into deteriorated areas plagued by social, physical, environmental or economic conditions. Through redevelopment effort the affected area will received urgent attention and financial investment to reserve the deteriorating trends, create employment, revitalize the business climate, rehabilitate and add to the housing stock which would not otherwise occur.

Redevelopment refers to a complex demolition of highly blighted neighbourhood and the re-use or reconstruction of cleared land for the implementation of new projects. It involves the processes of displacement and resettlement of affected slum dwellers, laying out of the new neighbourhood as well as reconstruction of housing units. The major criticism against redevelopment is that apart from the problem of displacement, break-up of family relationship and destruction of workplace in relation to home arrangement, outright clearance of slum is known for eating deep into government's budgets such that other equally essential services are neglected (Egunjobi, 1983, 1987).

Okpala (1986) recognizes the prevalence of slums in Nigeria urban centres and associates this with the generation of water and deterioration of the environments that are attendant effects of high concentration of people, uncontrolled growth and development, poor planning and implementation.

Urban decay is not peculiar to developing countries alone, it is a universal phenomenon which exists in varying degrees from place to place and country to country. In other words, urban slums are a worldwide problem. Urban renewal refers to the redevelopment and or rehabilitation of the older parts of towns and cities, including their central business districts. It is highly associated with housing improvements of the poor.

Operationally, it is intricately linked with issues of blight, deterioration, housing standards declining tax base, property values (Onokerhoraye and Omuta, 1986). And general obsolescence in cities, particularly traditional cities in the developing countries, which may have had long experiences of colonial rule and urbanization before the introduction of modern development planning.

2.1. The Dynamic System Concept

A system functions as a whole with the interaction of several sub-systems. All the sub-systems of the system are interconnected and interdependent to each other, and form a system. If one of the subsystems of the system is defunct or functions with higher degree (taking lead role during its function) or partly function, its effects can be visualized in the entire system over a period of time. In some cases, the system may not function at all, while some cases the system may function but with many disturbances or smooth functions of the system may be paralyzed (Sonar, 2008).

System theory is an outgrowth of the concept of general system theory and cybernetics (Jothimoni, 1997). It is more of a practical philosophy of solving problems in societal systems. It suggests a holistic approach in defining the problem, designing the change and evaluating the design and known as design methodology.

3. THE STUDY AREA

Ikot Ekpene urban is known throughout the country as "The Rafia City". The urban area is located between latitude 5°08" and 5°75" North of the Equator and longitude 7°39" and 7°45" East of the Greenwich Meridian. It lies on the North-Western flank of Akwa Ibom State. Its position makes it the economic gateway to Akwa Ibom State. The area covers a total of 48.31 sq.m (125 km^2) (Nair, 1972). It serves as a nodal point linking Abia State and Cross River State.

The area has two seasons the dry season and wet season. The dry season start from November to March, whereas rainy season starts from April to October annual rainfall is about 337.8mm around the month of June and July with maximum precipitation. Relative

humidity falls between 80 – 100% in the afternoon. The mean annual temperature of the study area is 30.1°C or 80 Fahrenheit and highest temperature occurs between February and April (Udo, 1970). The subject is known as a regional centre of commerce with notable exports of palm products especially palm oil, kernel, raffia product made from raffia fibre. Some of the products from the raffia fibre include but not limited to shoes, bags, caps, office files jacket vests, hats, mats etc. other notable products of the area include carvings, masks and sculpture

4. RESEARCH METHODOLOGY

The sources of data for this research include both the primary and secondary sources of data collection. However, a total of 400 respondents were adopted as the sample size for the study derived from a projected population of Ikot Ekpene urban of 55,062 (NPC, 2006). These comprises of the population of those areas that were within the 3 kilometre radius from the city centre where the redevelopment exercise occurred.

Taro Yamane formula was used to arrive at the sample size, (Uzoagulu, 1998).

$$n = \frac{N}{1+N(e)}$$

A total of 400 questionnaires were administered using both simple random and purposive sampling techniques. The questionnaires were administered to residents in the four (4) major roads in Ikot Ekpene urban (Aba road, Uyo road, Abak road and Umuahia road). It was assumed that members of the population have identical characteristics needed for the investigation. Therefore, any member of the population within the confines of Ikot Ekpene urban were eligible to be chosen for the interview.

Data collected were subjected to statistical analysis. Two (2) types of statistical analysis were employed for the data analysis. The first was the simple descriptive statistics and the second was inferential statistics. The simple statistics involved frequency count and percentage scores. Those percentages were derived from the frequency count on all responses obtained.

Similarly, the Relative Satisfaction Index (RSI) was used in rating selected attributes of a functional (sustainable) city as it relates to Ikot Ekpene urban, on a three-point scale. To calculate the RSI, the different levels were scored thus:

Satisfied (3) points, Partially Satisfied (2) points and Not Satisfied (1) point. The RSI for a particular attribute is calculated as:

$$RSI = \frac{3N1+2N2+1N3}{N1+N2+N3}$$

Where: N1 = Number of respondents who indicated “Not Satisfied”
N2 = Number of respondents who indicated ‘Partially Satisfied”
N3 = Number of respondents who indicated “Satisfied”.

5. Results and Discussion of Findings

Table 1 shows the questionnaire distribution and return rate in the study. A total of four hundred questionnaires were administered to respondents in the study area and a total of 396 of the questionnaire was returned. This indicated a response rate of 99% very high, this shows a high participation by the people considering the important of the project. Socio-demographic characteristics of the respondents on city centre redevelopment.

Table 1: Questionnaire distribution and rate of return

Study Area	No. of Questionnaire Administered	No. Returned	No. Not Returned	Response Rate
Ikot Ekpene City Area	400	396	4	99%

The specific socio-demographic characteristics of the respondents considered in this study were sex, age, marital status, educational attainment, occupation and income. Table 2 indicates information with regards to the socio-demographic characteristics of the respondents.

The sex determines the gender type of individual involves in the study which revealed that the number of male respondents interviewed in the study area was greater than the number of the female counterpart. This is indicated by 68.43% for males and 31.57% for female respondents. Age determines to some extent how mature an individual is to determine the implication of city centre redevelopment. The marital status indicates if individual is married or otherwise. The educational attainment level has some implications for the quality of labour requirement in any economy. The higher the level of educational attainment, the higher the quality of service expected from the person.

The occupation of the respondents actually involved the engagement of the respondents and this may determine the actual people affected in this programme. The income level has some implication as those displaced during the city centre redevelopment activities will affect their income generation. The study revealed that 68.43% of the respondents were males while 31.57% were female respondents. As indicated from the table above it is apparent that the domineering age group that was interviewed in the study area were those between the ages of 26-35 years and the least was those above 56 years of age. This is justified by 30.05% against 12.25% as presented above while 18-25 years had 23.99%, whereas 36-45 years had 15.91% and 46-55 years had 17.50%.

The study revealed that a total of 116 respondents representing 29.29% were single, 120 respondents representing 30% were married, while 81 respondents representing 20.46% were divorced and 79 representing 19.75% are widows. The educational attainment of the respondents revealed that 29.80% have primary education, 28.03 had secondary education, 19.75% had university/tertiary education while 12% had no formal education and 10% were for others. The study indicated that the most dominant occupation amongst the respondents was trading with 28%, the artisan had 25.26%, the unemployed respondents constituted 18.25%, while the public/civil servants had 13.8%, farming 10% and 4% of the respondents constituted others.

The income level of respondents in the study indicated that respondents with N11,000 - N20,000 income group had 28.75%, the group of N31,000 - N40,000 had 21.20%, those earning below N10,000 was 20.20% while N21,000 = N30,000 had 19.25% and N41,000 and above had 12.00%. The occupation and income level factors of respondents was mostly affected during the redevelopment programme.

Table 2: Socio-demographic characteristics of the respondents on city centre redevelopment

Variables		Respondents	Percentage (%)
Sex	Male	271	68.43
	Female	125	31.57
	Total	**396**	**100**
Age	18-25 years	95	23.99
	26 – 35 years	119	30.05
	36 – 45 years	63	15.91
	46 – 55 years	70	17.50
	56 and above	49	12.25
	Total	**396**	**100**
Marital Status	Single	116	29.29
	Married	120	30
	Divorced	81	20.46
	Widowed	79	19.75
	Total	**396**	**100**
Educational Attainment	No formal education	48	12
	Primary education	118	29.80
	Secondary education	111	28.03
	University/tertiary	79	19.75
	Others	40	10
	Total	**396**	**100**
Occupation of Respondents	Farming	40	10.00
	Trading	112	28.00
	Artisan	100	25.26
	Public/Civil servants	55	13.89
	Unemployed	73	18.25
	Others	16	4.00
	Total	**396**	**100**
Income Level of Respondents	Below N10,000	80	20.20
	N11,000 - N20,000	115	28.75
	N21,000 - N30,000	69	19.25
	N31,000 - N40,000	84	21.20
	N41,000 and above	48	12.00
	Total	**396**	**100**

5.1. Socio-economic Implications

The study revealed that quite a number of residents living within the Ikot Ekpene city centre were displaced from their original places of residence and relocated to other places assigned by the government and also compensated accordingly. The number of demolished structures were forty-six (46) which consists of 17 commercial buildings, 1 prison yard, 1 local government secretariat and 27 residential buildings. Using a household size of 6 people to calculate the population of displaced dwelling residence and household size of 3 for the commercial buildings, the population of displaced residents were calculated thus:

Residential:

Household size = 6 people

No. of residence = 27

Therefore, population = 6 x 27 = **162** people

Commercial:

Household size = 3 people

No. of commercial = 17
Therefore, population = 3 x 17 = **51** people

The total population of displaced people becomes 51 added to 162 people which gives **213** people. The population of both the prison yard and the local government secretariat were not analysed because the buildings are owned and operated by the government and compensation payment not relevant. Taking into consideration the number and percentage of the displaced residents in the redeveloped area, 213 people (0.38%) of the entire population in the study area. The relocation of the Federal prisons from the city centre to the out-skirt of the town will assuage the psychological feeling of a city in bondage with the establishment project.

The poor housing facilities that strung along the streets demolished and compensation paid to the few families that own them enable them relocate out of the city centre. This will mean the building of a new spare and auto-repairs workshop at an appropriate location outside the city. The redevelopment activities is a conscious and deliberate effort made to rearrange the road networks in the city centre. This is to reduce vehicular traffic into the city centre and encourage pedestrianization. This definitely will reduce vehicle/pedestrian conflict and competition for road space. The action was quite necessary to reinvent the city centre for a better growth and socio-economic development.

Table 3: Respondents satisfaction to redevelopment

Response Option	Number of Respondents	Percentage (%)
Fully satisfy	300	75.75
Partially satisfied	68	17.17
Not satisfied	28	7.08
Total	396	100

$N_1 = 28$
$N_2 = 68$
$N_3 = 300$

$$RSI = \frac{3 \times 28 + 2 \times 68 + 1 \times 300}{28 + 68 + 300}$$

$$RSI = \frac{84 + 136 + 300}{396} = \frac{520}{396}$$

$RSI = 1.31$

The above table 3 indicated the result of respondents rating of their satisfaction levels with the city centre redevelopment project. It is evident from the table that most respondents within the sample population were generally satisfied with the government redevelopment efforts. This is indicative by a percentage of 75.75% as against 17.17% who partially supported the redevelopment effort and 7.08% who do not support the redevelopment effort.

As this study has analysed it is unavoidably evident that quite a number of residents living within the Ikot Ekpene City Centre will be displaced from their original places of residence and relocated to other places assigned by the government and adequate compensation paid. The development of Ikot Ekpene city centre therefore represent a strong revitalization strategy in an overall land use planning. Apparently, physical decline makes redevelopment, a necessity for cities and investments is needed to reverse declining incomes and loss of middle-class population

6. CONCLUSION AND RECOMMENDATIONS

The study has noted a number of issues relating to the socio-economic implications of redevelopment of Ikot Ekpene city centre and having carefully identified the present state of the city centre. The population of the people that was displaced by the redevelopment project and the benefits of the redevelopment effort. The redevelopment action has promoted the city centre functionality by introducing the concept of pedestrianization in the study area. This definitely will reduce vehicle pedestrian conflict and competition for road space.

The new disembarkation points outside the city centre be encouraged to help transporters and travellers operate in a more comfortable environment. The city centre redevelopment effort into a public square is a good thing to happen in the study area in a couple of years' time, Ikot Ekpene will attend a century since the first local government in Nigeria was established. If these recommendations are adopted it will lead to a total transformation of the area to modern city square.

REFERENCES

Egunjobi, Layi (1983). "Upgrading of Housing Stock as an Essential Part of Housing Policy in Depressed Economy." Paper Presented at the 14th Annual Conference of NITP Ibadan.

Egunjobi, Layi (1987). "Urban Renewal Issues, Policies, Strategies and Planning in Adepoju, G. O. *et. al.* (eds.) Ibid.

George, C. K. (2009). The Challenges of Urbanization in Nigeria Urban Centres: The Lagos Mega City Situation – A planner's Perspective.

Jothimoni (1997). Dynamics of Urban Sprawl Changing and Mapping.

Koebel, C. T. (1996). Urban Redevelopment, Displacement and the Future of the American City. Virginia Polytechnic Institute and State University.

Koebel, C. T. and Squires, G. D. (1990). Unequal Partnerships: The Political Economy of Urban Redevelopment in Postwar America. New Brunswick, N.J.

Nair, K. K. (1972). Politics and Society in South Eastern Nigeria, 1841 – 1906, London, Frankcass.

NPC (2006). Nation Population Commission, Abuja.

Okpala, D. (1986). Institutional Problems in the Management of Nigeria Urban Environment NISER Monogram Series, No. 15.

Onokerhoraiye, A. and Omuta, G. (1986). Urban Systems Planning, University of Benin Planning Series Publications.

Sonar G. (2008). Urban Sprawl A System Dynamic Approach. 44th ISOCARP Congress, China.

Tesco-Kotzi (1974). Regional Setting and Master Plan for Ikot Ekpene.

Udo, E. U. (1970). The History of the Annang People, Calabar Nigeria: APCAN Press Ltd.

Uyo Master Plan: Site Appraisal Report and Alternative Concepts Plan (1988). Inter Designs Partnership.

Uzoagulu, A. E. (1998). Practical Guide to Writing Research Project Reports in Tertiary Institutions. Enugu: John Jacobs Classic Publishers Ltd.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

DIGITAL TRANSFORMATION OF THE CONSTRUCTION INDUSTRY UNDER THE FOURTH INDUSTRIAL REVOLUTION

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ABSTRACT

Purpose: This study presents the result of an investigation of the fourth industrial revolution and digitalisation within the Nigeria construction industry from the construction firm's perspective.

Design/methodology/approach: The study adopted a qualitative research approach through the interview, carried out among eight case companies in Abuja, Nigeria. Thematic analysis was used in analysing the data generated. The specific method of thematic analysis adopted was conversational analysis.

Findings: The study revealed that fourth industrial revolution systems and processes such as: RFID, BIM, and cloud computing have 87.5% level of adoption; internet of things witness 100% level of adoption; drones with 75% level of adoption and Big data witness 62.5% level of adoption. However, augmented reality, robots and 3D printing have 37.5%; 12.5% and 0% level of adoption respectively, indicating a low level of adoption of the systems and processes that constitute fourth industrial revolution.

Originality/value: The study concluded that the adoption of the fourth industrial revolution and digitalisation in the construction industry has started but its full adoption has been slow and foreign construction firms have adopted more of the systems and processes of the fourth industrial revolution when compared to indigenous construction firms. The study recommends an increase in awareness of the fourth industrial revolution through seminars, workshop and training on the fourth industrial revolution.

Keywords: Construction industry; digitalisation; industry 4.0; Nigeria; qualitative research.

1. INTRODUCTION

The world is currently at the beginning of a fourth industrial revolution, it began at the turn of this century and it is building on the digital revolution (Schwab, 2016). The fourth industrial revolution is characterised by a much more ever-present and mobile

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internet, by smaller and more powerful sensors that have become cheaper, and by artificial intelligence and machine learning (Schwab, 2016). Li and Yang (2017) referred the fourth industrial revolution as an era employed by intelligence at its peak. Before the fourth industrial revolution, they were other revolution such as: first industrial revolution was characterised by water and steam power to mechanise way of doing things; second industrial revolution focused on electric power for the mass production process, and the third industrial revolution used electronics and information communication technology to automate production. One of the major challenges of the existing industrial revolutions is the fact it does not support machine to machine communication and transfer of data between two devices (Lavanya *et al*., 2017). On this platform the fourth industrial revolution was introduced.

The fourth industrial revolution can be traced to Germany in early 2012 (Rojko, 2017). The manufacturing industries in Germany sought for way to overcome its challenges and the solution arrived at, ushered the industry to the fourth industrial revolution and outcome of this revolution has helped the construction industry stay competitive, and also today Germany's manufacturing industry is one of the most competitive industries in the world. Since the introduction of the fourth industrial revolution, it has swept around Europe and also in Asia, and this revolution has enabled a total connection of people and the work environment (Rojko, 2017; Osunsanmi *et al.,* 2018). The fourth revolution is characterised by the internet and also the speed at which work is done and an important part is that it is customer friendly.

The introduction of multiple technological advancements in areas, such as; artificial intelligence, advanced robotics, automation systems, big data, 3-D technology, virtual/augmented reality and the internet of things (IoT) has changed and alter the way worked is done and life is lived (Lavanya *et al*., 2017). Therefore, the fourth industrial revolution is built on a vision of having a future, where work is done is automated. The fourth industrial revolution consist of systems and processes such as; mobile solutions, cloud computing, internet of things, data analytics, cyber physical systems and advanced manufacturing technologies such as robots, laser scanner, and 3D printing (CGI, 2017; Osunsanmi *et al*., 2018; Berger, 2016; Leal *et al.,* 2018; Rojko, 2017; Crnjac *et al*., 2017). Lavanya *et al.* (2017) argued, the fourth industrial revolution is not just about its components but an introduction of new inter-disciplinary field that combined both the cyber physical systems, the internet of things and service and smart factories.

Furthermore, several studies reviewed did not take into cogitation the systems and processes that constitute the fourth industrial revolution adopted among construction firms, and this reflects a gap in the evaluation of the adoption of the fourth industrial revolution in the Nigeria construction industry. This demand the need for the study.

Having gone through the variables that constitute the background of the study, it can be understood that there is a need to carry out a study on the fourth industrial revolution and digitalisation of the construction industry in Nigeria with a view to focus on the adoption of the systems and processes that constitute the fourth industrial revolution by the construction industry. The aim of the study is to investigate the fourth industrial revolution and digitalization of the construction industry in Nigeria, with a view to determining the fourth industrial revolution systems and processes currently adopted by construction firms in Nigeria.

2. REVIEW OF RELATED LITERATURE

The specific challenge facing the construction industry around the world is the challenge of slow or low adoption and application of digital technologies. The case might not be different in the Nigerian construction industry, as low adoption to the digital trend is an identified problem that has inhibited the growth of the construction industry (Ezeokoli, *et al.,* 2016; Osunsanmi *et al.,* 2018). However, the authors above revealed that the level of adoption and application of digital technology was at infancy stage, moreover, this could be due to lack of capacity, technical knowledge and digital transformation dynamism among managerial teams. This challenge has contributed to the low productivity of Nigeria indigenous construction firms. Aniekwu and Audu (2010) revealed that Nigeria construction firm's productivity is at a low level when compared to that of foreign counterpart.

However, since the introduction of multiple technological advancements in areas, such as; artificial intelligence, advanced robotics, automation systems, big data, 3-D technology, virtual/augmented reality and the internet of things (IoT) has changed and altered the way worked is done and life is lived (Lavanya *et al*., 2017). Therefore, the fourth industrial revolution is built on a vision of having a future, where work is done is automated. The fourth industrial revolution consist of systems and processes such as; BIM, RFID, Drones, cloud computing, internet of things, data analytics, cyber-physical systems, augmented reality, automation, and advanced manufacturing technologies such as robots, laser scanner, and 3D printing (CGI, 2017; Osunsanmi *et al*., 2018; Berger, 2016; Leal *et al.,* 2018; Rojko, 2017; Crnjac *et al*., 2017).

Osunsanmi *et al*. (2018) asserted that systems and processes of the fourth industrial revolution such as BIM were one of the first innovation providing the background for the fourth industrial revolution in the construction industry. Azhar (2011) added BIM was conceived to revolutionise construction sector in many aspects. BIM involves capturing the additional layers of information throughout the entire lifecycle. BIM is used on construction sites due to its ability to provide a simulation about the technical information of the building regarding cost estimate, material inventories, collaboration and time for completion.

The fourth industrial revolution systems and processes such as radio frequency identification (RFID), is used in tracking equipment, tools, monitoring, theft prevention and inventory management, and also the device is attached with sensors that can act as a tracker to locate stolen equipment. Augmented reality is a technology that coordinate virtual objects or images in real-world images (Ismail *et al*., 2018). Augmented reality is deployed to create or provide an efficient way to visualise the progress of construction projects and marker-based AR are used to facilitate on-site information for construction site activities.

According to Leal *et al*. (2018), the fourth industrial revolution is based on cyber-physical systems (CPS) and these systems deals with a deeper interaction of the real and virtual world. The fourth industrial revolution is an execution system that is based on the connections of cyber-physical building blocks and these blocks are embedded system with decentralised control, advanced connecting that are collecting and exchanging real-time information to identify, locate, tracking, monitoring and optimising the production (Rojko 2017). CPS is defined as a concept that combines the physical and cyber world. Lee (2010) these systems act as if they were one, and this means everything that happens in the physical impacts on the virtual and vice versa.

Automation is a key concept in the fourth industrial revolution. Automation of the construction process makes day to day construction operation easier, faster, better and even free construction firms from labour and monotony of repetitive tasks (Madakam, Holmukhe, and Jaiswal, 2019). Robots are electromechanical designed machine,

programmable by a computer and are capable of carrying out a complex series of action automatically, robots have the intelligent connections of perception to action and these robots carry out the task by moving into the real world (Madakam *et al*., 2019). For instance, Hadrian robots are designed for bricklaying. These Hadrian robots can build a house in two days with the ability to lay 1000 bricks per hour and can be part of construction activity where work is to be performed in dangerous conditions to optimise the operation and improve safety in work environment (Singh *et al*., 2017; Berger, 2016).

3D technology is relatively at its infant stage in developing countries like Nigeria (Raji, 2017). Hager, Golonka, and Putanowicz (2016) agreed 3D printing is still young and presents a lot of limitations, but there are high expectations and hopes for the future of 3D printed buildings and building components. Tay, Panda, Paul, Noor Mohamed, Tan, and Leong (2017) stated that 3D printing of full-scale construction components is still an emerging technology and as an alternative construction method is attracting increasing attention.

According to Balogun, Otanocha, and Ibhadode (2018), 3D printing technology is currently used in prototyping and distributed manufacturing with applications in architecture, construction, industrial design, automotive design, aerospace, military, engineering, and so on. From a construction perspective, 3D printing can be used different stages of the design process (Leal *et al.,* 2018). Balogun, *et al*., (2018) further suggested 3D printing can be applied in an area which could include for example, in Engineering, this technology is adopted in iterative designs, robust parts and precision prototyping and could enhance designs and help engineering (project) teams manage risks and understand the performance implications of designs. Andrade (2016) asserted in the conceptual stage, the 3D printing technology can help understand the relationship between building and its environment, testing a constructive feature, visualising the design solutions, and also combining the study of complex form.

There lies an opportunity in adopting fourth industrial revolution systems and processed such as big data, as construction firms are leveraging big data to lead its market (Maaz *et al*., 2018). Since the introduction of big data, construction firms that adopt it will gain insight and improve productivity, customer experience, reducing business cost and opportunity to new business, and also big data will increase from 5% to 6% profitability of construction firms (McAfee and Brynjolfsson, 2012). Therefore, there are need to utilise the potentials of big data (technological advancement) which will require having a place in the system and capabilities to make sense of the unprecedented flood of data.

One of the major or main advancements of the fourth industrial revolution, which bridge the gap between the physical and digital application is called the internet of things and sometimes referred to the internet of all things (Schwab, 2016). Mahmud *et al*. (2018) further explained the concept of internet of things as a man-made technology invented by the involvement of intelligent virtual objects, which are capable of knowing all things and also allows devices to connect and interact automatically without human control. Chandanshive and Kazi (2017) the internet of things (IoT) as a combined division of forthcoming internet, it involves the combination of prevailing and rapid development and also the internet of things is a branch of information technology which generates a connectivity link between the internet and actual physical things.

There has been significant adoption of ICT by the construction industry over the past 35 years (Teicholz, 2004). Xiao, Yamani, and Md (2018) posited an important advancement in the delivery of information technology (IT) in the construction industry is cloud computing. Redmond, Hore, West, and Alshawi (2010) argued that the construction industry has been traditionally recognised as a fragmented sector associated with a poor level of implementation and penetration of Information Communication Technology (ICT).

The new Information and communication technologies (ICTs) promising significantly change in the construction industry is cloud computing technologies and this technology is not new to construction stakeholders, as they have utilised it in one way or the other, informally or formally and the examples of cloud service are Google App Engine, Google Drive, Google Doc, Microsoft Office Live and Dropbox are commonplace to construction professionals (Afolabi, Ojelabi, Fagbenle, and Mosaku, 2017).

Drones such as an unmanned aerial vehicle (UAV) is an aircraft operating under remote/autonomous control without a human pilot on board and this type of drones do not carry pilot, instead, the drone can fly autonomously or be remotely piloted (Dastgheibifard and Asnafi, 2018). Drones are capable of sensing and responding to their environment, drones will be able to perform tasks such as checking electric power lines or delivering medical supplies in war zones (Schwab, 2016). Janssen (2015) opined drones are aerial modules that are deploying to be operated by a manned remote or by a predetermined flight path. Drones have been greatly used in different construction and operation applications of various types of construction projects. Drones can be deployed to many areas of construction activities. Cajzek, Gradnje and Klanšek (2016) developed an unmanned aerial vehicle for multiple purpose usage in the construction industry such as construction site monitoring, the examination of construction, infrared thermography, photogrammetry, transport application, and also for marketing activity. The unmanned aerial vehicle is needed in construction projects to collect visual data in form of images, videos, as well as 3D models from the most relevant locations and views of a construction site (Dastgheibifard and Asnafi, 2018).

3. RESEARCH METHODOLOGY

This study adopted a case study research approach and qualitative data were gathered from construction firms operating in Abuja, Nigeria. Towards meeting the objectives of the study, which entails assessing the fourth industrial revolution systems and processes currently adopted by construction firms. Since the study deployed a case study approach, hence it is right to adopt a purposive sampling technique. Purposive sampling is extremely useful when a researcher wants to construct a historical reality, describe a phenomenon or develop something about which only a little is known and also purposive sampling strategy is more commonly used in qualitative research. The instrument for data collection for the study was the interview. The interview was employed to have an in-depth understanding of the fourth industrial revolution and digitalisation and also to gain an understanding of underlying reasons, opinions and motivation to uncover trends in thought, thereby diving deeper view into the fourth industrial revolution. Eight construction firms were interviewed in a category of four foreign and four indigenous construction firms. The study has an attribute of multiple case studies. Eisenhardt (1989) posited some cases between four and ten in multiple case studies, reasons that with less than four cases it might be difficult to generalise as you cannot get much complexity and with more than ten cases the complexity and volume might become too heavy. To analyse the qualitative data generated, the study adopted a thematic analysis. Guest (2012) posited the most common forms of qualitative analysis are thematic analysis. Thematic analysis is deployed in pinpointing, examining, and recording patterns of meaning or themes within data and the specific method adopted was conversational analysis. The conversation analysis focus on a detailed exploration of the conversation between two or more people. The purpose of data analysis in qualitative

research is to recognize or identify similarities, differences and patterns and description of the matter studied.

4. DATA ANALYSIS, RESULTS AND DISCUSSION OF FINDINGS

4.1. Details of 'Case' Companies Representative

Table 4.1 indicates the information of the case companies' representative from the position held in the company, to the profession of the representative and also their respective working experience in the company and the construction industry at large.

Table 4.1: Details of case companies' representatives

S/N	Company Type	Categorisation of the company	Position Held	Profession	Working experience
1.	Company A	Foreign	Asst. IT manager	IT Eng.	12years in IT business and 3years in the company
2.	Company B	Foreign	Project Manager	Quantity Surveying	21years in the construction business and 20years in the company
3.	Company C	Foreign	Asst. IT manager	IT Eng.	12years in IT business and 3years in the company
4.	Company D	Foreign	Project Manager	Quantity Surveying	20years in the construction business and 15years in the company
5.	Company E	Indigenous	Project Manager	Architecture	10years in construction business and years in 3years
6.	Company F	Indigenous	Cost Accountant	Quantity Surveying	20years in the construction business and 17years in the company
7.	Company G	Indigenous	CEO/Project Manager	Architecture	20years in the construction business and 12years in the company
8.	Company H	Indigenous	HOD Technical Unit	Quantity Surveying	11years in the construction business and 11years in the company

Table 4.1 indicates the categorisation of the case companies are into foreign and indigenous construction firms (four foreign and four indigenous, in a total of eight), were interviewed to have an in-depth understanding of the fourth industrial revolution. Table 4.1 also indicates the position held by the case companies' representatives. Four representatives are project managers (company B, D, E and G). While representative of company 'A' and 'C' are assistant I.T managers. Company 'F' representative position held as the cost accountant of the company and company 'H' held the position of the head of the technical

unit. Table 4.1 further indicates the profession of the case companies' representatives. Company B, D, F and H, representatives are registered quantity surveyors and company E and G representative are registered architects and also company A and C are information technology engineers.

Table 4.1 shows the working experience in the respective case companies and the construction industry at large. Company A and C worked in the I.T business for 12 years and both worked for the company for 3yrs. Company 'B' representative worked in the construction business for 21 years and 20 years with the company. Company 'D' worked in the company for 15 years and have been in the construction business for 20 years and company 'E' had 10 years working experience and have worked with the company for 3 years. Furthermore, company 'F' worked in the construction business for 20 years and worked with the company for 17 years and company 'G' representative worked in the construction business for 20 years and worked with the company for 12 years. Company 'H' representative has been in the construction business for 11 years and has been with the company for 11 years.

4.2. Fourth Industrial Revolution Systems and Processes Currently Adopted by Construction Firms in Nigeria

Table 4.2 revealed major findings on the fourth industrial revolution systems and processes currently adopted by construction firms in Nigeria. Systems and processes such as; RFID, BIM, internet of things, cloud computing, drones, big data, augmented reality, robots and automation were revealed.

As revealed in Table 4.2, indicates the analysis of the major findings and issues addressed concerning the fourth industrial revolution systems and processes currently adopted by construction firms in Nigeria. The major interviewed findings show company 'A, C, D and E' have adopted the fourth industrial revolution and also the application was high for the respective company. While company 'B, F, G, and H', just started the adoption of the fourth industrial revolution systems and processes but at a slow pace of adoption, and also the application of this systems and processes has been low (Table 4.2). the fourth industrial revolution systems and processes such as; RFID, BIM, internet of things, cloud computing, big data, drones, augmented reality, robots, and automation was adopted by various case companies interviewed.

Table 4.2 further showed the case company representatives response on systems and processes of the fourth industrial revolution currently adopted by their respective companies. According to Company 'A' claimed,

"Many of these things from what I know we have many of these things in place that is why I said there is room for improvement because in many of our construction sites, you see drones and it gives us real-time situation on the ground on sites".

Company B' also claimed "the one we are trying to work on presently is BIM, which I think we deploy on one of the projects", the project was an international project and all those things have to be synchronised before we commence. Company E' indicated the company have adopted much innovation so as it can facilitate the construction of smart homes,

"We adopted BIM, RFID, drones, augmented reality, cloud computing, internet of things and before I forget automation, which is the foundation the company is built.

Company C' indicated the company use drones for monitoring project due to their sizes, they also do BIM, "We have to understand what we are building, we have to make it look

real, so we that with BIM.

Table 4.2: Major Findings on the Fourth Industrial Systems and Processes Currently Adopted

Key info. Provider	Major Interview Findings	Issues Address
Company 'A'	"We have adopted the fourth industrial revolution, we have gone far in the application and the adoption for the company has been high"	Company 'A' adopted; RFID, BIM, IoT, cloud computing, drones, Big data, augmented reality, robots, and Automation.
Company 'B'	"The company is just at the beginning stage of the adoption of the fourth industrial revolution, although the adoption and the extent of application has been low for the company"	Company 'B' adopted; RFID, BIM, IoT, cloud computing, and Big data
Company 'C'	"The company have adopted the fourth industrial systems and processes, the rate adoption and extent of application has been high but there is room for improvement"	Company 'C' adopted; RFID, BIM, IoT, cloud computing, drones, Big data, augmented reality, and automation
Company 'D'	"The company have started the adoption of the fourth industrial revolution and the rate of the adoption and the extent of application has been satisfactory to the company"	Company 'D' adopted; RFID, BIM, IoT, cloud computing, drones, Big data, and automation
Company 'E'	"The company are currently building smart homes with the aid of the fourth industrial revolution, the adoption and also extent of the application has been high and the company process and operations have been automated for some time now"	Company 'E' adopted; RFID, BIM, IoT, cloud computing, drones, Big data, augmented reality, and automation
Company 'F'	"The company just started the adoption of the fourth industrial revolution, the adoption and the extent of application of these systems and processes have been low/poor"	Company 'F' adopted; RFID, BIM, IoT, cloud computing, and automation
Company 'G'	"Honestly speaking the company just started the adoption of the fourth industrial revolution systems and processes, the extent of application has been low, due to fact the company just started"	Company 'G' adopted; BIM, IoT, cloud computing, drones, and automation
Company 'H'	"The company just introduce about two to three systems and processes of the fourth industrial revolution, the adoption and the extent of application has been low"	Company 'H' adopted; RFID, IoT, and drones

Company D' claimed the company have adopted internet of things, BIM, RFID, drones and automation, while company F' added the company have adopted BIM, internet of things, "We are at the early adoption of cloud computing and we try as much as to automate our processes". Company H' said "For now, one adopted by this company is radio frequency identification and company G' had to wait for follow up questions to indicate which system and processes currently adopted by the firm.

4.2.1. RFID

Radio frequency identification is innovation-based tools to help stakeholders in the construction industry, by collecting and managing data over the portable database and this tools also assists stakeholders in the construction industry in communication various routing and control instruction. RFID based systems collect and distribute information among construction stakeholders or construction professionals at the construction sites.

Seven out of eight case companies agreed to have adopted RFID only company G have not adopted the RFID. The companies that adopted the RFID use it to track their equipment, product to prevent it from been stolen. According to Company 'A' claimed that all their vehicles and equipment use a tracker that sends the location of equipment and this enables their construction firms to keep records and prevent theft. Company 'B' added since we started using RFID we have not to record any theft of equipment. Company 'C' suggested the adoption of RFID will help construction companies to track, monitor materials and equipment which in turns develop automated timesheets.

The RFID offers and provides a wireless medium for gathering and storing data, this will enable the construction firms to trace the real-time information of any tracked equipment or vehicles. RFID deploy tags, these tags provide information on specification, dates, detects, vendor original equipment manufacturers, maintenance records, operating parameters and among other application.

4.2.2. BIM

The major point of the fourth industrial revolution and digitalisation of the construction industry is the connection of embed sensors on equipment and at each stage of construction projects to monitor progress with the help of virtual simulation such as BIM. BIM allows the digital simulation of construction projects before the construction starts. Company H' have not yet adopted BIM, while the rest have adopted BIM. Company 'A' revealed

"For more than a decade now, we have been planning our projects in a 3-dimensional way and we have been handling all our projects using BIM, it helps us to ensure quality and safety of operations, it also helps us to reduce waste and improve our overall performance".

According to company 'E' claimed

"We use BIM to simulate our projects before it starts, so we can minimise errors and in turn reduce waste and ensure quality and safety".

BIM provides all needed information on the entire lifecycle of a proposed project from inception to completion. Company F' claimed,

"Honestly you cannot be relevant in the construction industry without BIM, the BIM is here to assists us to have a view on how this project will be in real life and we adopted BIM to help us minimise waste".

Company 'C' claimed that you cannot be in this construction business and you operate without BIM.

"BIM gives you an advantage in stiff competition, you complete projects on time, you eliminate errors and even reduce waste of materials and even before the project commence it gives you the view on how the project will be after completion" Company 'C'.

4.2.3. Internet of things

The internet of things has been adopted by all case company representative interviewed. Company G' revealed that their devices are highly connected and company C' added the internet of things is about making everything even non-living thing smart and these

technologies are already integrated into the company,

"We need them to be smart, we need them to be connected".

Company 'A' suggest internet of things is a smart network that can detect, control and program objects automatically and also the important potential areas of the application of internet of things in construction operation/industry could include logistics, transport, assets recording, energy-saving, intelligent homes and buildings. Internet of things offers great connections of devices.

Company 'H' added internet of things is the way of life now, the world is more connected than ever before, and also the internet of things offers smart communication such as social media. Company 'B' claimed

With this internet of things, you are capable of knowing all things and connect at any point without stress and the good things about this internet of things, it can view any context anytime, can be used by anyone, can be used on any device, can be used at any place and anytime, work on any network or any path and can be adapted for any business.

Internet is a way of life and the smart connectivity and ease of access to the internet of thing are what makes it unique for the construction business. Company 'F' added internet of things has helped us improve on our decision making, better our communication, which before now has been poor.

4.2.4. Cloud computing

Cloud computing is a disruptive innovation of the internet of things, which on-demand access to a shared pool of configurable resources is provided. Cloud computing is applied in the construction industry in various including but not just limited structural analysis cost estimating, architectural design, procurement management, and project planning and control.

Company A – G' have adopted cloud computing, only company H' still have many of their information in hard copies. Company C' claimed

"As you can realise we can't continue to rely on on-premises computing, we have to move to the cloud as an augmentation or though we augment it with the cloud, having our data on the cloud and stuff like that it makes us more secure than when we just had them on sight and premises".

The advantage of using cloud computing in the construction industry is to make better use of distributed resources, combined them to achieve greater output. Also, cloud computing supports the construction industry and its currently available collaboration tools such as desktops, internet networks, tablets, smartphones and laptops.

4.2.5. 3D printing

All case companies interviewed agreed not to have adopted 3D printing. 3D printing involves the printing of full-scale construction components is still an emerging technology and as an alternative construction method is attracting increasing attention. However, 3D printing is a concept of creating the entire building which is now being explored around Europe already and also there exists a prototype printer system which utilizes concrete as well as other specialised materials to make a structure comparable to a small house. The 3D printing starts with loose materials and then build objects into a 3D dimensional shape by using a digital template, by so doing makes 3D printing products are to be easily customised. 3D printing is a system of the fourth industrial revolution that needs to be adopted.

4.2.6. Drones

The adoptions of drones are still at the early stage in the construction industry in Nigeria. Construction firms that have adopted the drones, use drones to take aerial views, pictures and to monitor work progress.

Company 'A' claimed that drones are unmanned aerial vehicle (aircraft) operating under a remote control without a human pilot, drones are capable of sensing and responding to their environment. Company E' claimed that the company have adopted drones,

"Yes, we have drones, we use them to take shots, we take the aerial view, we take the landscape of our so many sites",

And company C' gave a holistic response,

"Drones are a very important part of what we do, we need to capture the moment, we need to ensure that there is monitoring", you can't be with the workers in person but we can be with them with drones and then ensure they are doing the right thing.

Company D added drones are flying objects,

"We use it to capture real-time images, monitor and have an aerial view and communicate these images to our office or client as part of progress report".

Only company B and F have not adopted drones.

4.2.7. Big data

Big data offers great benefits, notwithstanding the adoption of big data is still at the infancy stage. Company A, B, C, D, and E' adopted big data. Company C' responded to the follow-up question by saying

"yes, we have to keep analysing stuff, we have to keep analysing our data, keep knowing so that we can make trend, we can look at the trend in the construction industry and see how we can improve on them, so yes big data, very well we analyse data".

Company 'B' claimed big data reflects the situation of an extremely large amount of data for the current technology capacity to store, manage and process efficiently. The big data has attributes which are; volume (terabytes, petabytes of data), variety, (texts, sensors, audio, video, graphs), velocity, (continuous streams of data).

Company D' added that the company have adopted big data and it has helped the company decision making. Company A' claimed by saying "we have a big data centre and we are building a very big, big data centre in the country". Company F, G, and H' that have not adopted big data. Company 'E' claimed big data helped us turn data into actionable insights, which has to improve our decision making and reduce operational costs.

4.2.8. Augmented reality

Company A, B, C, and E' have adopted augmented reality. Company E' claimed

"We use it to place a model of a proposed project or design on an existing space; this is made possible via mobile devices and 3D model, the application of augmented reality in this company ranges from project planning, automated measurements, project modification, team collaboration, safety training and on-site project information, so you see how augmented reality has been an important tool for this company".

Company B' also claimed, "I think we do with the help of the architectural department, they come with a model and we try to synchronised everything that has to be in that building, we do use that". Company 'C' also added, we adopted augmented reality to provide an efficient way to visualise the construction projects. Augmented reality gives the clients or construction stakeholders that the object is present in view even though it is absent physically. Company B, F, G, and H' have not adopted augmented reality.

4.2.9. Robots

Only company A' adopted robots. Company 'A' claimed,

"We have adopted robots; we deploy it on repetitive, predictable activities and it has optimised operation and improved safety in work environments. These robots offer to us an effective way of mechanisation of our company, thereby increasing productivity, speed, and quality of products we put out there".

Company 'A' further added robots are artificial intelligence which involves the simulation of human intelligence in machines; they are programmed to think like a human. Robots are gaining popularity; influencing the way we live, interact and improve client experience.

4.2.10. Automation

Company F' started the company to some extent automate its processes and company C' also agreed "Yes, we try as much as possible to automate our processes to the extent we can, though we still need a lot of manpower". Company 'C' claimed that the company use sophisticated technology, highly automated which makes activities fast and easier. Company G' responded by saying "Well, some clients do request for that and we apply it". Company 'A' claimed that their construction processes are highly automated which makes the day to day site operation easier, faster, better and also free the company of monotony of repetitive tasks and also free the company from labour.

Company E' gave more insight,

"Yes we automate our processes, and let me tell you it is a way of simplifying our day to day activities or construction, like for us as a company is a way that you simplify interaction between you and your homes, commanding things for you without you making effort to do, the automation comes in different part, you have the security part of automation, you have the convenient part of automation, you have the entertainment part of automation and lastly the access part of automation".

In summary, fourth industrial revolution systems and processes such as: RFID, BIM, and cloud computing have 87.5% level of adoption; internet of things witness 100% level of adoption; drones with 75% level of adoption and Big data witness 62.5% level of adoption. However, augmented reality, robots and 3D printing have 37.5%; 12.5% and 0% level of adoption respectively, indicating a low level of adoption of the systems and processes that constitute fourth industrial revolution.

Company A, C, D, and E' rate the adoption of the systems and processes of the fourth industrial revolution very high but still believe there is still room for improvement while company B, F, G, and H' rate the adoption very low for their respective companies (Table 4.3). The internet of things and RFID, BIM, and cloud computing were adopted by seven case companies. Follow by drones and automation, adopted by six case companies and big data adopted by five case companies. Augmented reality was adopted by three case companies (A, C, E), only company A' adopted robots. 3D printing was not adopted by all case companies.

Only company A' had 90% level of adoption on the systems and processes that constitute the fourth industrial revolution, while company C, and E' witnessed 80% level of adoption and company D' had 70% level of adoption of the systems and processes that constitute the fourth industrial revolution. Company B, F, and G' witnessed 50% level of adoption and company H' had 30% level of adoption of the systems and processes that constitute the fourth industrial revolution systems and processes, and this company that adopted the least.

Table 4.3: Cross Case Analysis of Interview Findings on Fourth Industrial Revolution Systems and Processes Currently Adopted

S/N	Similarities of Issues Address	Differences of Issues Address
1.	RFID was adopted by both foreign and indigenous construction firms (company A, B, C, D, E, F, and H)	Company 'G' did not adopt RFID. RFID was adopted more by foreign construction firms (company A, B, C, and D) when compared to indigenous construction firms
2.	BIM was adopted by both foreign and indigenous construction firms (company A, B, C, D, E, F, and G)	Company 'H' did not adopt BIM. BIM was adopted more by foreign construction firms (company A, B, C, and D) when compared to indigenous construction firms
3.	Internet of things (IoT) was adopted by both foreign and indigenous construction firms (company A, B, C, D, E, F, G, and H)	No difference in the adoption. Internet of things witness the same level of adoption between both foreign and indigenous construction firms
4.	Cloud computing was adopted by both foreign and indigenous construction firms (company A, B, C, D, E, F, and G)	Company 'H' have not adopted cloud computing. Cloud computing was adopted more by foreign construction firms (company A, B, C, and D) when compared to indigenous construction firms
5.	3D printing was not adopted by both foreign and indigenous construction firms (company A, B, C, D, E, F, G, and H)	No difference, since none adopted it. 3D printing witness the low level of adoption between both foreign firms and indigenous firms
6.	Drones were adopted by(company A, B, C, D, E, F, G, and H) (company A, C, D, E, G, and H)	No difference in the adoption. Drones witness the same level of adoption between both foreign and indigenous construction firms
7.	Big data were adopted by both foreign and indigenous construction firms (company A, B, C, D, and E)	Company F, G, and F have not adopted Big data. Big data was adopted more by foreign construction firms (company A, B, C, and D) when compared to indigenous construction firms (Company 'E' was the only indigenous firm to have adopted it
8.	Augmented Reality was adopted by both foreign and indigenous construction firms (company A, C, and E)	Company B, D, F, G, and H, did not adopt augmented reality. Augmented reality witness low level of adoption when compared to other systems and processes of the fourth industrial revolution
9.	Robots witness low adoption by both foreign and indigenous construction firms. It was not adopted by (company B, C, D, E, F, G, and H)	Only Company A (foreign firm) adopted robots
10.	Automation was adopted by (company A, C, D, E, F, and G) Automation witness the same level of adoption between both foreign firms and indigenous firms.	Company ‘B’ and ‘H’ have not adopted Automation No difference in adoption as automation witness the same level of adoption between both foreign firms and indigenous firms

Table 4.3 revealed the similarities and differences in the issues addressed by both foreign and indigenous construction companies on the fourth industrial revolution systems and processes currently adopted. Systems and processes of the fourth industrial revolution such as; RFID, BIM, internet of things, cloud computing, drones, big data, automation are evident in both foreign and indigenous construction firms while 3Dprinting augmented reality and robots witness low adoption by both foreign and indigenous construction firms.

In conclusion, Table 4.3 shows no difference between both foreign and indigenous construction firms in the adoption of the internet of things, 3D printing, drones, and

automation. The major difference in the adoption of the fourth industrial revolution systems and processes by construction firms in Nigeria was the fact that these fourth industrial revolution systems and processes were adopted more by foreign construction firms when compared to the indigenous construction firms (Table 4.3). The indigenous construction is still saddled with the problem of low adoption to digital trend, this low adoption will hamper the growth of indigenous construction firms and also the indigenous construction firms might find it difficult to compete with the foreign counterpart.

4.3. Discussion of Findings

This study recognised the fourth industrial revolution in the construction industry is driven by the need to have an improved construction industry. The result from this study shows that the systems and processes of the fourth industrial revolution such as the internet of things have been largely adopted by foreign and indigenous construction firms in Nigeria. The adoption of the internet of things is to make things smart, construction of smart homes, use of smart devices and get things connected. This finding agrees with Bilal *et al*. (2016) suggested the primary vision behind the adoption of the internet of things is to bring together smart devices and objects together.

The results of the finding revealed the adoption of RFID in the construction industry was at a peak and their applications in the tracking of equipment are evident in the construction industry. This finding supports Osunsanmi *et al.* (2018) observed RFID in construction processes are a device used in the tracking of equipment and tools, monitoring, theft prevention and also the device is attached with sensors that can act as a tracker to locate stolen equipment or tools.

Another significant finding of the fourth industrial revolution systems and processes currently adopted is the BIM, the adoption was high, as its application involves the simulation of projects before it starts, minimises errors, eliminates waste and provides needed information on the entire lifecycle of a proposed project from inception to completion. This similar to the finding from Azhar (2011) observed that BIM involves the capturing of additional layers of information throughout the entire lifecycle of the building. Furthermore, BIM has five features; simulation, visualisation, coordination, optimisation, the ability to create and providing information about the whole life cycle of any projects, therefore eliminate waste and minimise errors. The adoption of BIM is evident in both foreign and indigenous construction firms.

The result from the finding shows the adoption of cloud computing is evident in both the foreign and indigenous construction firms in Nigeria. This finding is similar to Afolabi *et al*. (2018) observed, cloud computing has a significant change the construction industry, and it is not new to construction stakeholders and construction stakeholders have utilised cloud computing in one way or the other, informally or formally.

The results from this study show the high adoption of drones by both foreign and indigenous construction firms and were used to capture real-time scenario/images and monitor construction works. This finding is in line with findings from Tatum and Liu (2017) who suggested that drones collect real-time information from the location of personnel, equipment, hazards materials, moving equipment as well as the blind spot of a construction site to prevent the unsafe condition.

The findings of the study show the adoption of automation is evident in the construction process, much of the construction processes in Nigeria, are automated which in turn makes construction work easier, faster, and it simplifies day to day construction activities. This

finding collaborates with Madakam *et al*. (2019) suggested that automation of the construction processes makes day to day operation easier, faster, better and even free from construction labour and monotony of repetitive task.

The finding of this study shows the adoption of big data is moderate and still at the infancy stage in the construction firms in Nigeria. This finding confirms Maaz *et al.* (2018); Ismail *et al*. (2018) both observed big data from the lens of the construction industry is limited in contrast to the other industries resulting to primitive understanding. However, construction activities generate a high volume of data exchange from many stakeholders to be gathered and processes, the construction is indiscrete in dealing with a huge amount of miscellaneous data. Construction firms or stakeholder that adopt and utilise big data will gain insight and improve customer experience, reduce business cost, improve productivity, and it will increase the profitability of construction firms. The finding also indicates the adoption of big data was evident in foreign construction firms.

The finding of this study shows the low adoption of augmented reality and robots by construction firms in Nigeria and this could be due to lack of technical knowledge or expensiveness and complexity of these systems and processes that constitute the fourth industrial revolution. This finding is similar to the findings of Ezeokoli *et al.* (2016) who observed the application of digital technologies was at infancy stage due to lack of critical and technical knowledge among other managerial terms. This finding also confirms Oke *et al.* (2018) revealed the expensiveness and complexity of digital technological innovations which makes it hard to buy and operate, in operating, will require specialised training which will make all process expensive to acquire.

Furthermore, the finding of this study indicates that both foreign and indigenous construction firms in Nigeria have not adopted 3D printing. This finding is similar to the finding of Raji (2017) suggested 3D technology is relatively at its infant stage in developing countries like Nigeria. The finding is also similar to Hager *et al.* (2016) agreed 3D printing is still young and presents a lot of limitations, but there are high expectations and hopes for the future of 3D printed buildings and building components. *Tay et al.* (2017) also added 3D printing of full-scale construction components is still an emerging technology and as an alternative construction method is attracting increasing attention.

The finding of the study shows the low adoption of the fourth industrial revolution by indigenous construction firms compared to foreign construction firms. The foreign construction firms have adopted more of the fourth industrial revolution which has improved the way they work and also improves their productivity. This finding is in line with Aniekwu and Audu (2010) posited that Nigeria construction firm's productivity is at a low level when compared to that of foreign counterpart.

The finding of this study revealed the low adoption of indigenous construction firms. This finding confirms Ezeokoli *et al., (*2016); Osunsanmi *et al., (*2018) revealed that the level of adoption and application of digital technology was at infancy stage; moreover, this could be due to lack of capacity, technical knowledge and digital transformation dynamism among managerial teams.

In summary, the finding of this study revealed the adoption of fourth industrial revolution systems and processes such are internet of things, BIM, RFID, cloud computing, drones, and automation are more evident in the construction industry in Nigeria.

5. CONCLUSION AND RECOMMENDATIONS

The fourth industrial revolution has been slow to penetrate the construction industry in Nigeria; this is due to the low level of awareness on the fourth industrial revolution. The concept of the fourth industrial revolution has been understood, with it been limited to the advancement of ICT, automation, artificial intelligence and BIM. Most construction firms are uninformed about the concept of the fourth industrial revolution. It can be concluded that the adoption of the fourth industrial revolution and digitalization in the construction industry has started but its full adoption has been slow and foreign construction firms have adopted more of the systems and processes of the fourth industrial revolution when compared to indigenous construction firms.

The adoption of fourth industrial revolution systems and processes such are internet of things, BIM, RFID, cloud computing, drones, and automation are more evident in the construction industry in Nigeria. The benefits of digital transformation under the fourth industrial revolution are so many that it cannot be ignored. It offers benefits such as increased operational efficiency improve accuracy, makes working easier, mass customisation of products, improve productivity and performance, among many others. Therefore, the study recommends an increase in awareness of the fourth industrial revolution through seminars, workshop and training on the fourth industrial revolution.

REFERENCES

Afolabi, A., Ojelabi, R., Fagbenle, O. and Mosaku, T. (2017). The Economics of Cloud-Based Computing Technologies in Construction Project Delivery. *International Journal of Civil Engineering and Technology* (IJCIET). Volume 8, Issue 12, December 2017, pp. 233–242, Article ID: IJCIET_08_12_027. Available online at http://http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=8&IType=12ISSN Print: 0976-6308 and ISSN Online: 0976-6316.

Aghimien, D., Aigbavboa, C., Oke, A and Koloko, N. (2018). DIGITALISATION in CONSTRUCTION INDUSTRY: CONSTRUCTION PROFESSIONALS PERSPECTIVE. Retrieved from https://www.researchgate.net/publication/329141252_DIGITALISATION_IN_CONSTRUCTION_INDUSTRY_CONSTRUCTION_PROFESSIONALS_PERSPECTIVE on February 2018.

Andrade, M. (2016) Prototipagem rápida. In: BRAIDA, F. et al. 101 Conceitos de Arquitetura e Urbanismo na Era Digital. São Paulo: ProBooks, 164-165 p.

Aniekwu, A. N. and Audu, H. O. (2010). The Effects of management on productivity. A comparative study of indigenous and foreign firms in the Nigeria construction industry.

Azhar, S. (2011). Building Information Modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. Leadership and management in engineering, 11(3), 241-252.

Balfour Beatty (2017). Innovation 2050: A Digital Future for the Infrastructure Industry.

Balogun, V.A., Otanocha, O.B. and Ibhadode, A. O. (2018). The Impact of 3D Printing Technology to the Nigerian Manufacturing GDP. Modern Mechanical Engineering, 8, 140-157.https://doi.org/10.4236/mme.2018.82010.

Berger, R. (2016). Digitalization in the construction industry: A comprehensive guide to reinventing companies. www.rolandberger.com (Retrieved 3rd September 2018).

Business Europe (2015).BUSINESSEUROPE Recommendations for a Successful Digital Transformation in Europe, 2015.Online available from www.businesseurope.eu.

Cajzek, R., Gradnje, G., and Klanšek, U. (2016). An Unmanned Aerial Vehicle for Multi-Purpose Tasks in the construction Industry. *Journal of Applied Engineering Science*. Paper number: 14(2016)2, 385, 314 – 327. Doi :10.5937/jaes14-10918.

CGI (2017). Industry 4.0 making your business more competitive. Visit cgi.com or contact us at info@cgi.com for more information. © 2017 CGI GROUP INC.

Chandanshive, V. B. and Kazi, A. M. (2017). "Application of Internet of Things in Civil Engineering construction projects- A State of the Art". Proceedings of the 11th INDIACom; INDIACom-2017; IEEE Conference ID: 40353 2017 4th International Conference on "Computing for Sustainable Global Development", 01st- 03rd March 2017.

Crnjac, M., Veža, I., and Banduka, N. (2017). From concept to the introduction of industry 4.0. *International Journal of Industrial Engineering and Management*, 8(1): 21-30.

Dale, J. (2007). Innovation in Construction: Ideas are the future, CIOB Survey, 2007. www.Ciob.org.uk.

Dastgheibifard, S. and Asnafi, M. (2018). A Review on Potential Applications of Unmanned Aerial Vehicle for Construction Industry. Sustainable Structure and Materials, Vol. 1, No.2, (2018) 44-43DOI: https://doi.org/10.26392/SSM.2018.01.02.044

Deloitte, (2017).The Fourth Revolution is now: are you ready? Future of Operations.www.deloitte.com/futureofoperations© 2017Deloitte LLP. All rights reserved.

Eisenhardt, K. M. (1989) "Building Theories from Case Study Research". The Academy of'Management Review, Vol.14, No.4, pp.532–550.

Ernest and Young (2015). Risk and Opportunity in an increasingly digital world, insurance Governance Leadership Network, Tapestry Networks Inc, 2015. www.tapestrynetworks.com (Retrieved 13th September 2018).

Ezeokoli, F. O., Okolie, K. C., and Okoye, P. U. (2016). Digital transformation in the Nigeria construction industry: The professionals' view. *World Journal of Computer Application and Technology,* 4(3): 23-30.

Gaith, F. H., Khalim, A. R., and Ismail, A. (2012). Application and Efficacy of Information Technology in Construction Industry.Scientific Research and Essays. Vol. 7(38), pp. 3223-3242, 27 September 2012.

Gartner. (2015). Building the Digital Platform: Insights from 2016, Gartner CIO Agenda Report, 2015. Online available from http://gartner.com/cioagenda.

Gosling, J. and Naim, M. M. (2009). Engineer-to-Order Supply Chain Management: A Literature Review and Research Agenda. *International Journal of Production Economics* 122, 741-754.

Guest, G. (2012). Applied Thematic and Analysis. Thousand Oaks, California: Sage. P. 11.

Hager, I., Golonka, A. and Putanowicz, R. (2016). 3D Printing of Buildings and Building Components as the Future of Sustainable Construction? International Conference on Ecology and new Building materials and products, ICEBMP 2016. Procedia Engineering 151 (2016) 292 – 299.

Idoro, G. I. (2004). The effect of globalisation on safety in the construction industry in Nigeria. Proceedings: The International Symposium on Globalisation and Construction. School of Civil Engineering, Asian Institute of Technology, Bangkok, Thailand, November.

Idoro, G. I. (2012). Influence of the Monitoring and Control Strategies of Indigenous and Expatriate Nigerian Contractors on Project Outcome. *Journal of Construction in Developing Countries*, 17(1) 2012, 49–67, 2012.

Iheme, C. C. and Chiagorom, C. F. (2018). Construction Industry and its Constraints in Nigeria. *International Journal of Advanced Research in Social Engineering and Development Strategies*. IJARSEDS. Hard Print: 2315-8379 | Online: 2354-161X| Vol. 5, No. 1 January 2018.

Ishaq, I. M., Omar, R., and Mohammed, M. (2018). Challenges of communication between client and contractor during construction projects: The Nigerian Perspective. *International Journal of Engineering and Modern Technology,* ISSN 2504-8856. Vol. 4.No. 2. 2018. www.llordpud.org.

Ismail, S. A., Bandi, S. and Maaz, Z. N. (2018). An Appraisal of the Potential Application of Big Data in the Construction Industry. *International Journal of Built Environment and Sustainability.* Published by Faculty of Built Environment, Universiti Teknologi Malaysia. Website: http://www.ijbes.utm.my. IJBES 5(2)/2018, 145-154.

Janssen, S. (2015). Assessing the perception of drones in the construction industry. The University of Twente, Faculty of Constructional Technical Science, Construction Management and Engineering.

Kagermann, H., Walister W., and Helbig, J. (2013). Recommendations for implementing the strategic initiative Industrie 4.0: final report of the Industrie 4.0 working group.

Lavanya, B., Shylaja B. S., and Santhosh M. S. (2017). Industry 4.0 – The Fourth Industrial Revolution. *International Journal of Science, Engineering and Technology Research* (IJSETR) Volume 6, Issue 6, ISSN: 2278 -7798.

Leal, B. M. F., Salgado, M. S., Silvoso, M. M., (2018). Impact of Fourth Industrial Revolution in Architecture Undergraduate Course. ZEMCH 2018 International Conference, Melbourne, Australia 29th January – 1st February 2018.

Lee, E. A. (2010). CPS foundations. In Proceedings of the 47th Design Automation Conference, June pp. 737-742.ACM.

Lee, J., Bagheri, B., & Kao, H. A. (2015). A cyber-physical systems architecture for industry 4.0-based manufacturing systems. Manufacturing Letters, 3, 18-23.

Li J.and Yang, H. (2017). A Research on Development of Construction Industrialization Based on BIM Technology under the Background of Industry 4.0. MATEC Web of Conferences 100, 020 (2017). DOI: 10.1051/ matecconf/2017 710002046.

Maaz, Z. N., Bandi, S., and Amirudin, R. (2018). Big Data in the Construction Industry: Potential Opportunities and Way Forward. *The Turkish Online Journal of Design, Art and Communication* - TOJDAC ISSN: 2146-5193, September 2018 Special Edition, p.1470-1480.

Madakam, S., Holmukhe, R. M., and Jaiswa, D. K. (2019). The Future Digital Work Force: Robotic Process Automation (RPA). *Journal of Information Systems and Technology Management* – Jistem USP.Vol. 16, 2019, e201916001.ISSN online: 1807-1775 DOI: 10.4301/S1807-1775201916001.

Mahmud, S. H., Assan, L., and Islam, R. (2018). Potentials of Internet of Things (IoT) in Malaysian Construction Industry. Annals of Emerging Technologies in Computing (AETiC), Print ISSN: 2516-0281, Online ISSN: 2516-029X, pp. 44-52, Vol. 2, No. 1, 1st March 2019, Published by International Association of Educators and Researchers (IAER), Available: http://aetic.theiaer.org/archive/v2n4/p4.pdf.

McAfee, A., and Brynjolfsson, E. (2012). Big Data: The Management Revolution. Harvard Business Review, 90(10), 61–68. https://doi.org/10.1007/s12599-013-0249-5.

National Bureau of Statistics (NBS). Nigerian Gross Domestic Product Report, First Quarter 2016, Issue 9, 2016. www.nigerianstat.gov.ng (Retrieved 11th September 2018).

Oladapo, I. O. (2016). Problems of the construction industry in Nigeria. Pp140-144. Article Zeitschrift: IABSE reports of the working commissions de travail AIPC = IVBH Berichte der Arbeitskommissionen. http://dx.doi.org/10.5169/seals-21509

Oladinrin, T. O., Ogunsemi, D. R. and Aje, I. O. (2012). Role of Construction Sector in Economic Growth: Empirical Evidence from Nigeria. *FUTY Journal of the Environment*, Vol. 7, No. 1, July 2012. © School of Environmental Sciences, Modibbo Adama University of Technology, Yola – Nigeria. ISSN: 1597-8826. http://dx.doi.org/10.4314/fje.v7i1.4

Osunsanmi, T. O., Aigavboa, C. and Oke, A. (2018). Construction 4.0: The future of the construction industry in South Africa. *World Academy of Science, Engineering and Technology International Journal of Civil and Environmental Engineering*, 12(3): 206-212.

Redmond, A., Hore, A., West, R., and Alshawi, M. (2010). Building Support for Cloud Computing in the Irish Construction Industry. Proceedings of the CIB W78 2010: 27th International Conference –Cairo, Egypt, 16-18 November.

Rojko, A. (2017). Industry 4.0 concept: Background and overview. https://doi.org/10.3991/ijim.vlli5.7072 (Retrieved 10th September 2018).

Schwab, K. (2016). The Fourth Industrial Revolution. World Economic Forum 91–93 route de l a CapiteCH-1223 Cologny/Geneva Switzerland. ISBN-13:978-1-944835-01-9. ISBN-10: 1944835016. REF: 231215. www.weforum.org.

Singh, R., Gehlot, A., Singh, V. P., Garg, V., Kumar, S., Choudhury, S., Pachauri, R. (2017). Role of automation in construction industries: a review. *Journal of Engineering Technology* (ISSN: 0747-9964) Volume 6, Issue 2, July 2017, PP.799-831.

Solis, B., Li, C., Szymanski, J. (2014). Digital Transformation: Why and How Companies are investing in New Business Model to Lead Digital Customer Experience, Altimeter Group, 2014. Online available from http://www.altimetergroup.com/disclosure.

Tatum, M. C. and Liu, J. (2017). Unmanned Aircraft System Applications in Construction. Procedia Engineering. 2017 Jan 1; 196:167-75.

Tay, Y. W. D., Panda, B., Paul, S. C., Noor Mohamed, N. A., Tan, M. J and Leong, K. F. (2017): 3D printing trends in building and construction industry: a review, Virtual and Physical Prototyping. Virtual and Physical Prototyping, 2017.https://doi.org/10.1080/17452759.2017.1326724

Teicholz, P. (2004), "Labor Productivity Declines in the Construction Industry", Causes and Remedies, AECbytes Viewpoint #4, available from http://www.aecbytes.com/viewpoint/issue_4.html.

Winch, G. M. (2006).Towards a Theory of Construction as Production by Projects. Building Research & Information 34(2), 154-163.

Xiao, C. L., Yahya, M. Y., and Md, Y. A. (2018). Challenges of Implementation of Cloud Computing Technology among Construction Participants. Advanced Science Letters, Volume 24. Number 5, pp. 3300-3305(6).https://doi.org/10.1166/asl.2018.11362.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

CONTEXTUALIZING "DRAW IN ORDER TO SEE" FOR INNOVATIVE REFORMATION IN THE NIGERIAN SUSTAINABLE ARCHITECTURAL EDUCATION

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ABSTRACT

Purpose: There is continuous demand for improvement and sustainable innovations on architectural education globally and as such, this demand leads the discourse in all spheres of architecture. Coinciding with this demand is the requirement for sustainable practices/services within the built environment professions and the reformation of their educational training. Therefore, Nigeria cannot be an exception but to align with the global trend in order to secure a favourable future for the profession of architecture.
Design/methodology/approach: The recent 12 points/Ways identified to Reform Architectural Education by Hewitt's book titled "Draw in order to see" are adopted for this study in addition to a review of other related literature to form the theoretical underpins. Also, perceptions were collated through hard copy questionnaire and monkey online survey amongst architects within Nigeria in December 2020. A total of 129 responded but only 123 completed the survey questions.
Findings: Their responses are presented with the aim to validate and contextualize findings to the Nigerian context. Findings suggest that history, site visits, collaborations and abstract critical thinking remain very relevant. Whilst virtual representations of designed environment are opined to be necessary to the architectural education in the Nigerian context.
Originality/value: This study's conclusion and recommendations were drawn with the aim provides insights towards the reformation in the Nigerian architectural education. These includes; harmonizing the design/studio practices across all schools of architecture, mandatory sites visit at all level of architectural training, maintain traditional and modern architectural studies, promote contacts and collaborations between students and with artisans, manufacturers and tradespeople.

Keywords: Architectural education; improved design innovation; Nigeria; sustainability.

1. INTRODUCTION

The book, "Draw in Order to See: A Cognitive History of Architectural Design" has 300 pages and the subject matter is aimed at reforming architectural design education

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through history. Over 12,000 years' period in the history of architectural design was surveyed by the author – Martin Alan Hewitt. This he did in order to draw out specific information and schemes used in architectural design by humans to build houses and other structures. His historical findings divide the design thought into three cognitive areas; crafting, depicting and assembling.

The book is structures into chapters, from depictions during the Renaissance, the education of architects in the modern era, Baroque illusionism and scenography, the breakdown of artisanal literacy during the enlightenment, modern experiments with models, montage, and to illusions of movement. Although a book, the author's presentation of the chapters made it possible to read each chapter as stand-alone and such contributions in text are observed to make it easy for specific conservations with each grapple with different approaches, concepts, problems, and themes therein (Lock, 2016).

Furthermore, the author gave some highlights on the way forward to address the concerns for the reformation of architectural education amid the global challenges for sustainable innovations in the design of structures and design education (Chance et al., 2016). In conclusion, the author critiques the contemporary architectural design education deducing from the trends and experiences covering the 12,000 years' period covered by the book.

In the overall, the book 'Draw in Order to See: A Cognitive History of Architectural Design' is relatively new but it has been noted to bridge the gap and concern for a sustainable architectural education (ArchDaily, 2020). This concern has also been expressed by the Nigerian Institute of Architects (NIA) 60th Annual General Meeting and Conference (AGM 2020), particularly in the Pedagogy (Architectural Education) sub-theme as captured in the NIA, AGM 2020 Poster.

This study is limited to the architectural design education reformation uncovered for the western economies. A quantitative inquiry is employed to gauge the opinions from the Nigerian context perspective. The reformations highlighted therein, in the book are documented into 12 points/ways, which underscore this study's discourse and are supported by other underpins from literature and the AGM 2020 concerns for; "sustainable development, city configurations, demographics etc., as well as establishing ways of keeping the profession relevant in the ever expanding array of professional disciplines within the built environment" (NIA, AGM 2020 Poster p.1).

This background forms the justification for this study, and hence the review of the 12 points/ways to reform architectural education as a spring board that would promote and make the Nigerian architectural education and profession relevant amidst the continuous challenges in the built environment disciples to prosper sustainably.

2. REVIEW OF RELATED LITERATURE

The proposed 12 Points/Ways to Reform Architectural Education:

1. **Go back to the hand-drawn sketch as the fundamental medium and tool for creating architecture**. *Hand drawing is a must, not only for practicing architects (many of whom have never stopped doing it), but for the most technologically oriented students. The daily or weekly practice of drawing strengthens neural networks and engages cognitive faculties at many levels, just as playing scales and other keyboard exercises keeps musicians sharp. Students should sketch from the very beginning of their education and be required to use sketches to document and develop their visual ideas (Hewitt, 2020).*

This position put forward by Hewitt (2020) resonates with other design researchers, who also suggests the importance of hand drawing despite the technological made-easy design tools readily available to architectural design professionals. Hand sketching or drawing is considered to be a universal skill and it allows design students to try out ideas, imaginations, access abstract thinking and also putting a pen to paper has great benefits in learning, processing and retention of ideas (Torem, 2017). Additionally, free hand drawing has a way of simplifying complex information to just the essentials, helping ideas like pattern, composition, relationship to emerge with just a few hand sketches, which tell a better story of the design process (Torem, 2017). Furthermore, Torem, (2017) asserts that hand drawing makes the designer have an intimate and emotional connection between existential being and the surrounding world. Whilst in recent decades, the useful invention of architectural software has fundamentally changed the look and the mental connection of new construction, and minimizes interactions and collaborations (Torem, 2017; Moses, 2019). The relevance on just the technological architectural stools becomes a disadvantage it is solely used in the design of buildings.

2. **Make every effort to see new places and to visit outstanding buildings, landscapes, and urban ensembles as often as possible**. *Rather than only using a camera or a cell phone, record experiences in a sketchbook via images with words attached. Travel abroad as often as is practicable, to extend the breadth of direct experience with the spaces and places that have inspired predecessors through the centuries. Architecture programs can learn valuable lessons from Notre Dame, which requires all of its third-year students to study in Rome* (Hewitt, 2020).

Hewitt (2020) suggests that travel is part of architectural education for meaningful application of experiences, mental connection with history and to draw lessons from the past. Suneja (2018) opined that travel enables the architectural student to explore and to understand transition of designed spaces and the environment (Ebohon et al., 2013; Allu, 2014). The travel architecture explains why architecture goes way beyond aesthetics into comfort determined climatic conditions of a place and what determines the uniqueness of parts of a building. It is also important for the student to understand the intricacies of any building or structure, which might easily get overlooked when explored through a video or some photographs (Suneja (2018). Thus, traveling is much more than a mare experience but a process of the timelessness of architecture of the past, the present and the future.

3. Make architectural history a requirement in all design programs, and avoid the pitfall of presenting only modern architecture. *Beginning these courses in the 18th or 19th century is as inexcusable today as failing to present non-Western buildings, cultures and artifacts. It is also useful to teach young architects the proportional and grammatical systems associated with classical architecture, Chinese traditional architecture, and other non-Western systems, which may soon prove to be linked to schemata in the brain (Hewitt, 2020).*

In architectural education the history of architecture traces the trends, changes, challenges in architecture through different traditions, regions, culture, overarching stylistic trends, climates and dates. As such, the importance of making the study of architectural are many to include; learning for knowledge and avoiding past mistakes (Craven, 2020), integrating sustainable solution and options (Allu, 2014a), the intentions that distinct the different architecture due cultural difference, climate, location and systems (Avila, 2018) and establishing interconnectivity between various traditional architecture (Sagdic and Kosova, 2013). In architecture, the memory of the past is needed to figure out the present (Kasapi, 2018). This has been reflected in Figures 1a, 1b and 1c showing that there is a

connect between old buildings and new buildings in their design requirements and architectural form.

Figure 1a: Temple of Artemis, Corfu Greek Temple (Built 580 BC).
Source: Adhikar (2019).

Figure 1b: *Palladian villa of the Veneto* by *Andrea Palladio was an Italian Renaissance architect. Source: https://www.google.com/search?q=Palladian+villas+of+the+Veneto&client=firefox-b-ab&sa=X&stick=H4sIAAAAAAAAAONgecRYyC3w8sc9YamMSWtOXmNM4uIKzsgvd80rySypFNLiYoO*

Figure 1c: The White House. Washington, D.C., began in 1792 occupied in 1800
Source: Craven, (2019)

4. **Require students to engage with building users as soon as possible in their studio experiences**. *Many schools now offer classes that allow students to build small projects for clients needing pro bono services. The Yale Building Project is the one of most famous of these, but most schools now bring studios to the public and engage in solving "real" problems for those in need. Drawings are limited in their capacity to inform students about space and materiality. Only by experiencing the construction of buildings can they grasp the fundamental tectonic qualities of their art* (Hewitt, 2020).

This fourth point by Hewitt to engage users has been emphasized by many researchers globally (Sani et al., 2011; Zubairu, 2012; Allu, 2014a; Osei-Kyei and Chan, 2017). These

researchers suggest that, students should be engaged with design projects that would allow them to engage with users in order to provide functional and useable spaces.

5. **Maintain regular contact with tradespeople, artisans, and makers of building components and materials.** *The modern continuing education system in the U.S. provides many opportunities for such contact, but longer workshops with master artisans are always more meaningful than distance education or online courses. At the university level, maintain workshops in the architecture program or in allied engineering and material science departments, and make certain that all students are exposed to their projects and processes* (Hewitt, 2020).

On one hand, the use of workshops is not uncommon to the Nigerian architectural educational context and should be encouraged to continue and improved upon. On the other hand, the contact between students and artisans, tradespeople and manufacturers is seemingly not satisfactorily established (Allu, 2018). Whilst in other developed economies such contacts are embedded in the education of built environment professionals (Pour, et al., 2014; Iyer-Raniga and Andamon, 2016) to enhance sustainable innovations. Therefore, developing economies like Nigeria cannot afford to miss out in this sustainable innovation drive.

6. **Balance linguistic and theoretical dialogue with purely visual and haptic means of presenting architectural ideas**. *The field has drifted too far into modes of thinking that pull the curtain over the visual brain, literally preventing designers from engaging with the essential qualities of environments, spaces, and type forms. Though all architects must understand the power of physical forms to convey symbolic meaning, focusing mainly on semantic knowledge has led us away from the core concerns of our discipline* (Hewitt, 2020).

Balancing holistic requirements which includes, aesthetics, appearance, comfort, lifestyle, mental and physical health are important for a sustainable building design. The importance of this balancing these requirements in design is an important factor of architectural design education, particularly in the times of an unexpected pandemic (Xu, 2020). The act of balancing mental and physical health with other design requirements are necessary for a holistic and sustainable design output, particularly at such a time as the current covid-19 pandemic.

7. **Integrate analog and digital tools in the design studio, as Pixar does in its film production. No designer can afford to throw away powerful computers and software when they improve accuracy and productivity in so many areas**. *However, there is no reason why much basic design cannot be done with traditional drawings and models, nor is it necessary to ignore low-tech and artisanal processes when considering how to make buildings more beautiful and durable*. (Hewitt, 2020).

Integrating all design concerns into the different processes of the traditional and contemporary design would produce a holistic approach to adopted design options in architectural education. According to Yildirum and Yavuz (2012) in their study on comparison of traditional and digital visualization technologies in architectural design education, concluded that conventional tools are still relevant and digital technologies are necessary and therefore, hybrid architectural educations is the way to go as transition until such a time that the traditional educational method is inevitable.

Khodeir and Nessim (2019) in their study on architectural education and employability concluded that, two and three dimensional drawings are still very relevant but also assert that digital tools may be maintained as additional tools for visuals in design education. Similarly, Becerik-Gerber et al. (2011) observed and notes that there are disparities in educational programs using different technological tools, which needs to be realigned to harmonize and to develop the workforce of the future for improved sustainable architectural

education. In Nigeria, the onus for such harmonisation is with the professional institutes and government regulators.

8. **Avoid all forms of virtual representations of designed environments until the presentation stage of design**. *Research suggests that these "worlds" distort and misconstrue the nature of the spaces and forms they are meant to convey. As software engineers develop more accurate means of representing buildings and natural environments, adopt these means cautiously. Tablets have not yet matched the flexibility and expressive capacity of paints, inks, pencils, and charcoal on paper* (Hewitt, 2020).

Pure flexible creativity is an in-built talent which must be expressed before such imaginations are allowed to be aided or distorted by external influences. The reason for this stipulation is that lack of imagination stunt creativity. Memory and Imagination in Architecture informs the creative processes (Kasapi, 2018). Shuaib, (2018) argued that, creative thinking skills using a cognitive-based creativity in architectural education must be pursued sustainably. This is obvious in many schools of architecture in Nigeria, where 'theory of creative thinking' is taught and must be continued. As important as architectural presentation software is, it is better introduced after the design concert process is actualized, thereafter, design software can be used as support tools during presentations. In addition, sustainability must be enshrined into creative thinking to ascertain the sustainable design options are considered, so as not to distort the natural spaces and health concerns for the sake of aesthetics (Allu, 2016 and 2018).

9. **Employ digital drafting platforms as adjuncts to hand drawing, using these tools the same way architects used hard line drawings during the 19th and 20th centuries**: *as means of accurately conveying construction plans, sections, elevations, and details. Avoid "smart" software such as Revit, which layers and attaches proprietary products to the design process before creative decisions can be objectively rendered* (Hewitt, 2020).

An earlier study by Shuiab (2018), viewed problem-solving activity beyond the traditional process of solving problems in cognitive psychology and further states that, creative thinking skills that employ visual, verbal expressions and cognitive rationale are necessary. Although, there are evidence suggesting that visual expressions are considered to be non-rational way of learning and are thus, rarely pursued in design education (Shuiab, 2018). Digital platforms are encouraged to be used as a means for actualizing visual expression and not as the means in themselves.

10. **In the academy, employ research professors in areas of bona fide applicability to the task of building.** *Demand evidence-based, peer-reviewed research products. Remove such nonprofessional faculty from the studio and employ only practicing architects at all levels of design instruction (Hewitt, 2020).*

Emam et al. (2019) deduced from their study on collaborative pedagogy in architectural design studio, opined that, participatory design studio with experienced instructors who are knowledgeable in architectural in specific area of practice help to develop better students' skills. Whilst, Allu (2018) also argues that industry based professionals' participation in the education of built environment professionals promotes collaborations for the present and the future. The professional and student collaborative design thoughts and applications also serves as an architectural mentoring process (Allu, 2015).

11. **Teach basic drawing with constant reference to the most recent research in cognitive science and visual perception**. *Engage with direct experience as well as with mnemonic models and schemata, and use references from well-known visual artists and artworks (Hewitt, 2020).*

In architectural education, theory must always connect with the environment and its sustainability and relate same to the position of the perceiver or user. This interconnectivity has been noted and documented in earlier studies (Kubory et al., 2013; Allu, 2014) which

must be updated regularly through more current findings. Therefore, architectural design educators must ensure to engage in continuous professional development and be open to new innovations in their specific research areas for self-development and to transfer the knowledge to today's student for future applications.

12. **Emphasize the collaborative nature of design as a discipline, and foster collaboration in the studio curriculum rather than emphasizing individual "innovation" as a criterion for architecture.** *Encourage students to work in teams and provide opportunities to do so, despite the difficulty of assessing individual contributions during the grading process. These simple measures, even if implemented first on a small scale in design communities or individual schools, will provide positive proof of the benefits of a design practice based upon embodied cognition rather than purportedly rational or conceptual thinking. The results will be immediately evident in more beautiful, commodious, and healthy environments (Hewitt, 2020).*

On collaboration in the architectural educational domain, Idi et al. (2018) reported that many researchers and design educators perceive collaboration as individual designers collaborating with allied professionals mainly, playing down the student-to-student collaboration in studio design activities. Meanwhile, other studies also suggest that student collaborations are advantageous for many reasons to includes; provide equal opportunity for contributions, collective approach to design solutions which are provide holistic because of the different inputs by each of the students (Allu, 2013 and 2016). In the overall, students' collaboration allows designated task for each of the student designers to perform within key cognitive design requirements, such as, linking functional relationships, structural considerations, frame, movements, evaluation, abduction, analysis, induction, deduction and other design considerations (Allu, 2016; Idi et al., 2018).

Following the theoretical discourse, this study sought the opinions of architects and particularly from the architectural educators' opinions in regards to the 12 ways to Reform Architectural Education. For a couple of reasons; for contextualizing findings, to ascertain areas of commonality, to uncover areas of reformation and to buttress areas to be maintained or improved upon the Nigerian architectural education.

3. RESEARCH METHODOLOGY

In this study, a questionnaire research survey was adopted. A combination of monkey survey through an online link and hardcopy questionnaires were provided to architects across the country who are in education and or in architectural practice. Only completed questionnaires were used for the study, which were 123 out of the 129 respondents who responded to all questions in the questionnaire survey, representing 95% response rate.

The study sought to validate the degree of agreement with the 12 points statements proposed by Hewitt (2020) and to deduce the Nigerian peculiarity and thus contextualized the perceptions of the respondents accordingly. A five-point Likert scale was adopted to the responses as: 1 = Not Important (NI), 2 = Somehow Important (SI), 3 = Fairly Important (FI), 4 = Definitely Important (DI) and 5 = Very Important (VI). For data analysis a simple per cent were used to present the degree of importance of the proposed points as statements. A simple statistical metrics of numbers and percentages derived directly from the Excel Spreadsheet was used. This was explored to achieve easy understanding and clear presentation of the results obtained, this action has been supported by Di Leonardo (2017).

4. RESULTS AND DISCUSSION OF FINDINGS

The spread of the respondents who are architects showed that, those within the range between 5 to 10 years are in the majority (50%), whilst the much older architects form about 20% of the respondents. A number of this later group indicated their preference for the hardcopy questionnaire but failed to return the filled questionnaire within the three weeks stipulated time for the survey. The 12 points statements were validated for contextualization and presented in details on Table 1.

Table 1: Showing the responses to the 12 points for architectural education transformation

SN	STATEMENTS	1(NI)	2 (FI)	3 (SI)	4 (DI)	5 (VI)
1	Go back to the hand-drawn sketch as the fundamental medium and tool for creating architecture.	16 (13%)	17 (13.8%)	29 (23.6%)	24 (19.5%)	37 (30.1%)
2	Make every effort to see new places and to visit outstanding buildings, landscapes, and urban ensembles as often as possible.	0 (0%)	0 (0%)	7 (5.7%)	33 (26.8%)	83 (67.5%)
3	Make architectural history a requirement in all design programs, and avoid the pitfall of presenting only modern architecture	0 (0%)	3 (2.4%)	21 (18.1%)	37 (30%)	62 (50.4%)
4	Require students to engage with building users as soon as possible in their studio experiences.	1 (0.8%)	3 (2.4%)	17 (13.8%)	45 (36.5%)	57 (46.3%)
5	Maintain regular contact with tradespeople, artisans, and makers of building components and materials.	0 (0%)	1 (0.8%)	18 (14.6%)	49 (39.8%)	56 (45.5%)
6	Balance linguistic and theoretical dialogue with purely visual and haptic means of presenting architectural ideas.	0 (0%)	6 (4.9%)	28 (22.8%)	56 (45.5%)	33 (26.8%)
7	Integrate analog and digital tools in the design studio, as Pixar does in its film production. No designer can afford to throw away powerful computers and software when they improve accuracy and productivity in so many areas.	2 (1.6%)	1 (0.8%)	14 (11.4%)	42 (34.1%)	64 (52%)
8	Avoid all forms of virtual representations of designed environments until the presentation stage of design.	31 (25.2 %)	24 (19.5%)	36 (29.2%)	18 (14.6%)	14 (11.4%)
9	Employ digital drafting platforms as adjuncts to hand drawing, using these tools the same way architects used hard line drawings during the 19th and 20th centuries	4 (3.2%)	8 (6.5%)	34 (27.6%)	50 (40.6%)	28 (22.7%)
10	In the academy, employ research professors in areas of bona fide applicability to the task of design studio activities.	1 (0.8%)	4 (3.2%)	19 (3.2%)	46 (37.3%)	55 (44.7%)
11	Teach basic drawing with constant reference to the most recent research in cognitive science and visual perception.	2 (1.6%)	0 (0%)	12 (9.7%)	34 (27.6%)	74 (60.1%)
12	Emphasize the collaborative nature of design as a discipline, and foster collaboration in the studio curriculum rather than emphasizing individual "innovation" as a criterion for architectural education.	0 (0%)	2 (1.6%)	18 (14.6%)	49 (39.8%)	54 (43.9%)

Responses for the **first statement**: *Go back to the hand-drawn sketch as the fundamental medium and tool for creating architecture*, recorded the following results;

A total of 87.8% were in different level of agreement with the statement, whilst 12.2% felt it was not important to go back to the hand-drawn sketch as the fundamental medium and tool for creating architecture. The results show that, hand drawing is still relevant and therefore, hand drawing is still an essential process that must be retained in the education of future architects.

The **second statement**: *Make every effort to see new places and to visit outstanding buildings, landscapes, and urban ensembles as often as possible*, was responded to with absolute agreement thus, 67.5% of the agreed that it is very important and 26.8% of the respondents agreed that it is definitely important seeing new places and visiting outstanding buildings, landscapes and other urban ensembles should be a regular activity about 5.7% felt the statement was somewhat important. In the over all, no respondents were in disagreement with the statement. Clearly, the opinion expressed is an indication that travelling to see new places and visiting outstanding buildings and other environmental structures is considered a must-do aspect of sustainable architectural education. This has been noted in the theoretical discourse and has been further validated strongly in the Nigerian context. Thus, the timelessness of architecture is further emphasised as expressed with about 100% agreement.

Responding to the **third statement**: *Make architectural history a requirement in all design programs, and avoid the pitfall of presenting only modern architecture*. There were no respondents who felt, the statement was not important and out of the 100% agreement level 62% felt the statement was very important. This result further validates the interconnect between the old and new buildings. Furthermore, this suggests that buildings in different architectural periods, developed and transformed from past history with modifications to suit the needs of the contemporary time and culture sustainably. For the **fourth statement** on whether the students in architectural training are require to *engage with building users as soon as possible in their studio experiences*. The opinion of the respondents showed that one respondent 0.8% opined that the statement was not important leaving about 99% with varied agreement level as shown in Table 1. This result supports the theoretical discourse and suggests the potential for improvement in the design of design of functional spaces.

The **fifth statement**: *Maintain regular contact with tradespeople, artisans, and makers of building components and materials,* also had different levels of agreement with no respondent in disagreement with the statement. However, about 46% are of the opinion that the statement was very important and therefore, more is expected to ensure these contacts are sustained or improved upon on this regards. The implication for this absolute level of agreement, calls for institutional decisions and policies for embedding into the architectural education curriculum this two-way contact in the Nigerian architectural schools. Therefore, aligning with the international practices for sustainable innovation in act design, practices and for the production of building materials.

Similarly, the **sixth statement** had the same varied pattern of opinion in agreement with 26.8% of the respondent who agreed that the statement on requiring a - *Balance linguistic and theoretical dialogue with purely visual and haptic means of presenting architectural ideas* is very important. This result has also validated the need for balancing design requirements with health requirement. A sustainable balanced design has the potential to contend with health related challenges like the current global corona virus pandemic.

Only two of the respondents representing 1.6% disagree with the **seventh statement** suggesting the integration of analog and digital tools in the architectural design studio. The highest agreement level on this statement was 52%, these respondents agreed that the, statement was very important to architectural education for improved productivity.

However, in the review underpins, it was suggested there is need to harmonize the design studio across schools of architecture. In the Nigerian context, the architectural education must be guided to harmonize its programmes through the Nigerian Institute of Architects (NIA), the architectural education regulator – Architects Registration Council of Nigeria (ARCON) and National Universities Commission (NUC). These are the responsible agencies in this regard and are able to harness all architectural educational programme towards sustainable technological innovation and transformation of the architecture profession.

The **eighth statement** seems to be an outlier, this is because about 25% of the respondents disagree with the statement and those in agreement were spread across four level of agreement of the importance of the statement, where only 11% felt the statement was very important. This result suggests that other forms of virtual representations are deemed necessary at the initial design conceptions within the Nigerian context. The validity of this findings does not align with findings from the secondary sources suggested that, the absent of other forms of visual forms during design conceptions distort the natural/cognitive creative thinking.

Responding to the **ninth statement**, the respondents at a total of 97% agreement whilst 4 respondents representing about 3% are of the opinion that digital drafting platforms do not serve as adjuncts to hand drawing but as means in themselves. In responding to the **tenth statement**, a total of about 99% were in agreement with about 45% of those in agreement referring to the statement that, the assigning related *research professors into areas of bona fide applicability to the task of design studio activities* is very important to the sustainable reformation in the architectural education in Nigeria. Hence, schools of architecture must ensure that lecturers whose research interest are in specific architectural practice be encourage to be active members of relevant design studio activities and the tradition of inviting architects in practice to participate in design studio activities should be encouraged and maintained.

The **eleventh statement**: *Teach basic drawing with constant reference to the most recent research in cognitive science and visual perception*, also has a high per cent of 98% different levels of agreement from the result. The works of other professionals should be celebrated and referenced to inspire the creativity in students. This will require the support of NIA and ARCON to support the initiative and relate closely with the schools of architecture in this regard.

Similarly, the result of the final and **twelfth statement** had a 100% agreement with about 44% as shown on Table 1 believed the statement is very important. Studio instructors in Nigeria should ensure student-to-student collaborations are encouraged, where such is not in, by giving out group student assignments alongside other educational activities. The student-student design studio assignment has the potential for better design outcomes.

Other comments provided by respondents:

1. Hand drafting should be encouraged to the postgraduate level. Another respondent wrote – "hand drawing is fundamental" and a lone contrary comments was for schools of architect "to dead manual drafting."
2. The decline in the architectural practice in Nigeria is due to the introduction of computer drafting in the university system. In order to have a sustainable future, free hand drawings and technological/computer tools must be adopted to complement each other. A similar opinion was expressed thus; digital tools are to be used for only enhancement purposes only.
3. The need for collaborations cannot be overemphasis and students must be encouraged to express themselves without limits during design studio.

4. Continuous training, updated on new innovations and software of faculty members is necessary for their development and to provide students with information on current trends in architecture.
5. History of architecture should not be taught as a lone subject but alongside contemporary architecture as a course during training. Another responded added that, "new and tested process are of equal importance".
6. Develop a guide and syllabus for organisations where students are sent for their Student Industrial Work Experience Scheme (SIWES).
7. Architecture students should be trained to think outside the box.

These comments from a few of the respondents were a reflection of the results obtained from the survey.

5. CONCLUSION AND RECOMMENDATIONS

The socio-economic effects of road projects to the development of a nation, the

The focus of this study is the promotion of sustainable architectural education in the Nigerian context, using Hewitt's book which sought to enable the architect 'see" through the design processes via history to enhance design capacities and sustainable innovations for the future. The discourse therein, was not only in the education process, but on how and what needs to be pursued to position particularly the architect in training to be able to deal with the rapid pace of technological change, new educational pedagogy, sustainable requirements in a highly interconnected world, and how complex problems that require multidisciplinary solutions are pursued through an appropriate education. This is because architectural design education has an important role in improving the future practice of architecture.

Overall, Hewitt: Draw in order to see is an exciting springboard that gauges the Nigerian architectural education and its contextualization as this study suggests. It is also a remainder to the fact that, although architecture is dynamic, there are processes and trends that will continue to form the basic start point for sustainable design outcomes, despite the continuous environmentally induced changes, innovations and other challenges affecting the practice of architecture.

Consequently, this study recommends the following;

i. Emphasize free hand drawing at the concept formation for cognitive critical thinking in the initial design process.
ii. Encourage, promote and theoretical historical processes and trends in design and practice.
iii. Harmonizing architectural education towards global sustainable trends to be monitored by NIA, ARCON and NUC for standards and uniformity across all schools of architecture.
iv. Embed into architectural education, site visits and ensure contacts with artisans, manufacturers and tradespersons in line with global practice.
v. Current sustainable innovations in architecture within Nigeria and beyond Nigeria must form part of the Nigerian architectural education reference.
vi. Ensure every level and studio activities of architectural education are guided towards current architectural practices and industry requirements.
vii. Student-to-student, student-to-industry and student-to-research collaborations must be encouraged. Also,

viii. The continuous use of hybrid education, which engages with technological tools, visuals, and cognitive creative thinking are a necessary.

This study's limitation is in its use of a single methodology and context but serves as a springboard for kick starting further research for the way forward for architectural education using other methodologies in the Nigerian context and other contexts around the world.

REFERENCES

Adhikar, S. (2019). Top 10 Magnificent Examples of Ancient Greek Architecture. https://www.ancienthistorylists.com/greek-history/top-10-magnificent-ancient-greek-architecture/ (Accessed 13/10/2020).

Allu, E. L. A (2014a). Sustainability and Architectural Education in the University of Jos-Nigeria. Proceedings of the Conference of the International Journal of Arts & Sciences, 2nd-6th March 2014. Malta. pp. 99-106.

Allu, E. L. A. (2014). Climate Change and Buildings in Nigeria: A Search for Mitigation and Adaptation Framework for Residential Buildings Design Guide. PhD Thesis submitted to Leicester School of Architecture, De Montfort University Leicester, England. https://www.dora.dmu.ac.uk/browse?type=author&value=Allu,%20Evelyn

Allu, E. L. A. (2015). Mentoring Architectural Students in the University of Jos, Nigeria: A Case for Improving Sustainable Training and Practices. Journal of Humanities and Social Sciences Review, 4(3), 357-362.

Allu, E. L. A. (2016). Sustainable Architectural Education: Perceptions from University of Jos Post Graduate Students. Proceedings of the Joint International Conference (JIC), 21st – 24th March 2016. Akure. pp. 1211-1218.2016JIC-ST4-016.pdf www.jic.futa.edu.ng ISBN- 978-1-898523-00-0

Allu, E. L. A. (2018). Advancing Design Education and Industry Collaboration for Sustainable Development in Nigeria: A Review. Association of Architectural Educators in Nigeria (AARCHES) Conference Proceedings, Zaria, February 21-24. pp. 53-62.

ArchDaily (2020). Draw in order to see. https://www.archdaily.com/947822/draw-in-order-to-see (Accessed 15/10/2020).

Avila, Y. (2018). The Brief History of Architecture & Design. https://theartecentre.com/spaces-blog/2018/1/30/the-brief-history-of-architecture-design (Accessed 04/10/2020).

Becerik-Gerber, B. Gerber, D. J. and Ku, K. (2011). The pace of technological innovation in architecture, engineering, and construction education: integrating recent trends into the curricula, Journal of Information Technology in Construction (ITcon), 16, pp. 411-432, http://www.itcon.org/2011/24

Chance, S. M. Marshall, J. and Duffy, G. (2016). Using Architecture Design Pedagogies to Enhance Engineering Education. International Journal of Engineering Education, 32, 1(B), pp. 364–383.

Craven, J. (2019). 13 White House Facts You May Not Know. https://www.thoughtco.com/surprising-facts-about-the-washington-dc-white-house-178508 (Accessed 04/10/2020).

Craven, J. (2020). Architecture Timeline - Western Influences on Building Design: The Evolution of Classical Style Architecture. https://www.thoughtco.com/architecture-timeline-historic-periods-styles-175996 (08/10/2020).

Di Leonardo, G. Zaccagna, G. and Crisci, R. (2017). Basic Statistics with Microsoft Excel: A Review. Journal of Thoracic Disease, 9(6), pp. 1734–1740. doi: 10.21037/jtd.2017.05.81

Ebohon, O. J. Taki, A. H. and Allu, E. L. A. (2013). Sustainable Agenda: Challenges of Mitigation and Adaptation in the Nigerian Built Environment Proceedings of the ARCON 6th Architects Colloquium, 22nd -25thApril 2013. Abuja. pp. 150- 173.

Emam, M. Taha, D. and ElSayad, Z. (2019). Collaborative Pedagogy in Architectural Design Studio: A Case Study in Applying Collaborative Design. Alexandria Engineering Journal Volume 58(1), pp. 163-170 https://doi.org/10.1016/j.aej.2018.03.005

Glancey, J. "Draw in Order to See" (2020). ArchDaily. https://www.archdaily.com/947822/draw-in-order-to-see ISSN 0719-8884 (Accessed 15/10/2020).

Hewitt, M. A. (2020). Draw in Order to See: A Cognitive History of Architectural Design. Pgs 300. ORO EDITIONS, Novato CA 94949, USA. 300 pages.

Iyer-Raniga, U. and Andamon, M. M. (2016). Transforming learning: innovating sustainability education in built environment, International Journal of Sustainability in Higher Education, 17(1), 105 – 122.

Idi, D. B. Anwar, K. and Khaidzir, M. (2018). Critical Perspective of Design Collaboration: A Review. Frontiers of Architectural Research Volume 7, Issue 4, December 2018, Pages 544-560 https://doi.org/10.1016/j.foar.2018.10.002

Kasapi, J. (2018). Memory and Imagination in Architecture: Thinking on the Process of Creativity https://medium.com/@jorakasapi/memory-and-imagination-in-architecture-thinking-on-the-process-of-creativity-a-particular-4962d105fa0d (Accessed 04/09/2020).

Khodeir and A. A. Nessim, (2019). Changing skills for Architecture Students Employability: Analysis of Job Market Versus Architecture Education in Egypt, Ain Shams Engineering Journal, https://doi.org/10.1016/j.asej.2019.11.006

Kubovy, M. Epstein, W. Gepshtein, S. and Gepshtein, S. (2013). Visual Perception: Theoretical and Methodological Foundations. https://www.researchgate.net/publication/258021489_Visual_Perception_Theoretical_and_Methodological_Foundations (Accessed 14/10/2020).

Moses, N. (2019). Single-Handedly: Contemporary Architects Draw by Hand, Princeton Architectural Press. ISBN: 161689833X, 9781616898335

Osei-Kyei, R. and Chan, A. P. C. (2017). Perceptions of Stakeholders on the Critical Success Factors for Operational Management of Public-Private Partnership Projects, Facilities, 35 (1/2), 21- 38.

Pour, R. F. Arciszewski, T. and Goulding, J. S. (2014). Successful Education for AEC Professionals: Case Study of Applying Immersive Game-like Virtual Reality Interfaces, Visualizing in Engineering, 2(4). www.springeropen.com (Accessed 11/06/2018).

Ritter, S. M. and Mostert, N. (2017). Enhancement of Creative Thinking Skills Using a Cognitive-Based Creativity Training. J Cogn Enhanc 1, pp. 243–253. Doi:10.1007/s41465-016-0002-3.

Sagdic, Z. and Kosova, I. (2013). The Place of the Importance of History Learning On Architectural Education. Pocedia – Social and Behavorial Science, 106(2012), pp. 2977 – 2982.

Sani, R. M. Ulucay, B. and Ulucay, P. (2011). The Significance of User Participation in Architectural Design: The Case of Nicosia Social Housing Complex. International Journal of Architectural Research 5(3), pp. 1-12. DOI: 10.26687/archnet-ijar.v5i3.205

Suneja, P. (2018). Relevance of Travel in Architecture. https://worldarchitecture.org/articles/cvnnm/relevance_of_travel_in_architecture.html (Accessed 02/10/2020).

Tayfun, Y. and Yavuz, A. O. (2012). Comparison of Traditional and Digital Visualization Technologies in Architectural Design Education. Procedia - Social and Behavioral Sciences, 51, 69–73. DOI: 10.1016/j.sbspro.2012.08.120

Torem, E. (2017). The (Still Relevant) Role of Hand Drawing: How Moss Uses Drawings in Design & Architecture. http://moss-design.com/hand-drawing-design/ (Accessed 11/09/2020).

Xu, J. (2020). The Impact of Epidemics on Future Residential Buildings in China. Rochester Institute of Technology, 94 pages.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

EFFICIENCY OF INVENTORY MANAGEMENT TECHNIQUES AND PERFORMANCE OF CONSTRUCTION INDUSTRY FIRMS IN SOUTH-SOUTH, NIGERIA

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ABSTRACT

Purpose: The study aims at providing insight into the extent to which some factors influence the effectiveness of inventory management, as well as the level to which the inventory management affect the performance of firms operating in the construction industry in south-south, Nigeria.
Design/methodology/approach: Data for the study were collected from 204 small and 46 medium construction industry firms selected using stratified purposive sampling techniques. The relationships and hypothesis proposed in the conceptual framework were tested using structural equation modeling (SEM).
Findings: The finding of the study shows that the identified factors have positive relationship with the efficiency of inventory management techniques. Another finding from the study is that a positive relationship exists between efficient inventory management techniques and construction industry firms' performance in terms of time, cost, quality and profitability, while an indirect positive relationship also exists between the identified influencing factors and the construction industry firms' performance.
Research limitation/implications: The study purposively selected only small and medium construction firms in south- south, Nigeria. This is not exhaustive enough; therefore, the results may not be generalized for the entire construction firms in Nigeria.
Originality/value: The study established the significance of efficient inventory management and its contribution to the overall sustainability and survival of construction firms in the built environment.

Keywords: Construction industry firms; efficiency; firm performance; influencing factors; inventory management.

1. INTRODUCTION

Nigeria is one of the developing countries seriously plagued with increased population growth most noticeable in urban centres (Ajayi, Ajayi, Akinsiku &

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Osunsanmi, 2016) together with poor quality and quantity of infrastructure Obiadi, Irouke, Ezezue and Nzewi (2017).

Consequent on the volumes of basic infrastructure requirements to address the infrastructural needs of these countries, Ofori (2018) noted the pressing need to substantially increase the capacity, capabilities and performance of the construction industries in the developing countries where the majority of the world's population live. Characteristically, infrastructural projects are categorised into tasks and sub-tasks, which need renewable (machines, tools, work force, information and others) or non-renewable (raw material, space, time, fuel, energy, and others) resources depending on the nature on the project (Pinha & Ahluwalia, 2019). One of the ways of substantially improving the performance of the industry is by improving the management of these construction resources. Consequent upon the resource-driven nature of construction projects, construction managers have tried to develop plans of action for directing and controlling resources of workers, machines and materials in coordinated and timely manner in order to deliver a project within the frame of cost, time and quality (Nagaraju, Reddy, & Chaudhuri, 2012).Ugochukwu, Ogbuagu and Okechukwu (2014) observed that despite the significant importance of the building/construction sector to the economy of Nigeria and its impressive efforts, the Nigeria's construction sector is yet to realize its full potentials. Abah and Adamu (2017) also observed that the construction industry in Nigerian is famous for high inventory, absence of formal relationship, poor interaction with supplier and high cost and time overrun.

In corroboration, Othman, Napiah and Potty (2014) noted that construction industry stakeholders are discovering that their process for managing tools / machines /equipment, materials, labor, methods, costs and consumables is broken and hence the field of construction in developing countries has largely failed to make progress in the last decade (Ofori, 2018). Some of these basic construction resources used in production in the form of goods or materials is termed inventory (Sabure, 2020). Inventory management is a portion of current resources management, which is concerned with maintaining optimum investment in inventory and applying effective control system so as to minimize the total inventory cost. It can be referred to as the process by which a firm is supplied with the goods and services that is needed to realize its goals of buying, storage and movement of materials for effective production (Subramani, Nair, David, Ghouse & Kumar, 2017). Inventory management covers raw materials, processed materials, components for assembly, consumable (fuels), general stores, maintenance materials and spares, work in progress and finished products (Sabure, 2020). The level to which firms usually hold inventory of these items depends on the nature of production, which may be construction, manufacturing, fabrication, hiring and servicing, among others in the construction industry. Building materials therefore constitute the major aspect of inventory management. Building materials range over different types of elements and also come in various sizes and shapes. While some materials like cement, iron rods, roofing sheets, floor tiles and wall tiles are produced by large manufacturing companies, others like timber, block, and so on are produced by medium and small sized manufacturers.

The importance of management of these materials in construction, stems from the view that the cost of material is a major proportion of the total project costs. Studies have established that the material contents for building usually range between 50% and 70% of total cost depending on the nature of the project (Arijeloye & Akinradewo, 2016). Another reason why materials management is very important and source of concern in developing countries is their supply, as a large proportion of the construction

materials used in most developing countries are imported as finished products and those manufactured locally have high foreign content resulting in high cost of construction (Ugochukwu, Ogbuagu & Okechukwu, 2014).Therefore, inventories management is important to organization because it helps in proper planning of the materials needed so as to ascertain the gap between the desired and the actual level of materials, allocation of resources, purchasing, sales and employment of staff and everything concerned to human resources management all of which reduce the costs incurred by the firms in the production departments for improved performance of the organization (Inegbedion, Eze, Asaleye & Lawal, 2019, Sabure, 2020).

This paper is of the view that the inventory control of other items also contributes to firm performance, as construction industry utilize materials in different forms. Hence it aims at providing insight into the extent to which some factors influence the effectiveness of inventory management, as well as the level to which the inventory management affect the performance of firms operating in the construction industry.

2. REVIEW OF RELATED LITERATURE

This section covered the overview of the inventory management techniques and the empirical review of the influence of some factors on the efficiency of inventory control techniques as well as the relationship between inventory management and firm performance.

2.1. Inventory Management Techniques Used by Construction Industry Firms

The study of supply chain in the construction industry showed that it involves a chain of construction business with business-to-business relationships as well as network of diverse organization and relationships, or a network of facilities and activities that provide customer and economic value to the functions of design development, contract management, service and material procurement, material manufacture and delivery, and facilities management (Oludare, Okunola & Oluseye, 2018). In order to overcome the complexity of the construction supply chain process which usually causes resources like equipment, raw materials, processed materials, components for assembly, consumable (fuels), general stores, maintenance materials and spare parts, work in progress and finished products and other services not to be available on time, in right amounts and in the desired quality and price, several inventory control techniques are used by different organisations. Some of the techniques adopted according to the firm's convenience as identified from several studies are as follows:

Always Better Control (ABC) Analysis
Vital, Essential and Desirable (VED) Classification
Scarce, Difficult Easy to obtain (SDE) Classification
High, Medium and Low (HML) Classification
Economic Order Quantity(EOQ) Analysis
Fast moving, slow moving and Non-moving (FSN) Classification
Seasonal, Off- Seasonal (SOS) Analysis
XYZ Analysis
GOLF Analysis

Minimum-Maximum Technique.
Just-in-Time Technique
Materials Requirement Planning

The detail explanations of these techniques are available in the previous studies by Deshpande (2008), Brindha (2014), Biswas, Karmaker, Islam, Hossain, and Ahmed (2017) and, Pagare, Yadav, Mahale, Pawar, Patil and Bhadane (2017) and Pushpakumara (2018).

2.2. Factors Affecting Efficiency of Inventory Control Techniques

It has been established that some factors have certain influence on the effectiveness of inventory control technique used by different firms, companies or organisations. These are highlighted in this section. Adafin, Ayodele, and Daramola (2011) identified eight factors as follows; Bill of quantities, schedule of materials, construction programme, specification, accounting system, security system, traits of store officer and nature/type of stock control method. Nganga (2013) identified that the factors effecting inventory control are, delays in procurement of goods, frequent stock-outs and uncertain change of prices, inadequate and untimely dispatch of funds, unavailability of stationeries/stores records, lack of specific time or date for both posting stores records, lack of adequate qualified and well trained staff. Chan, Tasmin, Aziati, Rasi, Ismail, and Yaw (2017) identified four factors which have significant influence on the inventory management in manufacturing small medium enterprises namely; planning, documentation/store records, knowledge of employee/staff skill and funding.

Adafin, Ayodele, and Daramola (2011) utilized structured questionnaire to examine the methods of stock control utilized by construction firms on construction sites in South Western Nigeria, with a view to assessing the factors affecting material stock control practice used, and also determine the impact of the factors on building project performance. The respondents were randomly selected construction professionals and technicians. The data analysed descriptively showed that the stock control method utilized by most construction firms is the Action Level method, while the factors identified had significant impact on building project performance in respect of cost, time and quality. The study then recommended that material stock control should be practiced on all sites and by all categories of building construction firms in strict compliance with Action Level Method in connection with adequate use of project bill of quantities, schedule of materials, construction programme, specification, proper stock accounting and security systems. It was also suggested that competent and experienced personnel with basic material managerial skills be used as site store officer to enhance material stock control practice. Though this study is based on south western Nigeria, it did not investigate the impact of firm performance. The study did not also look at some other important factors and inventory management techniques.

Nganga (2013) assessed the factors influencing effectiveness of inventory control in ministry of state for provincial administration and internal security in Nairobi, Kenya. The study used Structured and unstructured questionnaires administered to stratify randomly sampled, three hundred and fourteen (314) staff involved in inventory control or any other related activities in five (5) agencies/parastatals of government. The study found that the factors effecting inventory control are, delays in procurement of goods, frequent stock-outs and uncertain change of prices, inadequate and untimely dispatch of funds, unavailability of stationeries/stores records, lack of specific time or date for both

posting stores records, lack of adequate qualified and well trained staff. It was recommended that there should be a reviewed and redesigned of the current inventory control practices and procedure, avoid too much red tape and rigid rules and policies, engage qualified and adequate personnel in stock control with adequate timely dispatch of funds.

Ondari and Muturi (2016) evaluated the factors affecting the efficiency of inventory management in firms in Kisii, Kenya. The study employed a self-administered questionnaire to collect information from a stratified random sample of 56 respondents selected from a population of 112 employees who work with four firms in Kisii Town. The data analyzed descriptively, established that bureaucratic procurement procedures, documentation, stock records, managerial skill and funding had a positive impact on the efficiency of inventory management among firms in Kisii town. It was recommended that firms in Kisii town should enhance their bureaucratic procurement procedures through elimination of overlapping or conflicting jobs or duties.

Chan, Tasmin, Aziati, Rasi, Ismail, and Yaw (2017) identified the problem of inventory management faced by the manufacturing small medium enterprise and also determine the factors that influence the effectiveness of inventory management in Batu Pahat, Johor, Malaysia. The study randomly selected 80 from manufacturing small medium enterprise in the study area. The study found that the problems of inventory management confronting manufacturing organization were underproduction, overproduction, stock out situation, delays in the delivery of raw materials and discrepancy of records. The significantly influencing factors are, documentation/store records, planning, and knowledge of employees/staff skill, with funds having slightly significant influence on the inventory management in manufacturing small medium enterprises. The study inferred that the finding is a demonstrated guideline which can help employers to overcome the problems of effectiveness of inventory management in Batu Pahat, Johor, Malaysia. They neither looked at the inventory nor the effect on the performance of the firms.

Pushpakumara (2018) identified types of inventory control system and the factors affecting effective inventory management system in government sector organizations in Sri Lanka. The study used descriptive research design with a sample of 65 of inventory section employees in 35 of government sector organizations in Dambulla Secretary Division. Primary data was collected through distributed questionnaires among selecting employees. Hypotheses were tested with one-way ANOVA and correlation coefficient analyses. It was concluded that inventory record system, storage system, wastage system, procurement system, security system and investment in inventory affect effective inventory management, while staff characteristics and method of inventory do not significantly affect effective inventory management system in government sector organizations in Sri Lanka, thereby recommending that inventory should be physically checked, properly classified, coded, recorded and kept in the storeroom. There should be proper recycling system, effective communication, while written document should be used to get approval for release of inventory from the storeroom.

Other factors identified in literature were Poor staff training, Poor control, Poor quality of stock used, Poor management and support, Poor communication, Poor time management, Corruption by other staff, Poor planning by Stores, Large quantities of stocks ordered, Complexity of the control system, warehouse operations and transportation costs, suppliers reliability, economic downturns and extent of local competition (Barwa, 2015; Okwaro,Iravo and Berut, 2017; Amachree,Apkan, Ubani, Okorocha and Eberendu, 2017).

2.3. Inventory Management and Firm Performance

Arijeloye and Akinradewo (2016) assessed the current material management practices on building projects, the problems associated with materials management and measures for managing materials in building projects in Ondo state. The study utilized questionnaire administered to professionals in both consulting and contracting firms, while data collected were analyzed descriptively. It was found that purchasing of materials, material planning method and transportation of materials are the most common practices of materials Management. The severe problems militating against materials management were lack of proper work planning and scheduling, inadequate cash flow and delayed payments, burglary, theft and vandalism. It was the recommended that there should be improved supervision on site, proper handling of materials. More awareness should be given on construction sites on the knowledge of materials management on building projects.

Agu, Obi-Anike and Nnate (2016) investigated the extent to which inventory control affect the productivity of selected manufacturing firms in Nigeria, to determine the nature of the relationship between demand management and customer satisfaction of selected manufacturing firms and to determine the effect of Just – in- time on the growth of selected manufacturing firms. The study utilised the view of 270 respondents collected with questionnaire and interview as primary data instruments. The hypotheses were tested using Pearson product moment correlation and simple linear regression tests. The findings indicate that inventory control significantly affects productivity of selected manufacturing firms, with a positive relationship between demand management and customer satisfaction, while Just –in – time has a significant effect on growth of the selected manufacturing firms. The study concluded that inventory management is essential in the operation of any business. The study recommended that Organizations should train their personnel in the area of inventory control management for efficient smooth running of the inventory management activities or program.

Subramani, Nair, David, Ghouse and Kumar (2017) carried out a Study of Inventory Management System In Construction Industry in salem, India. The study utilised a questionnaire-based survey to elicit the attitude of owners, consultants, and contractors towards factors considered in inventory management system which affect the performance of construction projects. The study found that Quality materials inventory control is of a greater interest for contractors in order to improve cost, time, and quality performance. It was recommended that inventory management should ensure that contractors maintain the stock list and purchase list, calculate materials usage and store materials in safety

Atnafu and Balda (2018) empirically examine the impact of inventory management practice on firms' competitiveness and organizational performance. Data were collected from 188 micro and small enterprises (MSEs)operating in the manufacturing sub-sector in Ethiopia and the relationships and hypothesis proposed in the conceptual framework were tested using structural equation modeling (SEM). The study found that higher levels of inventory management practice can lead to an enhanced competitive advantage and improved organizational performance. It was also found that competitive advantage can have a direct, positive impact on organizational performance. It was then recommended that policy makers, and any concerned stakeholder should provide the necessary training and resource to promote the inventory management practice of MSEs for increased competitiveness and organizational performance.

Inegbedion, Eze, Asaleye and Lawal (2019) examined the influence of classical inventory management techniques on the efficiency of a door sales company in Ilorin, Nigeria. The study applied classical inventory management techniques were applied to an organisation's inventory system. Relevant data were collected on six types of doors; panel, flush, sliding, folding and as well as manual and electronic garage doors. The company had no scientific inventory management strategy but the EOQ, inventory cycle time and reorder level were computed for the six doors using the average values of the data obtained for 2011-2017. The found that the company can minimise its total inventory cost by consciously adopting an identified inventory management policy. The study though did not concern construction directly, it suggested that an improved inventory management technique can influence the cost performance of an organisation in the construction industry.

3. THEORETICAL AND CONCEPTUAL FRAMEWORKS FOR THE STUDY

3.1. Theoretical supports of the study

Constraint and Multi-echelon inventory theories were adopted for this study.

3.1.1. Theory of Constraint

The theory of constraints which was introduced by Eliyahu M. Goldratt in 1984, posited that a chain is not strong when it has a weak link, this is a management concept that postulates that all businesses are limited in achieving their maximum success by one or more hindrances. It is used to identify those business bottlenecks that would have encumbered production and outputs, and by ultimately controlling them performance is improved (Atnafu and Balda, 2018).

Therefore, for firms to achieve effective inventory management, the constraints which constitute weak links to ensuring overall firm performance need to be identified controlled or removed. Using the theory of constraints, a firm can focus its efforts and attention on the business obstacles and optimise processes so that it sees improved performance or output.

3.1.2. Multi-echelon inventory theory

Multi-echelon inventory theory is directly linked to supply chain management which in recent years has become an important way to enhance the company's competitive strength and therefore very important for the growth of companies. Multi-echelon inventory management as an integrated approach, considers completely the factors related to inventory optimization: cost, variability, service and complexity. It sizes correctly the stock across the entire supply chain while taking into account the complex interdependencies between stages as well as variables that cause ineffective inventory (Noucaiba & Abdelaziz, 2018). This is related to this study because supply chain management covers all the activities involved in delivering a product from raw material through to the customer including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management,

distribution across all channels, delivery to the customer and the information systems necessary to monitor all of these activities.

3.2. Conceptual framework

The conceptual framework of this study is used to illustrate the expectation of the research and includes the relationship among variables which indicates variables of causes and effects.

Inventory control management comprises planning and control of inventory. Inventory planning involves determining when to order items, how much to order, forecasting demand and stock replenishment, inventory information, while inventory control consists managing the inventories that are in store, knowing that products are in stock, quantities, cost and location (Sabure, 2020). The theoretical review has shown that some factors influence the effectiveness of inventory control management, which eventually leads to increased firm performance. This relationship is represented in the theoretical framework presented in Figure 1.

Twelve inventory management variables were identified, while the factors affecting the technique were grouped into firm characteristics, inventory control strategies, external factors, staff characteristics and organizational factors. The firm performance comprises cost, time, quality and profitability. An efficient inventory management techniques arising from the positive influence of the identified factors provides proper planning of the materials needed so as to ascertain the gap between the desired and the actual level of materials, allocation of resources, purchasing, sales and employment of staff and everything concerned to human resources management all of which contribute to improved performance of the firm.

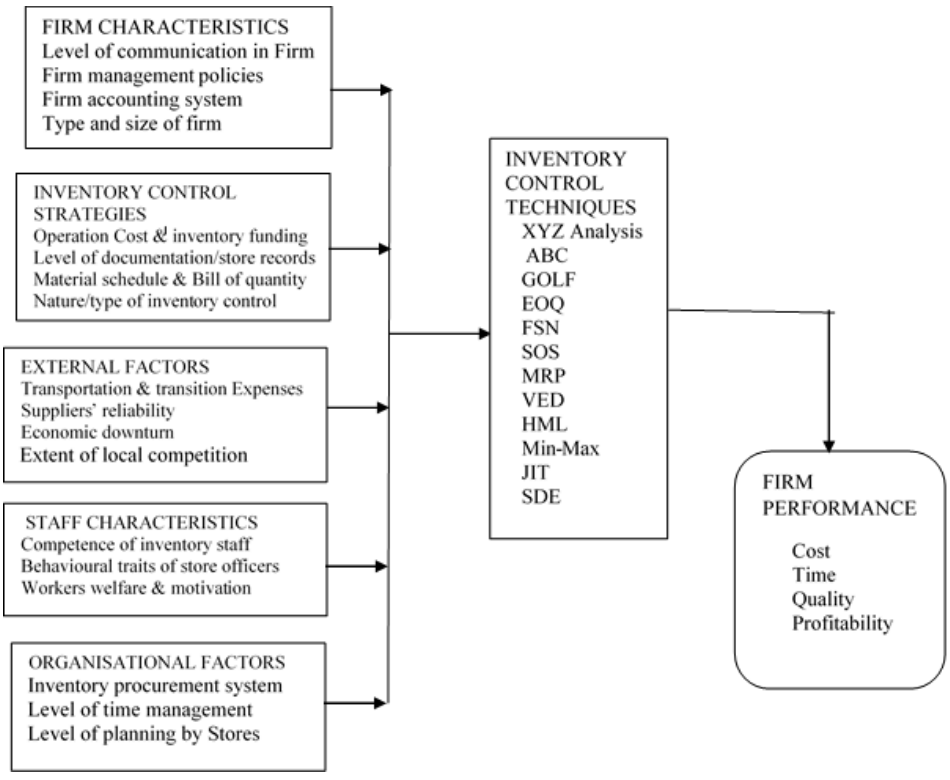

Figure 1: Conceptual framework for the study

3.3. Hypotheses of the study

Two hypotheses were postulated in this study based on the theories and relationships established in literature. The first hypothesis states that the identified internal and external factors do not have effect on the efficiency of inventory management techniques of construction industry firms in south-south, Nigeria. The second hypothesis States that the effectiveness of inventory management techniques do not affect the performance of construction industry firms in the study area.

4. RESEARCH METHODOLOGY

The study adopted quantitative survey approach which enables quantification, description and evaluation of the factors affecting the efficiency of common inventory techniques, as well as to measure the effect of the inventory management techniques on performance of small and medium size firms operating in the construction industry in south-south, Nigeria. A pilot survey was conducted to identify 304 small firms and 55 medium sized firms operating in the construction industry in four purposively selected towns in the study area and adopted as the study population. A sample size of 204 Small and 46 medium construction industry firms were selected using stratified purposive sampling techniques as respondent for this study. The use of small and medium sized construction industry firms as respondents is because, it was discovered that the two categories are considered key to economic growth, poverty alleviation and employment generation. They constitute the indigenous Nigerian firms, with low experienced and poor performance, who are unable to compete with their foreign counterparts that dominate the industry and execute major engineering projects (Ali, Awad, & Abdulsalam, 2019).

The study utilised structured questionnaire as the research instrument administered and filled by the firms' representatives, preferably managers. Questions on effective level of each of the inventory management techniques, factors influencing them and the firms' performance were formulated from extensive literature review. All questions were rated by using Likert scale ranging from 1(low) to 5 (very high) points. Data obtained through questionnaire, were analysed using SPSS25 and AMOS24 to obtain the output analysis of descriptive and inferential statistics. To test the hypothesis and examine the relationship between the variables, Structural Equation Model was adopted.

5. DATA ANALYSIS, RESULTS AND DISCUSSION OF FINDINGS

A total of 153 questionnaires were administered, only 138 usable questionnaires were The result and discussion are presented in this section.

5.1. Characteristics of Respondents used for the Study

For an understanding of the characteristics of the firm that were represented by respondents, the location, size, type of operation, years of experience and managerial status of representative were evaluated and the result presented in Figures 2 to 6. Figure 2 shows

that the firms were almost evenly selected from the four cities (Asaba, Calabar, Port Harcourt and Uyo). Figure 3 shows that majority of the firms were small size firms while others were medium size firms. Figure 4 indicated that the firms operate in the area of design development, production management, material manufacture and supply, facility maintenance and specialized services and plant and equipment hire. These cover reasonable areas of operation of firms in the construction industry that require inventory management. Figure 5 shows that over 90% of the firms have operated for more than eleven years which gives reasonable level of experience. Figure 6 shows that majority of the managers who represented the firms were of middle and high level management. Hence, the results generally imply that the information from the selected firms and representatives can be reasonably relied on.

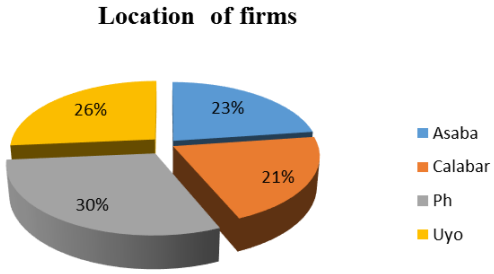

Figure 2: Location of firms

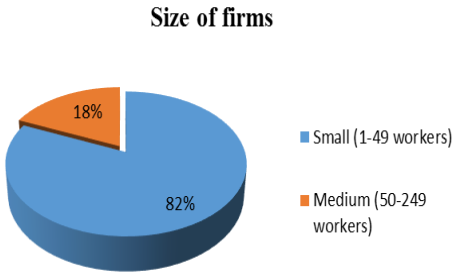

Figure 3: Size of firms

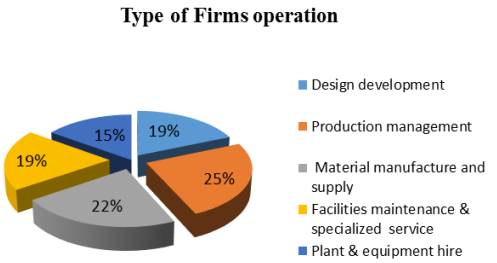

Figure 4: Type of firms

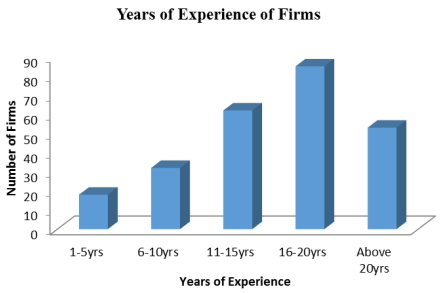

Figure 5: Years of experience of firms

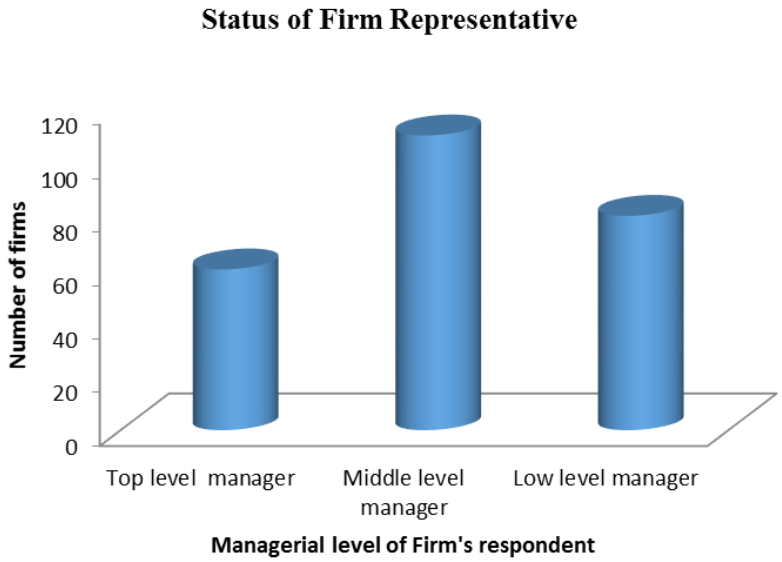

Figure 6: Status of firm representative

5.2. Exploratory Factor Analysis (EFA)

In order to determine if the identified factors fitted the constructs as described theoretically in the literature, exploratory factor analysis (EFA) was conducted. The result presented in Table 1 shows that all items had significant loadings on their respective factors with Eigen values above 1(one) and all the constructs exhibited relatively high factor loadings ranging between 0.832 and 0.982. The values of cumulative variance explained ranged from 24.098 to 88.675. The KMO (Kaiser–Meyer–Olkin) measure in Table 2 was 0.864 which is above the recommended threshold value of 0.50, indicating that there are sufficient items for each factor, while the reliability measure of Cronbach's alpha was 0.822, which is considered acceptable. The P-value of 0.000, is significant (less than .05), indicating that the correlation matrix is significantly different from an identity matrix, in which correlations between variables are all zero. The result provided evidence to support the theoretical conceptualization of the seven latent variables or constructs.

Table 1: Result of Rotated Component Matrix

		COMPONENTS						
FACTORS	CODE	1	2	3	4	5	6	7
XYZ Analysis	ICT1	.897						
Always Better Control (ABC)	ICT2	.913						
GOLF Analysis	ICT3	.901						
Economic Order Quantity(EOQ)	ICT4	.914						
Seasonal, Off- Seasonal (SOS)	ICT6	.928						
Materials Requirement Planning	ICT7	.955						
Vital, Essential and Desirable (VED)	ICT8	.906						
High, Medium and Low (HML)	ICT10	.832						
Minimum-Maximum	ICT11	.855						
Quality Performance	FPI1		.982					
Time Performance	FPI2		.976					
Cost Performance	FPI3		.949					
Profitability	FP14		.978					
Level of communication in Firm	ICF8			.924				
Firm management/investment policies	ICF13			.962				
Firm accounting system	ICF22			.933				
Type and size of firm	ICF23			.955				
Operation Cost & inventory funding	ICF15				.930			
Level of documentation/store records	ICF17				.939			
Materials schedule & Bill of quantity	ICF20				.948			
Nature/type of inventory control method	ICF24				.936			
Transportation and transition Expenses	ICF25					.848		
Suppliers reliability	ICF26					.953		
Economic downturn	ICF27					.944		
Extent of local competition	ICF28					.937		
Competence of inventory staff	ICF1						.917	
Behavioural traits of store officers	ICF10						.953	
Workers welfare & Motivation	ICF19						.951	
Inventory procurement system	ICF6							.949
Level of time management	ICF9							.951
Level of planning by Stores	ICF16							.933
Eigen value		7.470	3.805	3.638	3.588	3.475	2.760	2.753
Percentage Variance		24.098	12.273	11.735	11.574	11.210	8.904	8.881
Cumulative variance		24.098	36.371	48.106	59.679	70.889	79.794	88.675

Table 2: Result of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.864
Bartlett's Test of Sphericity	Approx. Chi-Square	10302.543
	Df	465
	Sig.	0.000
Cronbach's alpha		0.822

5.3. Evaluation of the goodness of fit of Models

In order ascertain if the data set satisfied the theory and provide a good fit to the model the results from the structural equation models were obtained and compared with the baseline criteria as adopted from Byrne (2010) and Gaskin (2012) for model goodness of fit. The result is presented in Table 3.

Table 3: Model goodness of fit result

		χ^2	Df	χ^2/Df	CFI	NFI	TLI	RMSEA	PCLOSE
Model	Factors \ Criteria			<3.0	≥ 0.95	≥ 0.90	≥ 0.95	≤ 0.05	>.05
1	7 factors (31 indicators)	918.351	428	2.146	0.954	0.917	0.954	0.068	0.000
2	7 factors (30 indicators)	860.644	399	2.157	0.956	0.920	0.951	0.068	0.000
3	7 factors (29 indicators)	718.859	371	1.938	0.965	0.931	0.962	0.061	0.003
4	7 factors (28 indicators)	550.514	344	1.600	0.978	0.944	0.976	0.049	0.569
Whereχ^2 = Chi Square; DF = Degree of Freedom; CFI = comparative fit index; NFI= Normed fit index; RMSEA = root mean squared error ofapproximation; TLI = Tucker-Lewis Index. PCLOSE= Closeness of fit									

Table 3 shows that the first model which is the hypothesized model consists of seven factors with 31 indicators, chi square for the model was 918.351 with 428 degrees of freedom at a probability level of $p<0.05$. Comparative Fit Index (CFI, 0.954) which is above the threshold of acceptance of >0.95 is a measure of the relative amount of variance and covariance in sample data that is jointly explained by the hypothesized model while that of the Normed fit index (NFI) is 0.917 >0.90. The Tucker-Lewis Index (TLI) yields a value of .954 which is within an acceptable range of 0-1.00, implying a good fit. However, the Root mean square error of approximation (RMSEA) which measures how well the model would fit the population covariance matrix if unknown optimally chosen parameter values are available (Byrne, 2010), has a value of 0.068> 0.05, while the closeness of fit (PCLOSE) is 0.000 < 0.05 criteria. These fell short of the criteria implies that the model did not fit the data.

The second model obtained by dropping ICF25 of external factors, consists of 7 factors with 30 indicators; it provides a model fit of (χ^2= 718.859, Df= 399, CFI= 0.956, NFI= 0.920, TLI= 0.951, RMSEA= 0.068, PCLOSE=0.000), while the third model obtained by dropping ICT10 of the inventory control techniques, consists of 7 factors with 29 indicators, provides a goodness of fit of (χ^2= 860.644, Df= 371, CFI= 0.965, NFI= 0.931, TLI= 0.962, RMSEA= 0.061, PCLOSE=0.003), with all the models having χ^2/Df<3.0. It can thus be seen that the second and third models though show a substantial improvement in the model fit, yet fail to satisfy the RMSEA and PCLOSE criteria in Table 3, hence the models did not fit the data.

The last and acceptable model obtained by dropping ICT11 of the inventory control

techniques, consist of 7 factors with 28 indicators having goodness of fit of (χ^2= 550.514, Df= 344, CFI= 0.978, NFI= 0.944, TLI= 0.976, RMSEA= 0.049, PCLOSE=0.569) with the models having χ^2/Df = 1.600<3.0. These values satisfied all the criteria, therefore the fourth model represents the final best-fitting and most parsimonious model representing the data. The path diagram of the final model is shown in Figure 7.

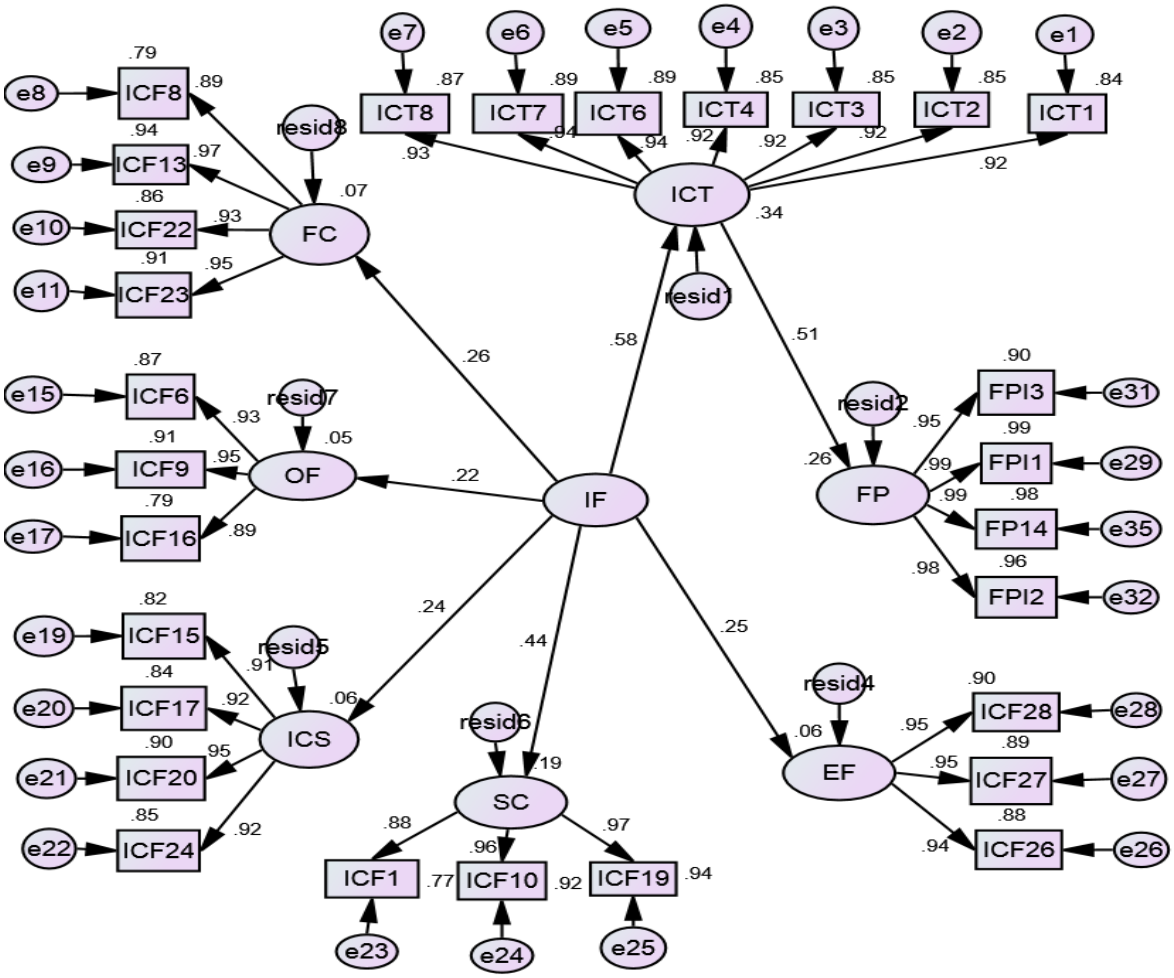

Figure 7: Path Diagram of Model 4 – Final model

5.4. Regression Estimates of factor loadings for the final model

The results presented in appendices 1 and 2 show the regression loadings of the factors in the final model. The result shows that all the estimated values in Appendix 1 were found to have critical ratio value >1.96, thereby implying their statistical significant difference from zero. ICT loads on IF with standardized regression value of 0.392, FC with 0.188, ICC with 0.211, EF with 0.185, PC with 0.353, while OF loads with the lowest value of 0.153. This implies that as IF increases by 1 standard deviation, ICT increases by 0.392, FC by 0.188, ICC by 0.211, EF by 0.185, PC by 0.353, while OF increases by 0.153. The probability of getting a critical ratio as large as the values in Appendix 1 is less than 0.001. For example, the regression weight for IF in the prediction of ICT is significantly different

from zero at 0.001 level (two-tailed). Therefore, the regression weight estimate is 4.873standard errors above zero. The result also indicates that FP loads on ICT with standardized regression value of 0.420 which is greater than 1.96.

5.5. Proposed relationship and hypothesis testing

The result in Table 4 is used to ascertain if the proposed structural equation model analysis indicated supports the postulated hypotheses. The decision criteria is that if p-value is less than 0.05, the hypothesis is rejected and if otherwise the hypothesis is accepted.

Table 4: Result of Proposed Structural equation model and hypothesis testing

Hypothesis	Relationship	Total Effect	Direct Effect	Indirect Effect	Decision
Hypothesis 1	IF → ICT	0.581	0.581	-	Reject
	p-Value	0.000	0.000	-	
Hypothesis 2	ICT → FP	0.512	0.512	-	Reject
	p-Value	0.000	0.000	-	
	IF → FP	-	-	0.298	

Table 4 shows that the standardized coefficient of the relationship between influencing factors and inventory management techniques is 0.581 with a p-value of 0.000< 0.05 significant level. This implies rejecting hypothesis 1, which indicates that the selected factors have direct positive effect on the effectiveness of the inventory management techniques. Hence, firms' characteristics, inventory control strategies, external factors, staff characteristics and organizational factors may directly enhance the efficiency of inventory management techniques if the negative aspects of the factor are adequately taken care. This finding is consistent with some previous studies by Ondari and Muturi (2016) which established that bureaucratic procurement procedures, documentation, stock records, managerial skill and funding had a positive impact on the efficiency of inventory management among firms in Kisii, Kenya, and Pushpakumara (2018) which identified staff characteristics, inventory record system, storage system, wastage handling system, inventory procurement system, among others as factors affecting effective inventory management system in government sector organizations in Sri Lanka.

Table 4 also shows that the standardized coefficient of the relationship between the inventory management techniques and performance of construction industry firms is 0.512 with a p-value of 0.000< 0.05 significant level. This implies rejecting hypothesis 2, which indicates that the effectiveness of the inventory management techniques has direct positive effect on the performance of construction industry firms in the study area. The effective application various inventory management practices, such as XYZ Analysis, Always Better Control, GOLF Analysis, Economic Order Quantity, Seasonal, Off- Seasonal, Materials Requirement Planning and Vital, Essential and Desirable techniques, may enhance construction firms' performance through enhanced cost, time, quality and profitability delivery of projects and services. This finding is similar to that by Subramani, Nair, David, Ghouse and Kumar (2017) which found that quality materials inventory control is of a greater interest for contractors in order to improve cost, time, and quality performance of construction projects in Salem, India, as well as Atnafu and Balda (2018) which found that higher levels of inventory management practice have direct positive relationship on firms' competitiveness and organizational performance in Ethiopia.

The result also with a standardized coefficient of 0.298 suggested some level of indirect relationship between the significant influencing factors and Firms' performance. This indicates that the factors also have indirect positive relationship with the performance of firms operating in the construction industry in the study area

6. CONCLUSION AND RECOMMENDATIONS

The finding of the study on the relationship between some influencing factors and efficiency of inventory management techniques is that the factors have positive relationship with the efficiency of inventory management techniques. This means that the better the influence of the factors are controlled the more efficient is the inventory management techniques. The factors were classified into firm characteristics, inventory control strategies, external factors, staff characteristics and organizational factors, while the important inventory management techniques are XYZ Analysis, Always Better Control (ABC), GOLF Analysis, Economic Order Quantity(EOQ), Seasonal, Off- Seasonal (SOS), Materials Requirement Planning and, Vital, Essential and Desirable (VED). The implication of this finding is that if construction industry firms do not understand and control the identified factors, efficiency of inventory management techniques may be difficult to achieve.

Another finding from the study is that a positive relationship exists between efficient inventory management techniques and construction industry firms' performance in terms of time, cost, quality and profitability. The finding is an indication that improvement in the efficiency of inventory management techniques will lead to improvement in the performance of construction industry firms in the study area. The implication on this is that if managers of construction industry firms under play the efficiency of the management of their inventory then sustainability, competitiveness and survival of the firms will be jeopardized. It was also found that an indirect positive relationship also exists between the identified influencing factors and the construction industry firms' performance.

It is therefore recommended that managers of construction industry firms should understand, emphasize and control the identified factors for enhanced efficiency of inventory management techniques and overall performance of the firms. It is also recommended that managers of construction industry should not under play the efficiency of the management of their inventory, so that they can remain sustainable, competitive and survive in the construction industry.

It is worthy of note that this study is limited to the twelve inventory management techniques, twenty-eight influencing factors and four firm performance indicators selected from literature and the views of managers who represented the various construction industry firms operating in south-south, Nigeria. Since the study was also limited to the views of 250 managers who returned their questionnaire, the result could be improved by further studies on other stakeholders, other factors and other geopolitical zones not covered in this study. In spite of these limitations the result could provide reasonable insight into the factors construction firm managers can control to ensure the efficiency of inventory management techniques for enhanced construction firms performance in Nigeria, as well as guide for further studies.

REFERENCES

Abah, E. & Adamu, A. D. (2017). Evaluation of Nigerian Construction Industry Preparedness to Adopt Supply Chain Management*, Project Management World Journal,* 6(11), 1-21.

Adafin, J. K., Ayodele, E. O. & Daramola, O. (2011). An Assessment of Factors Affecting Material Stock Control Practice on Selected Construction Sites in Nigeria, *Continental Journal of Environmental Design and Management,* 1 (1), 22 - 31.

Agu, A. O., Obi-Anike, H. O. & Nnate, E. C. (2016). Effect of inventory management on theOrganizational performance of the selectedManufacturing firms.*Singaporean Journal of Business Economics, and Management Studies (SJBEM),* 5(4), 56 – 69.

Ali, I. F., Awad, S. H. & Abdulsalam, D. (2019). Critical Factors Limiting the Performance of Small-Scale Construction Firms in Nigeria *International Journal of Engineering Science Invention (IJESI),* 8 (08), 46-57

Amachree, T.T., Apkan, E.O.P, Ubani, E.C., Okorocha, K.A, & Eberendu, A. C. (2017). Inventory Management Strategies for Productivity Improvement in Equipment Manufacturing Firms, *International Journal of Scientific & Technology Research*, 6(08), 99-107.

Atnafu, D & Balda, A. (2018). The impact of inventory managementpractice on firms' competitiveness and organizational performance: Empirical evidence from micro and small enterprises in Ethiopia, *Cogent Business & Management*, 5, 1-16.

Ajayi, O., Ajayi, O., Akinsiku, O. & Osunsanmi, T. (2016). Strategies for housing affordability in Nigeria, *Journal of Construction Project Management and Innovation 6*(SI), 1620-1632.

Arijeloye, B.T. & Akinradewo, F. O. (2016). Assessment of materials management on building projects in Ondo State, Nigeria, *World Scientific News,* 55,168-185.

Barwa, T. M. (2015). Inventory Control as an Effective Decision-Making Model and Implementations for Company's Growth, *International Journal of Economics, Finance and Management Sciences*, 3(5), 465-472.

Biswas, S. K., Karmaker, C. L., Islam, A., Hossain, N. & Ahmed S. (2017). Analysis of Different Inventory Control Techniques: A Case Study in a Retail Shop, *Journal of Supply Chain Management System,* 6(3), 35-45.

Brindha, G. (2014). Inventory Management, *International Journal of Innovative Research in Science, Engineering and Technology,* 3(1),8163-8175.

Byrne, B. M. (2010). *Structural equation modeling with AMOS: basic concepts, applications, and programming*, 2nd ed. New York: Routledge Taylor & Francis Group

Chan, S. W., Tasmin, R., A. H., Aziati, N., Rasi, R. Z., Ismail, F. B. & Yaw, L. P. (2017). Factors Influencing the Effectiveness of Inventory Management in Manufacturing SMEs, *Materials Science and Engineering,* 226, 1-8.

Deshpande, V. A. (2008). Optimal Inventory Control Using ABC, VED & SDE Analysis for Indian Industries. National Conference on Emerging Trends in Mechanical Engineering (ETME-2008), 28-29 March, Helt at G H Patel College of Engineering & Technology (GCET), Vallabh Vidyanagar, Gujarat, p. 12.

Gaskin, J. (2012). Model Fit, Gaskination's Startwiki. Retrieved December 29, 2019 from http://statwiki.kolobkreations.com/index.php?title=Confirmatory_Factor_Analysis&oldid=336404

Inegbedion, H., Eze, S., Asaleye, A. & Lawal, A. (2019). Inventory Management and Organisational Efficiency, *The Journal of Social Sciences Research*, 5(3), 756-763.

Nagaraju, S., Reddy, B. S. & Chaudhuri, A. R. (2012). Resource Management in Construction Projects – a case study *IRACST – Engineering Science and Technology: An International Journal (ESTIJ),* 2(4), 660-665

Nganga, K. J. (2013). An Assessment of the Factors Influencing Effectiveness of Inventory Control; Ministry of State for Provincial Administration and Internal Security, Nairobi - Kenya, *International Journal of Business and Commerce*, 3 (1), 33-53

Nouçaiba, S. & Abdelaziz, B. (2018). A literature review on multi-echelon inventory management: the case of pharmaceutical supply chain, MATEC Web of Conferences 200, 00013

Obiadi B. N. Irouke V. M, Ezezue A. M. & Nzewi N. U. (2017). Housing inadequacy in Nigeria: The case of failed government housing policies. *Tropical Built Environment Journal (TBEJ),* 1(6), 52-69.

Ofori, G. (2018). Construction in Developing Countries: Need for New Concepts, *Journal of Construction in Developing Countries,* 23(2), 1–6.

Okwaro, F., Iravo, M. & Berut, Z. (2017). Factors Affecting Inventory Management Efficiency in Kenya Seed Company, Kitale Branch, Kenya, *International Journal of Recent Research in Commerce Economics and Management (IJRRCEM)*, 4(1), 19-39.

Oludare, O. S., Okunola, O. S. & Oluseye, O. (2018). Construction Supply Chain Management Systems in Lagos State, Nigeria, *Journal of Scientific and Engineering Research*, 5(6), 299-309.

Ondari, L. M. & Muturi, W. (2016) Factors Affecting the Efficiency of InventoryManagement In Organizations In Kenya A Case of Firms In Kisii Town, *International Journal of Economics, Commerce and Management,* 4(4), 1019-1034.

Othman,I., Napiah, M. & Potty, N. S. (2014). Resource Management in Construction Project, *Applied Mechanics and Materials,* 567, 607-612

Pagare1, M., Yadav, S. K., Mahale, R., Pawar, M., Patil, P. & Bhadane, D. (2017). A Study on Inventory Control and Management Techniques, *International Journal of Science and Technology*, 5(1), 461-468.

Pinha, D. C. & Ahluwalia, R. S. (2019). Flexible resource management and its effect on project cost and duration, *Journal of Industrial Engineering International,* 15, 119–133.

Pushpakumara, W.M.P.G.R. (2018). Factors affect to effective inventory management system in government sector organizations in Sri Lanka: with special reference to government sector organizations situated in Dambulla secretary division. *International Journal of Scientific Research and Innovative Technology,* 5(9), 65-72.

Sabure, M. (2020). The Influence of Inventory Control Management on Financial Organization Performance, A research thesis, Department of Business, University of Arusha, Arusha, Tanzania.

Subramani, T., Nair, V. B., David, A., Ghouse, B. M.& Kumar, N. S. (2017). A Study of Inventory Management System in Construction Industry, *International Journal of Application or Innovation in Engineering & Management (IJAIEM),* 6 (5), 304-311.

Ugochukwu, S. C., Ogbuagu, G. O. & Okechukwu, F.E. (2014). An Appraisal of the sources, quantities and prices of imported building materials in Nigeria. *International Journal of Advanced Research* 2(9), 871-889.

Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 4, Numbers 1&2, 2020

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