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EDITORIAL

Isaac D. Ikediashi
Editor-In-Chief

It is with immense joy that I welcome you to the first and second issues of the fifth volume of the Journal of Contemporary Research in the Built Environment (JOCREBE) for the year 2021. 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 once again appreciate our worthy contributors for well researched and articulated papers. I therefore present to you ten (10) papers in this edition and are hereby summarised for you. Enjoy your reading.

The first paper by Ige, Oladapo and Adewusi explained the contributing effect of land titling on land value with a special focus on Akure, Nigeria. Questionnaires are distributed to 2026 household heads who are landowners of selected private residential layouts/estates in the study area. Data gathered were analysed using 2 stages hierarchical form of semi-log hedonic price analysis to determine the contribution of land titling to land value. It was discovered that when land titling is considered alone with land value, there is a statistically significant contribution of about 27% to land value and 126% when considered alongside the other independent variables. Therefore, the authors conclude that land titling is a unique factor to be considered when assessing land value. Otherwise, considerable discretion and logical judgment may be difficult to make under the untitled land transaction setting.

The second paper by Ikediashi and Bassey examined key drivers influencing the practice of value management practices and determined factors inhibiting the smooth implementation of VM practices for construction projects with a view towards bolstering construction project delivery in South-south Nigeria. Anchored on questionnaire survey approach, two hundred and twenty-seven (227) copies of the questionnaire were administered while one hundred and seventy-seven (177) were properly filled and returned which give a response rate of 78%. Data collected were analysed using percentage and relative importance index while Kruskal Wallis test was used to test the hypotheses. The authors discovered that the three top rated drivers were “VM was able to improve products and services”, “works towards arriving at a more effective design”, and “seek to obtain maximum efficiency ratio” in that order while “provision of alternative evaluation and supporting information at project brief/design state” was the least rated driver. Besides, it was also revealed that the three top rated barriers of VM implementation for construction projects in the study area are lack of awareness, absence of formal guidelines, and passive behaviour among VM practitioners while high cost of VM study was the least rated factor, while the two hypotheses postulated for the study were accepted.

The third paper by Olatunji, Adeniyi and Jegede examined the benefits of e-procurement in the Nigerian Construction Industry based on the perspectives of construction professionals in Ondo State. Quantitative research design was employed in which, professionals were chosen from construction organisations (contracting and consulting firms) and were asked to express their perception of the benefits of e-procurement on a 5-point Likert scale-based questionnaire. 84 copies of questionnaire were administered in the study area. Out of which a total of 53 copies were completed,

returned and successfully deemed fit for analysis. Data obtained was analysed using the Mean Item Score (MIS) and Kruskal-Wallis test. The paper observed that respondents from small-sized firms ranked all benefits high but the highest-ranked benefit is "cost and time saving". Also, the medium-sized firms ranked all benefits high but the highest-ranked benefit is "less paperwork". Similarly, respondents from the large-sized firms also ranked all benefits high but the highest-ranked among the benefits is "cost and time savings". Overall, "cost and time savings" was ranked as the top most benefit of e-procurement in the Nigerian construction industry. The paper recommends that practitioners and government should examine the perceived benefits and notice the fact that they were all highly rated by all the groups of respondents. This should encourage the drive towards the entrenchment of e-procurement in construction processes, irrespective of the cost and initial technical limitation.

The fourth paper by Abdulrazaq, Mohammed and Ibrahim assessed the risk factors prevalent in the idiographic setting of renovations of primary health care buildings in Kaduna state Nigeria. Data was collected via a questionnaire survey of contractors who had been engaged in carrying works of renovating primary health care (PHC) buildings in Kaduna state Nigeria. The questionnaire survey focused on determining the likelihood of occurrence/impact of thirty-one (31) risk factors on cash-out forecasts. Contractors were asked to rank on a scale of 0 to 5 the likelihood of occurrence/impact of the risk factors. The responses obtained were subjected to analysis with the use of IBM SPSS (version 21) software. The mean, standard error and standard deviation were computed. The computed means were used to rank the likelihood of occurrence/impact of the factors in descending order. Nineteen (19) risk factors were found to significantly impact cash-out forecasts- "change in management", "non-inclusion of project in yearly budget", "increased duration of the project", "change in currency exchange rates", "high cost of materials", among others.

The fifth paper by Bello, Allu-Kangkum and Nimlyat investigated energy efficiency in higher education buildings with a view to developing a conceptual energy efficient framework for sustainable higher educational building design in Nigeria. The paper adopted a mixed research method approach in which interviews were conducted and questionnaires distributed, analysed using the Likert scale grading system to test the relationship between users' perception of energy efficient buildings and amounts of energy conserved. Findings from the paper validated perceptive benefits of the passive and sensible cooling loads to the Primary and Total Energy Demand of educational buildings in Nigeria. The study also indicated the lack of conscious consideration to the environmental and socio-cultural impact of buildings on the environment but more attention seems to be focused on building costs, labour and materials in Nigeria.

The sixth paper by Ikediashi and Owoefiak identified critical success factors associated with TQM implementation for construction projects in south-south Nigeria and explored their underlying factors by categorising the critical success factors using principal component analysis (PCA). Anchored on quantitative questionnaire survey approach, 91 copies of the structured questionnaire were distributed while 50 valid responses were retrieved giving a response rate of 55%. Data were analysed using descriptive statistics, Mann-Whitney U-test, and principal component analysis. Findings revealed that customer satisfaction, top management commitment to quality processes, benchmarking, maintaining quality culture and design quality management were ranked top five (5) CSFs associated with TQM implementation for construction projects by respondents in the study while factor analysis conducted produced 7 components. The hypothesis postulated for the study was accepted because the p-value was greater than 0.05 which meant that there was no significant difference in the perception of respondents

on the CSFs associated with TQM implementation practices between Akwa Ibom and Rivers States. The paper recommended among others that, construction companies as well as stakeholders should take strategic measures in ensuring that customer satisfaction, top management participation and commitment to quality process and maintaining quality culture were given priority as they were the key CSFs for implementing TQM practices.

The seventh paper by Ekop, Ufia, Etim and Edet assessed the suitability of aggregate obtained from Use Ikot Amama and AfahaItiat both in Ibiono Ibom Local Government Area of Akwa Ibom State for concrete production. The paper also compared the evaluated engineering properties of these gravels with conventional granite from Akamkpa in Cross River State. The paper examined three samples of aggregates; two unwashed gravels from Use Ikot Amama and Afaha Itiat both in Ibiono Ibom Local Government Area and crushed granite from Akamkpa in Cross River State. Concrete mix of 1:2:4 and water to cement ratio of 0.55 were adopted while the specimens prepared were tested up to curing age of 28 days. Particle size analysis, aggregate crushing value and Aggregate impact, water absorption, compressive strength and flexural strength tests were also conducted on the concrete cube specimens. Concrete cube of 150mm were cast for each test and three specimens in each case were tested up to 28 days. The results indicated the mean compressive strength of 24.07N/mm² for AfahaItiat follow by 19.56N/mm² for Use Ikot Amama compared to the crushed granite which gave 26.96N/mm² at 28days. It furthers indicated that AfahaItiat gravel has the highest Impact value while Use Ikot Amama had the highest crushing value.

The eighth paper by Wahab, Mamman, and Nuhu examined factors responsible for the large gap created between demand and supply of housing in Abuja, Nigeria. The paper analysed 250 returned questionnaires administered to registered developers under Real Estate Developer association of Nigeria (REDAN). The information relating to interest rate on real estate financing in Nigeria was sourced from Federal Mortgage Bank of Nigeria (FMBN), while land cost and building cost per meter square were sourced directly from registered estate surveyors and quantity surveying firms respectively. The study utilized both descriptive and inferential method of analysis. The authors observed in their research that inadequate finance and cost of building materials were major factors affecting private housing development. Furthermore, the result of revealed that building cost/m2, land cost/m2 and interest rate on real estate finance jointly influenced variation in private housing development by 85%.

The last paper by Ojo, Ogiri and Babatunde used literature review to analyse the past, present and future of concrete admixtures (water reducing admixtures) and the need to develop effective eco-friendly (natural) admixtures. The paper observed that the discovery of cement has led to insatiable desire to improve it. According to the paper, Admixture has been useful in this regard which has led discoveries of different type of admixtures and in specific, different generation of superplasticizer. More so, the amount of cement production needs to be reduced, thereby requiring maximum performance whenever concrete is produced.

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CONTRIBUTING EFFECT OF LAND TITLING TO LAND VALUE: LEARNING FROM AKURE, NIGERIA

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ABSTRACT

Purpose: The purpose of this paper is to explain the contributing effect of land titling on land value with a special focus on Akure, Nigeria. Land titling has an abstract economic value that untitled physical assets do not have. The inability to measure this economic value as it affects land value in the context of the urban land market often poses a difficult task as there were no readily available data. The consequence may mean difficulty in determining the precise land value under competitive conditions in the urban land market.

Design/methodology/approach: Questionnaires are distributed to 2026 household heads who are landowners of selected private residential layouts/estates in the study area. Data gathered are analysed using 2 stages hierarchical form of semi-log hedonic price analysis to determine the contribution of land titling to land value.

Findings: The finding shows that when land titling is considered alone with land value, there is a statistically significant contribution of about 27% to land value and 126% when considered alongside the other independent variables.

Originality/value: The outcome of the paper will join the body of existing studies to empirically demonstrate to landowners, valuers, land administrators, other stakeholders and policymakers that land titling is a unique factor to be considered when assessing land value. Otherwise, considerable discretion and logical judgment may be difficult to make under the untitled land transaction setting.

Keywords: Land titling; Land market; Land value; Private residential layouts/estates; Semi-log hedonic price analysis; Titled land; Untitled land; Urban area; Akure; Nigeria

1. INTRODUCTION

As aptly observed by the International Federation of Surveyors (1995), land titling is the legal recognition of ownership or an interest inland. It is the delivery process of real rights to occupants of land or property. Land titling is associated with rights, restrictions and responsibilities connected with forms of ownership and use of land as well as the official recording of the title to provide reliable documentary evidence of the title granted. Given its great potential benefit to provide enforceable legal and secure rights to the possession and use of a given portion of land, land titling gives greater confidence to parties seeking to participate in the urban land market. Hence, titling provides a good

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hedge for a land transaction. The direct consequence of this is that stakeholders like financial institutions while granting loans, considered legal backing on land as convincing evidence of ownership to the exclusion of any other party claiming ownership to the same portion of land.

Correspondingly, the wide-ranging acceptability of title documents as conclusive evidence of rights subsisting on land has created an active market for land titling. This has a subsequent effect on land value. Brasselle, Gaspart and Platteau (2002) cited in Jacoby and Minten (2007) confirmed that land titling can increase land values due to its ability to guarantee the interests that can be enforced against a specific land. Nevertheless, despite the significance of land titling, measuring it is often difficult while appraising land value. According to Abidoye and Chan (2017), the traditionally expected variables in land value appraisals are structural, locational, neighbourhood and environmental attributes. Land value has however been argued as a fallout from the subjective assessments made by willing purchasers of the fulfilment derived from ownership of the interest subsisting inland (Oduwaye, 2009). Denman and Prodano (1972) cited in Udoekanem, Adoga and Onwumere (2014) established that land value is not only determined by mere claim of ownership and valuation of the physical land as a resource but by the rights subsisting on the land which can only be substantiated by titling.

Therefore, it is not just the value of the physical structure that is only important but the proprietary rights on the land. For instance, it is titling that creates the wherewithal to borrow the requisite funds and empower the mortgagee to take up title to land in case of foreclosure and not the physical development. According to De Soto (2000) cited in Smith, Williamson, Burns, Chung, Ha, and Quyen (2007), land titling has an abstract economic value, valid in a wide range of contexts, which untitled physical assets did not have. The critical question then is, how can this economic value be measured and how will land titling affect land value in the context of the urban land market? Inability to answer these questions may mean difficulty in determining the precise land value under competitive conditions in the urban land market. Regrettably, operationalizing the economic value inherent in land titling faces several empirical challenges. Due to the scanty research in this area, very little is known about the influence of land titling, particularly on land value. Thus, as a response to the existing knowledge gap, this study has attempted to investigate the possible effects of land titling on land value in the urban areas of Nigeria with a particular focus on the selected residential layouts/estates in the Akure metropolitan area of Ondo State, Nigeria.

A handful of studies established the influence of land titling on land value. On the one hand, another strand of literature has not been able to validate the contributory effects of land title to land values, but in particular, acknowledged the significant and positive effect of land titles on the likelihood to transfer land. To this end, the empirical evidence substantiating these viewpoints is inconclusive. Given the present position, the precise effect of titling on land value in an urban setting becomes necessary, as the emphasis of some of the existing studies was on the economic analysis of rural land. Akure area of Ondo State became the focus of this paper as an urban centre that is a typical illustration of a dynamic land market dominated by both formal and informal activities. However, given the high spate of land development in Akure, there is massive expansion towards all the urban-fringe areas of the city. This has allowed the establishment of most of the residential layout/estate used for the study.

2. LITERATURE REVIEW

2.1. Empirical Studies on contributing effect of Land Titling to Land value

The contribution of land titling to land values has not received enough attention in Nigeria as literature related to this aspect of the valuation of the land is limited. Consequently, land titling has not always been perceived as having a significant contributing effect on land value. However, the hedonic technique has been used in the past mostly on rural or agricultural land to determine the contributing effect of land titling on land value. Thus, studies attempting to measure the contributing effect of land titling to land value in the urban area are sparse. One of the first studies to analyse the contributing effect of land titling to land value is Asabere (1981) who employed the hedonic analysis to explain the value of vacant lands in Accra, the capital city of Ghana. The study regressed land prices on certain land attributes such as location, zoning, land title, ethnic clustering, time-of-sale, lot size, and site services. The results indicated that all the variables including land title contributed to land values. The study however did not state the magnitude of land title contribution to land value. In addition, the economic, geographic and cultural settings of the study area are different from this present study, hence its findings cannot be generalized in the study area. The time setting of the study is age-long and may not be relevant in the modern-day land valuation as the issue of land keeps changing with the trend. The variables used may be peculiar to the study area as there are other variables aside from this already established in the previous studies as germane to determining land value. In another study, Feder and Onchan (1987) estimated the effect of titles on economic performance in four of the rural provinces in Thailand. Hedonic analysis captured land titles data, soil quality and market proximity as independent variables. The result revealed a statistically significant effect of titled on land value in all the selected rural provinces of Thailand. In the same way, Feder, Onchan, Chamlamwong, and Hongladarom (1988) examined the economic implications of land titling in an agrarian area and utilized farm-level data from a sample of about 900 farmers in four Thailand provinces. The study selected sites in which squatters and titled farmers operate in geographical proximity within a similar agro-climatic environment. Land values reported by the sampled farmers were analysed through a hedonic price model in the study areas. Other variables like soil quality, market proximity which might affect land values were accounted for. Land titling had a statistically significant effect on land prices in all the provinces considered. Both studies though confirmed the significant effect of land titling on land values did not indicate the level of its contribution to land values.

In Brasington and Sarama (2008) a data set of 37,043 housing sales that have registered title in five metropolitan areas of Ohio was appraised. The explanatory variables employed include the 15 deed types and 14 structural characteristics of the houses which are the number of fireplaces, bedrooms, and full and partial bathrooms in the house; the number of detached structures on the lot; the age of the house; the size of the house and yard; and dummy variables for whether the house is one-story, made of brick, and has a deck, courtyard, garage, or finished basement. The title to the land was found to affect the house's sale price. The magnitude of the land titling effect which is germane to this present study is not also stated.

On the contrary, Antwi (2002) employed the hedonic technique to examine the relationship between the residential land plots and other independent variables that affect the land value such as date of transaction, state of development of the land, neighbourhood quality, whether the land was obtained from government or customary

landowners, source of finance, the extent of market search undertaken before purchase, sources of market information and perception of real estate rights purchased. Titling was not a significant contributory factor to land value. The reason may not be far-fetched as the land transaction data was obtained from land purchasers who did not have any formal title to land purchased. To them, titling is not an important variable in land value determination. This outcome aligns with Pagiola (1999) as well as Roquas (2002) that land titles may be less important where enforcement mechanism is persistently lacking. The repercussion of this may not be immediate, but such transaction is subject to litigation, public control and insecurity from financial institution assistance.

Nkurunziza (2007) explored a different approach in Kampala city of Uganda. Three case study settlements were used to analyse and explain the nature of institutions that regulate and underpin land delivery processes in informal settlements. It was found that the key factors influencing the price of land were the plot size, location, access to water, the existence or absence of a registered certificate of title, neighbourhood characteristics and the quality of available infrastructure and social services. Emoh, Oni and Egolum (2013) equally analysed the different contributory factors of residential land values and the strength of the different factors contributing to land value variations in Onitsha, Nigeria. Employing regression analysis, thirteen main factors (accessibility, neighbourhood quality, land title, zoning regulations, transportation, rent, improvement tax, environmental quality, view of amenities, travel time to the city centre and irrevocable power of attorney) were established as determining land values in the study area. The land title was ranked third out of the thirteen variables based on the magnitude of its contribution by using the Standardized beta (β) coefficient of 2.595, which implies a contribution of about 260%.

A more recent and similar study by Madalasa (2014) adopted a semi-log form of the hedonic model to evaluate the premium paid to a title in Bangalore, India. A data set of 2263 observations of appraised land prices was modelled into the hedonic equation as the dependent variable, while 9 independent variables to show the combined effects of title and planning were employed in the analysis. The value of the coefficient for the land title was found positive and significant. The coefficient value of land title indicated that it was one of the largest contributors to the pricing of the parcel. This accounts for about 7.4% of the price increase attributable to the land title premium. This study is unique in that it controls other variables such as locational amenities, neighbourhood characteristics amongst others that affect land values and only allows the isolation of the effect of titling. A similar methodology was replicated in this present study. However, because of the focus of this study which is to determine the contribution of land titling to land value, effects of titling were isolated while major categories of variables earlier established in the previous study were considered as may apply to the selected urban areas. This was done by ensuring minimal dissimilarities in the variables that affect land value.

In a similar study, Aikaeli and Markussen (2017), investigated the effects of land titling on land values in urban and rural areas of Tanzania. The log of land value is the dependent variable, while the independent variables include; land titling inheritance letter, purchase agreement, lot size, year of land acquisition, distance to home, distance to road, distance to market, soil type, soil quality and land slope. The results of the regression analysis showed that the effect of land titling is significant and strong in both urban and rural areas. Land titling made a contribution of about 32 per cent to land value in both areas. However, the results of the urban areas were based on fewer observations.

From the foregoing, it is apparent that empirical studies have been undertaken on the contributing variables to land value globally, but there exist very few studies on the

connection between land titling and land values. Nonetheless, none of the few available studies has painstakingly dealt with land titling as one of the factors influencing land values in Nigeria; yet, market values are also a reflection of the extent to which titled land makes the transaction easier or otherwise (Jacoby and Minten, 2007). Besides, most of the previous studies that consider titling as a contributory variable to land value are the result of government intervention that is followed by granting of title free of charge as such their model specifications were not clearly stated and defined.

2.2. Empirical adaptation from previous studies on the impact of Land Titling on Land Value

A vast number of the existing studies have empirically explored the value of titling to land values in the rural area, particularly land tiling impact on agricultural land with only a few in the urban area. For instance, in Jakarta (Dowall and Leaf, 1991); in rural India (Pender and Kerr, 1994); in Brazilian frontier (Alston et al. 1996); in Senegal and South Africa (Payne, Durand-Lasserve, Rakodi, Marx, Rubin, and Ndiaye (2008) and the city of Bangalore in India (Madalasa, 2014). However, since this present study is focusing on the urban area, it will be original in its approach by developing a unique conceptual framework that captures all variables in the study area.

From the pieces of literature reviewed, only Madalasa (2014) was identified to be relevant to the scope of this study; while the earliest application of the hedonic pricing model was on agricultural land. Given this, the conceptual analysis in this study was built on Madalasa (2014) to guide the empirical finding on the contribution of titling to land values in this present study.

However, the regression framework of the hedonic model should be specified correctly for both functional forms as well as for independent variables to achieve unbiased assessments (Case, Pollakowski, &Wachter, 1991; Malpezzi, 2003). Therefore, to ascertain the effect of guaranteed land title on land prices in the Bangalore city of India, the following variables were adopted by Madalasa (2014); appraised land price deflated by the housing specific deflator for the city of Bengaluru for the corresponding period, distance to the city centre, distance to the nearest infrastructure/employment point, displacement to nearest arterial road, distance to closest market/ commercial area, distance to nearest transportation hub, floor area ratio of the plot calculated as total buildable area/ plot area, a size variable calculated as the size of the plot, a dummy to denote whether the plot can be used for commercial purposes and dummy variables to denote the combined effects of title and planning.

In addition, the hedonic model developed by Madalasa (2014) to a data set of 2263 observations of appraised land values to ascertain the impact of guaranteed land title on land prices in the Bangalore city of Indian is represented in a log-linear form by equation (1):

$$L_{nPR} = \beta_0 + \beta_i \gamma_i + \mathcal{E}_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

L_{nPR}= land prices

β_0 = Constant term

$\beta_i\gamma_i$ = Variable characteristics

$\mathcal{E}$ = Error term

The model in equation (1) was further specified in equation (2) as follows:

$$\ln P = \beta 0 + \beta 1 \ln(\text{DistCBD}) + \beta 2 \ln(\text{DistEmp}) + \beta 3 \ln(\text{DistRoad}) + \beta 4 \ln(\text{DistMarket}) + \beta 5 \ln(\text{DistTrHub}) + \beta 6 * \text{FAR} + \beta 7 * \ln(\text{Sq}_{\text{Size}}) + \beta 8 * (\text{Use}) + \beta 9 \text{BDALyt} + \beta 10 \text{LargeprivateLyt} + \beta 11 \text{SmallPrivateLyt} + \beta 12 \text{RevenueLyt} + \sum_{j}^{n} y_j Y_I + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

P = Natural Log of deflated Appraised Sales Price on a per square feet basis4 for each land parcel. Price is in Indian Rupees

Ln (DistCBD) = natural logarithm of the linear distance of the site from the CBD measured in kilometres. The CBD is taken as the Main Railway terminal/ Bus terminal.

Ln (DistEmp) = natural log of the distance from the nearest employment centre in kilometres.

Ln (DistAR) = natural logarithm of the linear distance of the site from the nearest arterial road in kilometres.

Ln (DistMarket) = natural logarithm of the linear distance of the site from the nearest commercial centre in kilometres.

Ln (DistTrHub) = natural logarithm of the linear distance of the site from the nearest Transportation Hub, which could be a bus station or railway station, in kilometres.

Ln (Sq_Size) = natural logarithm of the square of the size of the site in square feet.

FAR = variable which measures the Floor Area Ratio of the land parcel (density regulation).

Dummy variable to denote whether the plot has the propensity to be used for commercial purposes.

BDALyt = dummy variable that denotes the site is in a BDA developed layout and has an applicable title and a planning premium (BDALyt =1).

LargePrivateLyt = dummy variable that refers to a site within a large private layout, with title premium = 0 and high planning premium (Largeprivatelyt =1).

SmallPrivateLyt = a site within a small private layout, title premium = 0 and low planning premium (SmallPrivateLyt =1)

RevenueLyt = a revenue site in an unplanned layout, title premium = 0 and planning Premium = 0 (RevenueLyt=1)

$\beta 0$ = the intercept

βi terms = the coefficient estimates from the linear regression model

εi = Errors

Yi terms = fixed effects in time (with coefficients of γ)

The focus of this particular study is, however, different from Madalasa (2014) as it considered the contribution of land titling to land value. Since the study is not unaware that there are other factors affecting land value, consideration was given to few variables under the major attributes of land value determinants as applicable to the selected communities in the study area.

Though the study's focus is to determine the contribution of land titling to land value, other variables affecting land value is taken into consideration. According to Madalasa (2014), it is imperative to do this as it is not only land titling that affects land value. However, defining the right attributes of land to be included in the hedonic price analysis is essential to avoid bias in variable selection. To maintain fairness in the selection of the right variables for the hedonic price analysis, this study referred to previous studies on various attributes of landed property and make representation for each category of attributes earlier identified.

Empirical studies have generally grouped major attributes contributing to land values to include; physical or land characteristics such as plot size, years of transaction and floor area ratio (Megbolugbe,1989; Arimah, 1992; Ottensmanna, Paytona, and Man, 2008); locational characteristic such as distance to CBD and distance from employment centres (Small and Song, 1994; Osland and Thorsen, 2008; Aluko, 2011); neighbourhood characteristic such as crime, education and health facilities (Bello and Ajayi, 2010; Kolowe, 2014); as well as environmental characteristic including distance to hazards, distance to parks and cemetery (Tse& Love, 2000; Bao, Glascock& Zhou, 2008; Akinjare, Ayedun, Oluwatobi, Iroham, 2011; Babawale, 2013).

Therefore, the following attributes are employed in addition to land titling in this study: physical or land characteristics (plot size), locational characteristics (distance to CBD and distance to the nearest bus stop), neighbourhood attributes (schools and health facilities) and accessibility. Accessibility as a value attribute is assumed to be different from locational attributes in this study, in that time taken to get to a particular place may not mean ease of getting there. Given the focus of this study, which is to investigate the contribution of land titling to land value as well as the contribution of other variables viz-a-viz land titling; a 2-stage hierarchical form of the semi-log hedonic price analysis was employed.

3. METHODOLOGY

To gather the quantitative data required for this study, the cross-sectional survey design was used. Cross-sectional sample surveys are used to take a snapshot of a proportion of the population at one point in time. It was adopted for this study as it has the advantages of generating adequate data in a short time and at a reasonably low cost. Besides, it can easily produce relevant data which can be generalized to a wider population. The target population in this study are the household heads of the selected private residential layouts/ estates, namely Ademola Adesida Estate, Alaba Layout, Ifelere Estate, Ire-Akari Estate, Obele Estate, Oke-Ogba Community, Osolo-Abibiri Estate and Wesco Estate in Akure city. They are of specific interest to this study as they are major participants actively operating in the land market. The selected private residential layouts /Estates, demographically similar communities will be adopted. This provided a unique dataset in a framework that assists not only to isolate the fundamental role of land-titling but also in minimizing the endogenous problems characteristic.

The housing population employed in Olamiju (2014) for the selected private residential layouts/estates (Ademola Adesida Estate, Alaba Layout, Ifelere Estate, Ire-Akari Estate, Obele Estate, Oke-Ogba Community, Osolo-Abibiri Estate and Wesco Estate) was adopted as the sampling frame. Given the target population, a household head per house was used. The sampling frame aggregates of the Eight (8) selected residential layouts/estates within the study area is as further shown in Table 1.

Kasiulevicius, Sapoka, and Filipaviciute (2006) acknowledged the application of formulae as the best approach to determining sample size. Yamane formula as explained by Bartlett, Kottrlliik and Hiiggiinss (2001); Isreal, (2012) provides a simplified formula for proportions to determine the sample size for large populations. Hence, the formula as shown in equation 3 was employed in the estimation of the sample sizes for the household heads in each of the selected residential layouts/estates in the study area.

$$n = \frac{N}{1 + N(e)^2} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Where, n = the sample size;

N = the population size;

e = the level of precision.

The level of precision also called sampling error is the range in which the true value of the population is estimated to be. This range is often expressed in percentage points, for instance, ±5 per cent. Selecting a 95% confidence level implies that 95 out of 100 samples will have the true population value within the specified range of precision (Israel, 1992). Hence, a 95% confidence level and ±5% (0.05) precision were adopted for this study. The total population of the eight (8) selected private residential layouts/estates is 8369 and taking 5% significant level, the equitable distribution of respondents sample size across the selected study area is as shown in Table 1.

Table 1: Estimated number of buildings in the selected residential layouts/estates in Akure

S/N	Residential Layouts/Estates	Location	No. of Exiting Building	Sample Size
1.	AdemolaAdesida Estate	Alagbaka	563	234
2.	Alaba Layout	FUTA Area	1052	290
3.	Ifelere Estate	Aule Quarters	386	196
4.	Ire-Akari Estate	OritaObele	1586	319
5.	Obele Estate	Ijare Road	1673	323
6.	Oke-Ogba Community	Agagu Road	2580	346
7.	Osolo-Abibiri Estate	Irese Road	244	152
8.	Wesco Estate	Akure-Ilesa Expressway	285	166
TOTAL			**8369**	**2026**

A 4 stage-multi sampling technique was used to select the residential layouts/estates and the corresponding respondents (household heads) therein. In the second stage, the selection of eight residential estates/layouts as highlighted in Table 1 was done. The eight residential estate/layouts were specifically selected from the eleven residential development corridors earlier identified by Olamiju (2014) using a non-random purposive sampling method. The selection of the specific residential estate/layouts was based on the availability of data on their housing population. In the third stage, one out of every ten buildings was selected for the survey of the household head residing in each of the chosen buildings across the selected residential estate/layouts. The fourth stage involved the separation of the household heads into titled and untitled groups for the survey. Primary data were obtained from field investigation using a structured questionnaire. Data collected from the study areas were thoroughly checked and validated for accuracy and completeness.

A collinearity test was conducted before the hedonic price analysis to see if the data meets the assumption that there was no multicollinearity. To achieve this, the Tolerance and Variance Inflation Factor (VIF) was used as the basis for measurement. If the VIF value is greater than 10, or the Tolerance is less than 0.1, then there is concern over multicollinearity. Otherwise, the data has met the assumption of collinearity (Tabachnick & Fidell, 2007). To check for independent errors or auto-correlation, the Durbin-Watson test was carried out.

Hedonic price analysis was used in investigating the contribution of land titling to land value in the study area to determine the marginal contribution of land titling to land value. Hedonic price analysis is a form of regression that is based on the recognition that land value is a direct function of several attributes (Oduwole and Eze, 2013). Therefore, with the hedonic price analysis, the marginal contribution of each of the attributes can be

determined (Jan and Diewert, 2013). According to Madalasa (2014), land prices are modelled in a hedonic setting to ascertain the value of various attributes including the title. The hedonic technique controls the heterogeneous nature of land by decomposing land value into its constituent characteristics since landed properties are a combination of many factors. Though attributes are not sold separately, when the sale price of properties based on their various characteristics are regressed, it gives the marginal contribution of each characteristic.

Xiao (2017), however, noted the sensitivity of hedonic price analysis to the choice of functional form, as it becomes inefficient when the correct functional form is not employed (Oduwole and Eze, 2013). Jan and Diewert (2013) acknowledged the fully linear model and the logarithmic-linear model as the two predominant hedonic functional forms in practice. However, the logarithmic-linear model provides a better fit to data than a linear model as it gives room for data transformation. Oduwole and Eze (2013) and Xiao (2017), corroborated Jan and Diewert (2013) assertion, but further expanded the logarithmic-linear function. In addition to the linear specification, other functional forms of the logarithmic-linear hedonic price regression model are semi-log, log-log or double-log and the Box-Cox transform. For this study, the semi-log form of the hedonic price regression analysis is adopted.

The semi-log form of the hedonic price analysis was adopted as it either accommodates the dependent variable in log form and independent variable in linear, or dependent variable in a linear and independent variable in log form. According to Xiao (2017), the semi-logarithmic form is the more predominant among the other functional forms in hedonic literature. It is easy to interpret the semi-logarithmic form coefficients as the proportionate change in price arising from a unit change in the value of the attribute. In addition, unlike log-log models, the semi-log model accommodates dummy variables for attributes that are either present or absent (0 or 1).

A 2-stage hierarchical form of the semi-log hedonic price analysis is employed. In the first stage of the hierarchical form of the semi-log hedonic price analysis, land titling was entered into the equation to identify its contribution to land value after other variables have been controlled for. Subsequently, in the second stage, titling and other variables were entered into the equation to determine their respective contributions. Land value is the dependent variable, while the selected variables (including plot size, accessibility to land, and presence of neighbourhood amenities) as the representation of land attributes and land titling (which is the subject of interest) are the independent variables. Generally, the semi-log specification of the hedonic price analysis usually takes the form:

$$\mathrm{lnP} = \mathrm{ln}\beta_0 + \sum_{k=1}^{K} \beta_k \mathcal{X}_k + \mathcal{E} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (4)$$

Where,

P = land value;

$\mathscr{E}$ = a vector of random error term; and

β_k= (k = 1, …, K) indicates the rate at which the price increases at a certain level, given the characteristics X (Xiao, 2017).

The framework specification for the 2 stages hierarchical form of the hedonic price analysis for this study is therefore defined respectively as follows:

$$\mathrm{lnLNDVAL} = \beta_0 + \beta_1 \mathrm{LNDTIT} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where,

β_0 = a constant;

β_1 = regression coefficients;

LNDTIT = a dummy variable representing land titling (independent variable); and

ε = residual error term.

$$\ln\text{LNDVAL} = \beta_0 + \beta_1\text{LANDTIT} + \beta_2\ln\text{LOCCHA} + \beta_3\text{NEICHA} + \ln\beta_4\text{LNDCHA} + \text{LNDACC} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Where,

lnLNDVAL = natural logarithm of Land Value on a per square meter basis for each land parcel;

lnLOCCHA = natural logarithm of locational characteristics (accessibility);

NEICHA = a dummy variable representing neighbourhood characteristics;

$\ln\beta_4$LNDCHA = natural logarithm of land characteristics;

LNDACC = a dummy variable representing accessibility characteristics.

The variables included in the hedonic price analysis are further operationalized in Table 2.

4. PRESENTATION AND DISCUSSION OF RESULTS

The interpretation and discussion of inferences made from the analysis of the data collected are presented in this section. The data was obtained from the house heads who are landowners in the selected Residential Layouts/Estates of the study area. Necessary tests and assumptions were also observed before the use of inferential statistics. The data obtained was used to examine the contributing effect of land titling on land value. The results are presented in the Table 3 and Table 4.

Table 2: Operationalization of variables for the hedonic price analysis

Variable Code	Definition	Measurement
lnLNDVAL	Natural log of land value	Actual price (₦)
LNDACC	Land accessibility (ease of getting to a particular plot)	1, if accessible, or 0 if otherwise
	Land characteristics	
PLSIZ	Plot size	M^2
LNTIT	Existence of land title	1 if titled land, or 0 if otherwise
	Locational characteristics	
DISCBD	Distance to the central business district	Km
DISBST	Distance to the nearest bus stop	Km
	Neighbourhood characteristics	
PBNAM	Presence of neighbourhood amenities such as school, clinic and other infrastructures	1, if present, or 0 if otherwise

Table 3: Collinearity test for the 2-stage hierarchical form of semi-log hedonic analysis

S/N	Variables	Tolerance	Variance inflation factor (VIF)
1.	Land Titling	0.115	8.733
2.	Accessibility	0.291	3.441
3.	Distance to central business district	0.687	1.457
4.	Distance to the nearest bus stop	0.111	8.988
5.	Plot size	0.148	6.765
6.	Neighbourhood Amenities (School, Clinic and other infrastructures)	0.159	6.289

Tests to see if the data employed in the 2 stages hierarchical form of semi-log hedonic price analysis met the assumption of collinearity was presented in Table 3. The outcome of the analysis showed that multicollinearity was not a concern (Land titling, Tolerance = 0.115, VIF = 8.733; Accessibility, Tolerance = 0.291, VIF = 3.441; Distance to central business district, Tolerance = 0.687, VIF = 1.457; Distance to the nearest bus stop, Tolerance = 0.111, VIF = 8.988; Plot size, Tolerance = 0.148 VIF = 6.765 and Neighbourhood amenities, Tolerance = 0.159, VIF = 6.289). The tolerance value shows the level of variability of a particular independent variable is not explained by the other independent variables in the analysis. The VIF value should not be greater than 10, or the Tolerance less than 0.1 (Tabachnick & Fidell, 2013).

A two-stage hierarchical form of the semi-log hedonic regression was conducted in Table 4, with land value as the dependent variable. Land titling was entered at stage one of the regression to control for accessibility, distance to the central business district, distance to the nearest bus stop, plot size and neighbourhood amenities. Accessibility, distance to the central business district, distance to the nearest bus stop, plot size, neighbourhood amenities including land titling were entered at stage two. The Durbin-Watson statistics has a value of 1.108 and therefore no independent errors and first-order autocorrelation is detected. According to Tabachnick and Fidell (2019), Durbin-Watson values can be anywhere between 0 and 4. However, a value close to 2 is appropriate to meet the assumption of independent errors.

The R Square value of 0.071, indicates that the overall model explains 7.1per cent of the variance after 'land title' have been inputted being the focused independent variable in the first stage. Similarly, after the second set of variables (Accessibility, distance to the central business district, distance to the nearest bus stop, plot size, neighborhoodamenities as well as land titling) have been integrated into the second stage, the variability accounted for went up from 7.1% to 81.3% - a significant increase. This suggests the model as a whole explains 81.3 per cent. This is an indication that the model captured a very reasonable share of the variation in the land value.

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Table 4: Analysis of the contribution of land titling to land value

	Stage 1: Semi-log model				Stage 2: semi-log model			
Variable	β Coefficient	Std. Error	t-Statistic	Prob.	β Coefficient	Std. Error	t-statistic	Prob.
Land Titling	**0.266**	0.019	**8.800**	**0.000**	**-1.264**	0.026	**-31.714**	**0.000**
Accessibility					-0.199	0.014	-7.949	0.000
Distance to central business district					0.404	0.014	24.834	0.000
Distance to the nearest bus stop					0.452	0.050	11.185	0.000
Plot size					0.612	0.000	17.438	0.000
Neighbourhood Amenities (School, Clinic and other infrastructures)					-0.424	0.021	-12.532	0.000
R	**0.266**				**0.901**			
R^2	0.071				0.813			
Adjusted R^2	0.070				0.811			
F-statistics	78.846				744.141			
Standard Error of Estimate	0.27213				0.12252			
Probability	**0.000**				**0.000**			
Durbin-Watson					**1.108**			
Observations	1037				1037			

The 2 stages semi-log form of hierarchical hedonic price analysis also shows the contributing effect of land titling to land value after controlling for the influence of other independent variables. Land titling was the first variable entered at Stage 1 while holding the other variables constant. The first stage shows the Standardized Coefficients Beta for land titling, $\beta = 0.266$, $t = 8.800$, which was statistically significant at $p < 0.05$. This implies that holding all other factors constant, land titling contributed about 26.6% to land value. It also implies that land titling has a positive impact on land value by way of securing rights to land in the study area. In the second stage, all the four variables were statistically significant, with land titling showing a higher beta value (beta = -1.264, $p < 0.05$), than the other variables in order of their beta values and significant contribution including: plot size (beta = 0.612, $p < 0.05$), distance to the nearest bus stop(beta = 0.452, $p < 0.05$), neighbourhood amenities(beta = -0.424, $p < 0.05$), distance to central business district (beta = 0.404, $p < 0.05$) and accessibility (beta = -0.199, $p < 0.05$). Consistently, the Beta Standardized Coefficients of $\beta = 0.266$, $t = 8.800$ and beta = -1.264, t= -31.714 for land titling in the first and second stage hierarchical semi-log form of the hedonic price analysis is statistically significant at $p < 0.05$. This shows that that land titling has a significant contribution to land value. Additionally, a Standardized Coefficients Beta of (-1.264), is an indication that a one standard deviation increase in titling leads to a 1.264 standard deviation decrease in land value.

In addition, the percentage contributions from the coefficient of the parameters of this analysis were measured in the second stage. In a trans-log functional form with the dependent variable being expressed in natural log terms, the contribution of each independent variable was determined using the beta values that is given multiplied by one hundred per cent. Land titling contributed about 126% to land value, while accessibility, distance to the central business district, distance to the nearest bus stop, plot size and neighbourhood amenities, contributed 19.9%, 40.4%, 45.2%, 61.2%, and 42.4% respectively to land value. This means that land titling makes a statistically significant contribution to explaining the land value when the variance explained by all other variables in the analysis is controlled for.

Given the foregoing outcome, the findings from the analysis supported earlier studies that found high coefficients on a dummy variable for the land title in the hedonic analysis of land value. For instance, Chalamwong and Feder (1998) earlier observed titled land is significantly correlated with higher land prices. The values of untitled land are 80%, 43% and 47% of titled land in Lop Buri, NakhonRatchasima, and KhonKaen provinces of Thailand. Alston, Libecap and Schneider (1996), though in an agrarian area of Brazil, found that at market-centre, land values were 189% higher for titled vs. untitled land; at a distance of 40 kilometres, they were 72% higher, and at a distance of 140 kilometres, values were predicted to be 45% higher. Dowall and Leaf (1991), also found that titled residential plots in Jakarta sold for a 45 per cent premium over comparable plots without a land title. Land values for plots with the land title are higher by 30% in Nicaragua (Deininger and Chamorro, 2004). Broegaard (2005), arrived at similar findings in Nicaragua. In the Khashaa districts of Mongolia located in East Asia and the Pacific, land titling leads to higher land value. The average percentage price premium for land titling ranges from 170 to 223% depending on the districts in consideration (CHF International, 2006). Galiani and Schargrodsky (2011) also observed increases in property values of approximately 19 per cent from titling in suburban Buenos Aires of Argentina. A similar finding is reported in a study carried out in the Onitsha area of Nigeria that land titling contributed approximately 260% to land value (Emoh, Oni & Egolum, 2013),

while in India land titling contributed about 7.4% in a hedonic model of land value (Madalasa, 2014) and correspondingly, 32% in Tanzania (Aikaeli and Markussen, 2017).

5. CONCLUSION AND RECOMMENDATIONS

This study examined the contributing effect of land titling on land values in some selected private residential layouts/estates of the study area. It adopted the cross-sectional survey method of sampling. Different factors influence individuals to value titling more in particular places. The factors range from threats to ownership security to more opportunities for using the landed property as collateral, or the ability to obtain a higher price when disposing of it. To empirically establish the value ascribed to land tiling, the study revealed that when land titling is considered alone with land value, there is a statistically significant contribution of about 27% to land value and 126% when considered alongside the other independent variables. This indicates that land titling made a significant unique contribution to the prediction of the land value in the study area. The results of this study have policy implications for the use of land titling in achieving the efficient utilization and exploitation of land both in Nigeria and countries of similar urban settings where the state of development requires genuine ownership of a relatively scarce expanse of land. Based on the findings of the study, the following are recommended on land titling practice in the study area:

1. Since land titling is a significant contributor to land values, it should be included for the proper specification of hedonic land value models.
2. Based on the significant contribution of land titling in this research, there is a need for special consideration to be given in policy formulation and the enforcement of titling on non-titled land.
3. Land titling institutions may also use the information on the contribution effect of land titling to land value in determining the reserve title premiums across different locations within and across the urban area.
4. Also, to the Nigerian Institution of Estate Surveyors and Valuers (NIESV), land titling is a unique factor to be considered when determining the land value in urban areas.
5. For policymakers, empirical evidence about the determinants of the value of title can assist in providing a decision-making framework.

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VALUE MANAGEMENT PRACTICES FOR CONSTRUCTION PROJECTS IN SOUTH-SOUTH, NIGERIA

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ABSTRACT

Purpose: The study examined key drivers influencing the practice of value management practices and determined factors inhibiting the smooth implementation of VM practices for construction projects with a view towards bolstering construction project delivery in South-south Nigeria.
Design/methodology/approach: Anchored on questionnaire survey approach, two hundred and twenty-seven (227) copies of the questionnaire were administered while one hundred and seventy-seven (177) were properly filled and returned which give a response rate of 78%. Data collected were analysed using percentage and relative importance index while Kruskal Wallis test was used to test the hypotheses.
Findings: Findings indicated that the three top rated drivers were "VM was able to improved products and services", "works towards arriving at a more effective design", and "seek to obtain maximum efficiency ratio" in that order while "provision of alternative evaluation and supporting information at project brief/design state" was the least rated driver. Besides, findings also reveal that the three top rated barriers of VM implementation for construction projects in the study area are lack of awareness, absence of formal guidelines, and passive behaviour among VM practitioners while high cost of VM study was the least rated factor. The two hypotheses postulated for the study were accepted.
Research limitations/Implications: Besides, formal and informal trainings in terms of graduate studies and some form of career counselling and development programs (like value management awareness program) could be organised by academic institutions or professional entities such as Nigerian Institute of Building (NIOB), Nigerian Society for Engineers (NSE), the Nigerian Institute of Estate Surveyors and Valuers (NIESV) among others.
Originality/value – The study established key drivers and barriers of VM for effective and efficient delivery of construction projects in Nigeria.
Keywords: Value; value management; project delivery; south-south Nigeria; construction projects.

1. INTRODUCTION

Value management (VM) originated as value analysis, a concept developed by Lawrence Miles during the Second World War (Shen and Liu, 2004) and was popular in the US manufacturing industry during the 1940s. Miles's work based its philosophy on providing the necessary functions at the lowest cost. The original methodology analysed

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the various components of a product in terms of its functions, considers ways of providing the functions at a lower cost, and confirms the economic and technical viability before changing production procedures (Male, Kelly, Fernie, Gronqvist and Bowles, 1998). The practice of VM is till date widespread but its application has been widened and the methodology adapted and translated to meet the needs of different sectors of industry. Value management is a structured and analytical process that seeks to achieve value and optimize the life cycle cost of a facility through identifying opportunities to do away with all unnecessary costs; while at the same time making sure that quality, reliability, performance and other critical factors are not compromised (Dell'Isola, 1997).

The application of VM in the construction sector has been widely applauded by various stakeholders. The practices have witnessed increased adoption in the areas of functional improvement, cost reduction, communication enhancement and promotion of creative minds. Based on the successes, VM is therefore used to provide clients or end users with the best possible outcome (construction project success). This ensures that functions and needs can be met at the most reasonable cost, hence providing optimal value for money expended. The application of VM has been linked with the need to foster innovation and excellence in the construction industry (Latham, 1994; Egan, 1998). However, it is noted that the practice of VM tends to vary across different parts of the world and not very popular in other places including Nigeria (Adu and Umoren, 2009; Oke, Aghimien and Olantunji, 2015).

One argues that the dearth in knowledge of value management practices in the construction industry (Adu and Umoren, 2009) has given rise to clients not receiving best value in their projects in terms of budget, time, the required quality, functions, aesthetic, image, safety and fitness for purpose (Oke, Aghimien and Olatunji, 2015). Olarewaju and Khairuddin (2007) similarly observed that value management concept is not widely adopted implemented in project delivery to achieve best value. Sabiu and Agarwal (2016) maintained that the problem of non-adoption of VM has been consistently drawn aback by apparent lack of deep insight into the key drivers and inhibitors affecting the concept in Nigeria. Regrettably, dearth of value management application in the Nigerian construction has detrimental implication on project performance and stakeholders' satisfaction. According to Oke and Ogunsami (2011), more than 70% of construction projects executed in Nigeria suffer from cost and time overruns irrespective of whether the client is private or public and regardless of the project size. This has ultimately induced low satisfaction rates among clients and concerned stakeholders. Nigeria's South-South geo-political zone comprises six states and is the main stay of the Nigerian economy accounting for 50% of Nigeria's GDP, 95% of her foreign exchange earnings, and 80% of all budgetary revenues that amount to ₦60 billion annually (Ikediashi, 2014). However, in spite of increased construction activities bolstered by the oil wealth, the concept of VM has not been fully explored in the area. This study therefore seeks to explore the VM practices application in construction project delivery in selected States in South-South, Nigeria with a view to ensuring a sustainable and vibrant VM process in the construction industry. The specific objectives are to (1) examine key drivers of value management practices in the study area; and (2) determine the factors inhibiting the smooth implementation of VM practices for construction projects in the study area.

2. LITERATURE REVIEW

2.1. Value Management

The concept of value management is defined as a systematic, multi-disciplinary effort directed towards analysing the functions of projects for the purpose of achieving the best value at the lowest overall life cycle cost. As incomplete as this definition may be, it suggests that the discipline of value management can be applied to any type of project regardless of size or time- frame and at all stages i.e. throughout the life cycle of the project from inception to completion. This may be contrary to the general belief that value management must and can only be applied at the design stage of construction project. This connote that value management is becoming dynamic and various forms of its application in the construction industry are springing up. This discrepancy is further clarified by Kelly and Male (2006) where value engineering is said to be a sub-set of value management in that, the former deals mainly with the design process while the later deals with the overall management of value throughout the contract. According to Odeyinka (2006), value management is 'a service, which maximizes the functional value of a project by managing its development from concept to completion and commissioning through the examination of all decisions against a value system determined by the client'. This paper aligns with this defines and proposes value management to be a systematic and multi-disciplinary process directed towards analysing the functions of project from inception to completion and commissioning (through examination) for the purpose of achieving best value and return on investment at lowest possible overall life cycle cost of a construction project.

2.2. Drivers of Value Management Practice

A Benefits of VM as observed by Coetzee (2009), ranging from financial benefits to helping to build the morale of the professional team. He further opined that, VM will affect everyone associated with the project, otherwise known as stakeholders. The client seeks to achieve value for money, whilst the users want a product that meets their needs as effectively as possible. The project managers are to ensure that the project is on time and falls within the budgetary constraints, the contractor wishes to provide a service which will afford them an adequate profit and the designers are keen to meet the expectations of the client whilst complying with certain standards and performance criteria. VM can address most of these needs directly or indirectly, thus bringing a degree of satisfaction to all the stakeholders involved. A summary of some of the drivers and their sources in the literature is provided in table 1.

2.3. Barriers to effective Value Management implementation

Evidence from the literature has affirmed Value management to be a veritable and acclaimed tool for meeting challenges arising from the construction industry. Despite this assertion, it has also encountered some problems such as passive participation in VM workshops and a lack of time and information to complete all tasks in the workshops (Fan, Shen, and Lin, 2007). Several challenges have been identified from literature (Abidin and Pasquire, 2007; Fan and Shen, 2011; Noor, Kamruzzaman and Ghaffar 2015) as impediments to VM studies. These are divided into; *Lack of awareness about VM***:** It is due to the lack of knowledge being disseminated in VM studies. A recent research by Noor, Kamruzzaman and Ghaffar (2015) reveals a low level of awareness of VM studies and its applications by clients and construction industry practitioners. Oke and Ogunsemi (2011) further argued that another contributing factor to the problem faced was due to

lack of input from the related specialists' as well as poor facilitation skills during the VM workshops. *Misperception about integration of sustainability and VM***:** Seeing sustainability and VM as two separate issues which becomes a burden to the VM participants as additional tasks when applied in the studies. *Passive behaviour among VM practitioners***:** VM practitioners remain passive to forward VM knowledge to client's attention; due to the fact that they may not have adequate knowledge to drive the novel idea.

Table 1: Drivers of VM Implementation Constructs

Code	Drivers	Sources
DRV01	Creates a clearer focus on the project objectives	Oke and Ogunsemi (2015)
DRV02	Works towards arriving at a more effective design	Coetzee (2009),
DRV03	Identification of alternative methods of construction and favourable adjustments to the construction timeline.	Oke and Ogunsemi 2015
DRV04	Discovery and discussion of project issues, constraints and risks involved	Coetzee (2009),
DRV05	Clearer project brief and decision making	Norton, and McElligott,1995 & Locke 1994
DRV06	Identifies and removes unnecessary costs associated with the project	Coetzee (2009),
DRV07	Deals with lifecycle costs	Institute of Value Management (2008)
DRV08	Seeks to obtain maximum efficiency ratios	Coetzee (2009),
DRV09	All options, alternatives and innovative ideas are considered	Coetzee (2009),
DRV10	It identifies possible problems early on in projects	Coetzee (2009),
DRV11	It provides management with authoritative evaluations and supporting information of the project brief or design and their related capital and operation costs	Norton, 1995 and Locke 1994
DRV12	It provides the structure for the team to collaborate and gain the benefits of partnering	Coetzee (2009),
DRV13	Mutual understanding and consensus between the stakeholders are enhanced	Oke and Ogunsemi 2015
DRV14	Improved communication and team spirit that is built between members of the professional team.	Coetzee (2009),
DRV15	Clear definition of roles and responsibilities	Coetzee (2009),
DRV16	Improved team and client relationships boosting morale of the team	Coetzee (2009),
DRV17	Higher efficiency can be achieved due to the multidisciplinary and multitask teamwork	Oke and Ogunsemi 2015
DRV18	Joint ownership of solutions and commitment to implementation	Coetzee (2009),
DRV19	Enhanced client involvement during the development stages of the project	Coetzee (2009),
DRV20	Improved products and services	Coetzee (2009),
DRV21	Enhanced competitiveness by facilitating technical and organisational innovation	Coetzee (2009),
DRV22	VM challenges the established views and private agendas that some of the project team members may have	Oke and Ogunsemi 2015

In Nigeria, the mind of the client and the professionals in the construction industry are hardened to the old ways (the resistance to change by the involved parties during the VM workshops sessions as well as the conflicting objectives of the project by different parties) and method of executing the project. This brings a barrier to value management implementation in Nigeria construction industry. *Lack of Training and Education in VM***:** The main Impediment to the application of value management in a construction project in Nigeria is inadequate training and educating of professionals that will involve in value management approach. It is necessary for professional institutions and universities to add VM to their curriculum in order to educate people in the construction industry so that they will not reject this new concept out of fear and will come to appreciate the true value of Value Management. Many important stakeholders are not even aware of the concept of value management and so are naturally resistant to change. *The High Cost of VM Study***:** Another major impediment to the application of value management in a construction project is the inability to fund the value management. It is believed that the additional cost of setting up a VM team and their attendant resources may increase the cost to the clients and therefore are avoided. The costs of conducting a VM workshop rarely ever exceeds 1% of total project costs, whilst potential savings of between 10 and 15% of total project costs are possible. *Procurement Issues***:** Undue emphasis on lowest price rather than best value impacts negatively on industry performance in terms of time, cost and quality. It affects the sustainability of enterprises and their ability to develop and retain a skilled workforce, and to actively promote safety, health and the environment. *Regulatory Barriers***:** Public policies and regulatory frameworks do not encourage the development of the construction sector. Meanwhile, Oke and Ogunsemi (2011) suggested the major impediments to the application of value management to construction projects in Nigeria: Ambiguous design; Time of completion/delay; Conflict management; Finance; Construction methodology; Inadequate knowledge of benefits of value management; Lack of involvement of professionals i.e. specialists right from the onset; Greediness of the contractors and consultants; Lack of total quality management principles in construction firm; Professional incompetence; Technology level; Finance/fund; Procurement style; Government factor; Human factor; Communication gap; Government policy; Unstable economy; Poor management especially on the part of the client; Lack of professional competence; Use of wrong/quack professionals for construction works; Lack of understanding of the concept; and Lack of information. Moreover, in a study conducted by Ahmad (2014) showed that, out of various inhibiting factors of VM practices by stakeholders in the north eastern construction industry of Nigeria. *Lack of training opportunities* was seen as the most significant factor among all with 79.5% followed by lack of trained professionals with 76.6%, ineffective procurement law 66.6%, lack of local guidelines/ information 66.2%, expensive to carry out VM 53.9% while interruption to normal work schedule was 50.0% among others. Although similar studies have been carried out in other parts of the country and world at large, such has no evident in Akwa Ibom and Rivers States. It is in this light that, the researcher seeks to compare the influence of these factors by construction stakeholders within south- south geo-political zone. A summary of the barriers to be tested in this study is shown in table 2.

Table 2: Barriers of VM Implementation

Code	Inhibiting factors (Barriers) of VM	Sources
BRR1	Time limitation	Kelly and Male (2004); Ellis, Wood and Keel (2005)
BRR2	Absence of formal guidelines	Fong & Shen (2004); Oke and Ogunsemi (2011)
BRR3	Lack of awareness about VM	Noor, Kamruzzaman and Ghaffar (2015)
BRR4	Misperception of about integration of sustainability/VM	Jaapar (2006), Bowen et al., (2009)
BRR5	Passive behaviour among VM practitioners	Che Mat (1999), Jaapar (2011)
BRR6	Lack of training / education in VM	Che Mat (1999), Jaapar (2006)
BRR7	High cost of VM study	Harty (2009), Jaapar (2011),
BRR8	Ineffective Procurement issues	Oke and Ogunsemi (2015)
BRR9	Regulatory barriers	Ahmead (2014), Oke and Ogunsemi (2015)

3. METHODOLOGY

3.1. Research Design

This study adopted exploratory and quantitative survey approaches. It was adopted for this study because of (1) the possibility to generate findings that are representative of the whole population which could potentially be generalised to all states in the South-South Nigeria; and (2) the fact that it gives the researcher more control over the research process (Saunders and Thronhill, 2009). The quantitative survey approach involved the use of structured questionnaire.

3.2. Area of study

This study was carried out in two selected south-south states of Akwa Ibom and Rivers. Akwa Ibom state lies between latitude $4^{0}32^{1}$N and $5^{0}33^{1}$N and longitude $7^{0}25^{1}$E and $8^{0}25^{1}$E. It is bounded on the east by Cross River state, west by Rivers state and Abia state, and south by the Atlantic Ocean. It was created out of the old Cross River state in 1987 and has a population of approximately 4million according to the 2006 national census. The state has the highest reserve of oil and gas in the country and boost of two major sea ports in the Atlantic Ocean and an international airport in the capital city of Uyo (Ikediashi, 2014). *Rivers state* on the other hand prides itself as one of the largest economies in Nigeria, mainly because of its crude oil. The state has two major refineries, two major sea ports, airports and several industrial estates spread across the state capital, Port Harcourt. It was created in 1967 and has an area of 11,077 square kilometres. With a population of 5,198,716 (NPC, 2007), it is bounded to the south by the Atlantic Ocean, to the north by Imo, Abia, and Anambra States, to the east by Akwa Ibom state and to the west by Bayelsa and Delta states (Ikediashi, 2014).These two states were selected for this study because of massive infrastructural development going on as result of oil wealth. Many companies both in the public and private sectors are jostling to grab a share of the massive construction boom taking place in the area. This study investigated how the use of VM can bolster effectiveness and efficiency in project delivery in the two states.

3.3. Population and Sample

Population of a study is defined as the collection of all items whether of people or of objects or of events, that are to be considered in a given problem situation (Udofia, 2011), The population for this study consisted of construction stakeholders who fall under

contractors and consultants and included builders, civil engineers, estate managers, architects and quantity surveyors, project managers and value managers operating within the study area. These stakeholders are responsible for managing clients' values and norms and interests when it comes to construction projects. The sample frame was drawn from the data base of the professional bodies such as NIOB, NIA, NIESV, NSE and NIQS among others. The population frame was established to be 523 based on the directories of professional bodies as shown in Table 3.

Table 3: Population Frame for Akwa Ibom State (AKS) and Rivers State (RVS).

Population (N)	AKS	RVS	Total
Architects	49	43	92
Builders	24	17	41
Engineers	117	134	251
Estate surveyors	47	26	73
Quantity surveyors	28	38	66
Total	265	258	523

The sample size of 227 is estimated for this study as obtained from Yamane (1967) expression as shown in equation 1;

$$n = \frac{N}{1 + N(e)^2} \qquad Equation\ (1)$$

Where n = sample size, N = Population size, e = level of precision = 0.05 at 95% confidence level. Substituting into the above formula we have;

$$n = 523/1 + 523(0.05)^2 = 227$$

The formula was adopted to take care of the confidence level as well as the level of precision required to accommodate the probable sample error.

3.4. Sample Technique

Stratified and simple random sampling techniques were adopted for this study. This is to enable proportional participation of selected contractors and consultants. Stratified random sampling divides a population into series of relevant strata in such a way that each of the strata is represented proportionally within the sample (Fellows and Liu, 2008) and was used to divide respondents into strata (sub-population) based on their geographical locations (as in the case of Akwa Ibom and Rivers States). Simple random sampling was used to select sample of respondents from each state. The calculation of sample size is shown in Table 4.

Table 4: Sample Size of Each Component of the Population Frame (AKS and Rivers)

Designation	Population(N)	Sample size(n)
Architects	92	75
Builders	41	37
Engineers	251	154
Estate surveyors	66	57
Quantity surveyors	73	62
Total	523	227

3.5. Data Collection and analysis

Data for this study were collected primarily through a cross-sectional questionnaire and was designed to take care of respondents' background, key drivers of VM, and barriers inhibiting VM process in the study area. To ensure a good response rate, copies of the questionnaire were first piloted by administering to the research supervisor, some

academics and some practitioners in the field of VM. Final copies of the scrutinised questionnaire were administered through face-face by a team of research assistants led by the researcher. Nominal, interval and ordinal (Likert) scales were used as scales of measurement in this study. Nominal scales were for questions relating to respondents' demographic characteristics while interval scales were used for questions that bothered on respondents' years of experience. Likert scales were used to address questions in sections 2 to 6 of the questionnaire.

The reliability analysis on the questionnaire constructs was conducted using Cronbach's alpha. Reliability is the extent to which the data collection and analytical techniques will yield consistent findings while alpha values greater than 0.7 are regarded as sufficient (Pallant, 2010). The questionnaire was examined and criticised by experts to ensure its adequacy and effectiveness in achieving the intended results. The reliability analysis on the study was carried out on the research instrument and the outcome of the test conducted on the data gathering instrument gave 0.769(Cronbach's Alphavalue). The results are satisfactory and implied internal consistency of test items.

Data collected were analysed using basic descriptive and inferential statistical tools while Statistical package for social sciences (SPSS) version 22 was used in processing the analysis. Specifically, descriptive statistics was used to analyse the demography of respondents and their organisations while mean and standard deviation were used to analyse the stated objectives.

4. PRESENTATIONAND DISCUSSION OF RESULTS

4.1. Response rate

The responses on the research objectives were analysed using relative importance index (RII) method while the test of hypothesis was carried out using Mann Whitney U-test. Table 4.1 shows the response rate of the questionnaires administered. Two hundred and twenty-seven (227) questionnaires were administered while one hundred and seventy-seven (177) were properly filled and returned, representing 78%.

4.2. Respondent's Characteristics

Table 5 shows the result of respondent's characteristics which were gotten from one hundred and seventy-seven (177) questionnaires used for the analysis. The characteristics are job description, years of experience, location of organisation, designation and academy qualification. As shown in Table 5, the job description outcome reflects that 56.5% of the respondents were consultants, 43.5% of them were contractors. The results of the respondent's years of experience reveals that 34.5% of the respondents were experienced between 5-10 years, 52.5% of them were between 10-20 years, 13.0% of them were experienced between 20-30 years and none of them were above 30 years.

The result of the respondent's designation reveals that 15.3% of them were builders, 16.4% were architects, 35.6% were engineers, and 18.1% were quantity surveyors while estate surveyors comprised 14.7%. This shows that the appropriate designations were represented in the study. The result also shows that none of the respondents were at the level of either national diploma (ND) or higher diploma (HND) in the academy qualification of the respondents. Thirty-three (33.3%) of them had Bachelor of Science (B.Sc.) degree, 32.8% had Master of Science (M.Sc.) while 33.9% attained the Doctor of Philosophy (Ph.D.) qualification.

Table 5: Analysis of Respondent's Characteristics

Characteristic	Frequency	Percentage
Job description		
Contactor	77	43.5
Consultant	100	56.5
Total	177	100
Years of experience		
5-10years	61	34.5
10-20years	93	52.5
20-30years	23	13.0
30 above	Nil	0
Total	177	100
Location of organisation		
Akwa Ibom	117	66.1
Rivers	60	33.9
Total	177	100
Designation		
Architect	29	16.4
Builder	27	15.3
Engineer	63	35.6
Estate surveyor	20	14.7
Quantity surveyor	32	18.1
Total	177	100
Academy qualification		
ND	Nil	0
HND	Nil	0
B.Sc.	59	33.3
M.Sc.	58	32.8
Ph. D	60	33.9
Total	177	100

Source: researcher's field work (2018)

4.3. Drivers of Value Management Practices

In order to examine key drivers influencing the practice of VM, a taxonomy of 21 drivers sourced from the literature were scrutinised and subjected to the views of respondents. They were asked to rate the drivers using a five point Likert scale of 1=strongly disagree, 2=disagree, 3=moderate, 4=agree, and 5=strongly agree. The result of analysis showing the RII rankings of the drivers are shown in Table 6.

The result in Table 6 shows that, in the evaluation of key drivers influencing value management practices in the study area, improved products and services ranked 1st with an overall RII score of 0.981, Work towards arriving at a more effective design ranked 2nd with an overall RII score of 0.948, Seek to obtain maximum efficiency ratio ranked 3rd with RII of 0.946, Create a clearer focus on the project objectives ranked 4th with an RII of 0.926, Higher efficiency can be achieved due to the multidisciplinary and multi-task teamwork ranked 5th with RII of 0.914 while Clearer project brief and decision making ranked 6th with an RII of 0.910. This implies that the first six drivers of value management concept are mostly common among stakeholders in Akwa Ibom and Rivers states.

Table 6: Key Drivers of Value Management Practices

	Contractor				Consultant				Total	
Drivers of VM	AKS-RII	R	RIV RII	R	AKS-RII	R	RIV-RII	R	RII	R
Create a clearer focus on the project objectives	0.170	1	0.208	6	0.484	2	0.064	5	0.926	4
Work towards arriving at a more effective design	0.165	3	0.224	3	0.481	3	0.078	1	0.948	2
Identification of alternative methods of construction and favourable adjustments to the construction timeline	0.140	10	0.194	11	0.470	5	0.059	7	0.863	9
Discovery and discussion of project issues, constraints and risk involved	0.149	8	0.200	9	0.476	4	0.060	6	0.885	7
Clearer project brief and decision making	0.155	6	0.207	7	0.484	2	0.064	5	0.910	6
Identifies and removes unnecessary costs	0.119	18	0.148	17	0.438	11	0.040	14	0.745	19
Deals with life cycle costs	0.139	11	0.180	14	0.429		0.053	9	0.801	16
Seek to obtain maximum efficiency ratio	0.163	4	0.219	4	0.493	1	0.071	3	0.946	3
All options, alternatives and innovative ideas are considered	0.133	15	0.151	16	0.444	9	0.053	9	0.781	18
It identifies possible problems early on in projects	0.139	11	0.184	13	0.429	14	0.051	11	0.803	15
It provides management with authoritative evaluations and supporting information of the project brief/design and their related capital and operational cost	0.094	21	0.118	19	0.426	15	0.036	17	0.674	21
It provides the structure for the team to collaborate and gain the benefits of partnering	0.137	12	0.172	15	0.461	8	0.043	13	0.813	13
Mutual understanding and consensus between the stakeholders are enhanced	0.098	20	0.147	18	0.432	13	0.038	15	0.715	20
Improved communication and team spirit	0.136	13	0.194	11	0.462	7	0.050	12	0.842	10

that is built between members of the professional team										
Clear definition of roles and responsibilities	0.147	9	0.215	5	0.419	16	0.059	7	0.840	11
Improved team and client relationships boosting morale of the team	0.129	17	0.193	12	0.466	6	0.050	12	0.838	12
Higher efficiency can be achieved due to the multidisciplinary and multi-task teamwork	0.157	5	0.219	4	0.470	5	0.068	4	0.914	5
Joint ownership of solutions and commitment to implementation	0.131	16	0.193	12	0.416	17	0.052	10	0.792	17
Enhanced client involvement during the development stages of the project	0.135	14	0.202	8	0.443	10	0.058	8	0.838	12
Improved products and services	0.168	2	0.253	1	0.484	2	0.076	2	0.981	1
Enhanced competitiveness by facilitating technical and organisational innovation	0.153	7	0.199	10	0.462	7	0.064	5	0.878	8
VM challenges the established views and private agendas that some of the projects team members may have	0.110	19	0.229	2	0.436	12	0.037	16	0.812	14

Test of hypothesis

A null hypothesis postulated for this study states that there is no significant difference in the opinion of target respondents on the drivers for value management practice in the study area. Kruskal Wallis was used to test the hypothesis. The decision rule is that the null hypothesis is accepted for all p-values greater than 0.05 (5% level of significant difference), otherwise the hypothesis is rejected and the alternative hypothesis accepted**.** The result of the analysis is presented in table 7.

Table 7: Kruskal Wallis test result for key drivers for value management practice

	Key drivers for VM practice
Number of variables	22
Mean rank for Architects	99.86
Mean rank for Builders	80.64
Mean rank for Engineers	83.56
Mean rank for Estate Surveyors	93.19
Mean rank for Quantity Surveyors	69.83
Chi-square	8.257
P-value	0.114
Significant level	0.05
Decision	Accept

The result in Table 7 indicates that the p-value is 0.114 which is greater than the significant level of 0.05. Therefore, the hypothesis is accepted indicating that there is no significant difference in the views of respondents on the drivers for value management practice in the study area.

4.4. Inhibitors of Value Management Practices

In order to determine factors inhibiting the smooth implementation of VM practices for construction projects, 9 factors were developed from literature and subjected to the views of respondents who are either contractors or consultants. The result of analysis is shown in Table 8.

The result in Table 8 reveal that in assessment of the inhibiting factors of value management practices in the study area, lack of awareness ranked 1st with an RII of 0.964 which is the most important factor among all, followed by Absence of formal guidelines (0.923) RII. However, Passive behaviour among VM practitioners (0.906), Ineffective procurement issues (0.879), Regulatory barriers with an RII score of 0.840 ranked 3rd, 4th, and 5th while Lack of training/ education in VM, Misperception of about integration of sustainability /VM, Time limitation and High cost of VM study with an RII score of 0.827, 0.787, 0.474 and 0.442 ranked 6th, 7th, 8th and 9th respectively.

Test of hypothesis

Another hypothesis postulated for the study stated that there is no significant difference in the stakeholder's perception of the factors inhibiting VM practice adoption for construction projects delivery. Kruskal Wallis was used to test the hypothesis. The decision rule is that the null hypothesis is accepted for all p-values greater than 0.05 (5% level of significant difference), otherwise the hypothesis is rejected and the alternative hypothesis accepted**.** The result of the analysis is presented in table 9.

Table 8: Factors inhibiting Value Management Practice

Inhibiting factors of VM	Contractor				Consultant				Total	
	AKS-RII	R	RIV-RII	R	AKS-RII	R	RIV-RII		RII	R
Time limitation	0.133	6	0.172	7	0.120	7	0.049	6	0.474	8
Absence of formal guidelines	0.154	2	0.233	2	0.472	2	0.064	3	0.923	2
Lack of awareness	0.163	1	0.244	1	0.486	1	0.071	2	0.964	1
Misperception of about integration of sustainability /VM	0.102	8	0.215	5	0.424	6	0.046	7	0.787	7
Passive behaviour among VM practitioners	0.148	3	0.231	3	0.463	3	0.064	3	0.906	3
Lack of training/ education in VM	0.137	5	0.190	6	0.423	5	0.077	1	0.827	6
High cost of VM study	0.119	7	0.165	8	0.115	8	0.043	8	0.442	9
Ineffective procurement issues	0.148	3	0.225	4	0.443	4	0.063	4	0.879	4
Regulatory barriers	0.141	4	0.215	5	0.423	5	0.061	5	0.840	5

Table 9: Kruskal Wallis test result for barriers inhibiting value management practice

	Barriers inhibiting VM practice
Number of variables	9
Mean rank for Architects	105.35
Mean rank for Builders	95.91
Mean rank for Engineers	91.07
Mean rank for Estate Surveyors	90.53
Mean rank for Quantity Surveyors	97.77
Chi-square	18.721
P-value	0.070
Significant level	0.05
Decision	Accept

The result in Table 9 indicates that the p-value is 0.070 which is greater than the significant level of 0.05. Therefore, the hypothesis is accepted indicating that there is no significant difference in the views of respondents on barriers to value management practice in the study area.

4.5. Discussion of findings

Findings indicated that the three top rated drivers were "VM was able to improve products and services", "works towards arriving at a more effective design", and "seek to obtain maximum efficiency ratio" in that order. This finding is consistent with previous studies (Coetzee (2009); Oke and Ogunsemi (2011) and goes to affirm that with improved products and services, value management provides clients with the best possible outcome in terms of cost reduction, improved quality and best value for money. Additionally, it is worth noting that in line with outcome of this study, value management helps in effective design and maximum impact on efficiency ratio which translates to efficient use of resources and ultimately adds more value to the client. These were the important criteria that the respondents stated they gained from the VM process. However, the finding that "provision of alternative evaluation and supporting information at project brief/design state" was the least rated driver is unexpected. The best possible explanation however is

that respondents in the study area do not see the factor as an important driver for VM in the area. The hypothesis that there is no significant difference in the views of respondents on the drivers for value management practice in the study area was accepted meaning that there are no dissimilarity on opinions of the respondents.

Findings also reveal that the three top rated barriers of VM implementation for construction projects in the study area are lack of awareness, absence of formal guidelines, and passive behaviour among VM practitioners. This is consistent with the findings of Noor, Kamruzzaman and Ghaffar (2015), Fon and Shen (2004), and Oke and Ogunemi (2015). Plausibly, this study agrees with the findings that lack of awareness on what constitutes value management, benefits, strengths and weakness is a very fundamental barrier to successful implementation of value management practice in south-south geopolitical zone of Nigeria. It equally important to add that where there are no formal guidelines on how to go about the practice, many prospective clients and stakeholders will be discouraged from adopting the technique for construction projects. The passive behaviour of VM practitioners as the third rated barriers among respondents is an indication that some practitioners who are deep in the use of VM are not willing to share their experience with the new comers thereby serving as a source of discouragement. The report that high cost of VM study was the least rated factor may imply that most respondents are of the view that since there is apparent lack of awareness in VM, the cost of its study should not be the problem at the moment. The hypothesis which states that there is no significant difference in the views of respondents on barriers to value management practice was equally accepted indicating that respondents were in agreement.

5. CONCLUSION AND RECOMMENDATIONS

The study contained in this paper examined the use of value management concept for construction projects in the south-south geopolitical zone of Nigeria. Anchored on quantitative and exploratory survey research, 177 respondents participated in the survey while descriptive and inferential statistical tools were used to analyse their responses.

More is now known about the major drivers of VM concept for construction projects in south-south Nigeria with “improvement of products and services” as the most significant driver. Besides, the finding that lack of awareness is the most significant barrier is a wake-up call to stakeholders that more advocacy should be carried out to sensitise the construction industry community on the benefits of the technique to the sector. Besides, formal and informal trainings in terms of graduate studies and some form of career counselling and development programs (like value management awareness program) could be organised by academic institutions or professional entities such as Nigerian Institute of Building (NIOB), Nigerian Society for Engineers (NSE), the Nigerian Institute of Estate Surveyors and Valuers (NIESV) among others. The training is expected to increase the knowledge of the subject and understanding of the importance of value management for construction projects delivery.

The study was carried out in the south-south geopolitical zone of Nigeria. More studies could be conducted in other parts of the country to triangulate outcome of this study. More so, more detailed qualitative approach could be employed using in-depth interviews, group discussion and other methods that could strengthen outcome of this study.

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PERSPECTIVES ON THE BENEFITS OF E-PROCUREMENT TO THE NIGERIAN CONSTRUCTION INDUSTRY

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ABSTRACT

Purpose: The e-procurement platform is an innovative tool that can reduce many of the challenges of the Nigerian construction industry. E-Procurement systems are believed to have the ability to tackle some of the bottlenecks of the traditional processes of procuring goods, services and managing the entire procurement process in the construction sector. This paper thus x-rayed the benefits of e-procurement in the Nigerian Construction Industry based on the perspectives of construction professionals in Ondo State.

Design/methodology/approach: To achieve this aim, the quantitative research design was employed in which, professionals were chosen from construction organisations (contracting and consulting firms) and were asked to express their perception of the benefits of e-procurement on a 5-point Likert scale-based questionnaire. 84 copies of questionnaire were administered in the study area. Out of which a total of 53 copies were completed, returned and successfully deemed fit for analysis. Data obtained was analysed using the Mean Item Score (MIS) and Kruskal-Wallis test.

Findings: It was observed that respondents from small-sized firms ranked all benefits high but the highest-ranked benefit is "cost and time saving". Also, the medium-sized firms ranked all benefits high but the highest-ranked benefit is "less paperwork". Similarly, respondents from the large-sized firms also ranked all benefits high but the highest-ranked among the benefits is "cost and time savings". Overall, "cost and time savings" was ranked as the top most benefit of e-procurement in the Nigerian construction industry.

Research limitations/Implications: The limitations include the use of Ondo State alone as the study area and reliance on solely questionnaires to obtain data. Methods such as interview as well as comparative studies should be considered in future studies. The contribution of this study to the body of knowledge is that it was able to substantiate the benefits of e-procurement and its importance in improving the construction process in the Nigerian construction industry.

Practical implications: This study recommends that practitioners and government should examine the perceived benefits and notice the fact that they were all highly rated by all the groups of respondents. This should encourage the drive towards the entrenchment of e-procurement in construction processes, irrespective of the cost and initial technical limitation.

Originality/value – The study revealed the perspectives of three categories of construction organisations on the benefits of e-procurement and the need to encourage the drive towards the entrenchment of e-procurement in construction processes, irrespective of the cost and initial technical limitation in the Nigerian construction industry.

Keywords: Construction industry, E-procurement, Firms, Professional, Technology

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1. INTRODUCTION

E-procurement has been maximally used worldwide but mainly for the goods and services industries, as indicated by Davila, Gupta & Palmer (2003), Hawking, Stein, Wyld and Foster (2004), Kheng and Al-hawamdeh (2002). Despite the uses of E-procurement in several areas of the economy, less success has been recorded in the construction industry. According to Eadie, Perera, Heaney & Carlisle, J. (2007), the use of information and communication technology in construction firms will continue to be 'piecemeal', only the organizations that can utilize Information and Communication Technology in their business processes will be able to integrate construction processes and procedures. Factors like computer illiteracy and inadequate knowledge of ICT have been cited among the reasons for the low adoption of ICT in the construction industry in many countries (Samuelson, 2008). Another fact is that construction firms' core business activities are performed basically on construction sites and applications upholding actual work on-site are hard to find (Esben, 2012). Also, the low adoption of e-procurement in the Nigerian construction industry is attributed to the many investment areas needed for e-procurement investment (i.e. people, process and technology) and, perhaps, a clear understanding of its benefits. Generally, it is believed that e-procurement is costly and adopting e-procurement requires substantial changes in the internal processes of organizations.

The development of internet technology has profoundly changed the way the construction industry does business. It has been over 40 years since the introduction of ICT tools and systems into the construction industry, yet some organizations are still unable to obtain the many potential benefits of ICT investment - many years after the initial expenditures have been incurred. Furthermore, the industry has been identified as 'slow' in embracing innovative ICT tools and systems such as e-commerce, e-Procurement, e-Tendering, etc. Therefore, an increase in the availability of information related to value benefit will be significant as one of the primary motivations for professionals in the industry to adapt to new technologies. The opportunity for direct benefits in their operations may drive change (Isikdag et al., 2011). As the construction industry implements e-Procurement, decision-makers need benchmarks to understand the value of e-Procurement for organizations and projects. Therefore, this paper aims to reveal the understanding of professionals on the benefits of e-procurement in the Nigerian Construction Industry and thus to provide a benchmark for future studies.

2. LITERATURE REVIEW

Studies on the adoption of e-procurement in the construction industry emerged in the early 2000s as indicated by Isikdag et al. (2011). There have also been studies on the benefits of e-procurement (for examples Issa et al., 2003; Aranda-Mena, 2004; Rankin et al., 2006; Hashim, Said &Idris, 2013). The purpose of this section of this paper is to discuss global submissions on the key benefits of e-procurement in the Construction industry. e-Procurement generally causes a reduction in transactional costs, achieves faster and automated transactions, and helps the buyer to focus more on the strategic part of procurement. This explains the findings of Croom and Brandon-Jones (2007) who observed that e-procurement include savings in purchasing transaction cost, resulting from less paperwork, fewer mistakes and a more efficient purchasing process. Eakin (2003) also classified e-Procurement benefits into three, by noting that the principle metrics that will demonstrate a return on investment (ROI) in e-Procurement are:

i. Hard benefits (directly measurable), which are required to deliver enhanced shareholder value and thus gain approval, such as price savings and process cost reduction.
ii. Soft benefits (indirect benefits), whose direct effect on cash flow may be difficult to quantify accurately (i.e. individual time freed up through more efficient processes), but may well be indicative of progress.
iii. Intangibles, which are benefits but are not directly measurable in financial terms. It is important not to misclassify soft but measurable benefits as intangible, just because measurement may be more difficult. Intangibles include cultural change, e-platform financial approval for all spending, high visibility of supplier performance.

Oladapo (2006) observed that the three main benefits of ICT oriented solutions like e-Procurement are; makes the professional job easier, facilitates decision making and savings in operating cost. E-Procurement also offers some of the best solutions to human inefficiency which according to Olusegun (2017), are so severe in the Nigerian Construction Industry. Also looking at e-Procurement models like e-tendering in quantity surveying firms, its benefits include: simplifying the process; reduced tendering period; fast and accurate pre-qualification and evaluation, avoiding the need for double or triple entry of the same information, and the reduction in labour-intensive tasks of receipt, recording and distribution of tender documents.

Oyediran and Akintola (2011) examined the state of e-tendering among 66 architects, contractors, engineers and quantity surveyors. The study found out that general lack of basic e-tendering infrastructure, low proficiency in the use of e-tendering technologies, irregular power supply, cost of e-tendering technologies and absence of legal backing for electronic transactions were the key barriers to the uptake of e-tendering in Nigeria. Further, a recent comparative analysis of barriers to e-procurement among quantity surveyors in the UK and Nigeria was conducted by Bello and Iyagba (2013). That study was based on the findings of earlier research conducted by Eadie et al (2012) as previously highlighted. The result revealed that there was no significant difference in the barriers to e-procurement as seen from the lens of quantity surveyors in the two countries; suggesting that despite the technological, socio-cultural and economic differences between the UK and Nigeria the barriers to e-procurement use in the two countries are similar.

There is increased integrity and transparency in the tendering process, reasonably high return on invested funds on such technology, improved quality of tender specification and supplier response and provision of quality management information (Lou & Ashalwi 2009; Oyediran & Akintola, 2011). Proponents of e-procurement argue that it helps governments to save money and provides a more accountable, effective and faster way to manage procurement by streamlining government acquisition processes and integrating technology infrastructures (Azadegan & Ashenbaum, 2009). Neef (2001) highlighted the potential benefits of e-Procurement to be the following; lowered transaction costs, faster ordering, wider vendor choices, standardised, more efficient procurement processes, greater control over procurement spending (less maverick buying) and better employee compliance, more accessible internet alternatives for buyers, less paperwork and fewer repetitious administrative procedures, reengineered procurement workflows. E-Procurement provides a wide range of important innovations that can drive adoption (Aslani, Laios & Moschuris, 2008; Aberdeen Group, 2009). It can transform the purchasing process from an operational to a strategic activity (Gupta & Narain, 2012). The benefits of e-Procurement according to Baily, et al (2008), Public Procurement

Authority (PPA) (2011), Chomchaiya (2014), Bikshapathi (2006) and Subramarian and Shaw (2002) include reduced administrative procedures, shortened procurement cycle times, reduced transaction cost, improved efficiency and transparency, and sharing of information. It should be noted that the aforementioned studies were conducted in different parts of the world –developed and developing countries, but the outcome remains a pool of benefits probably applicable to the overall construction process.

According to Eadie et al (2007), an organization that uses e-Procurement has some advantages. First is price reduction in tendering; Empirical studies carried out in the United States of America indicated that the two most important measures for the success of procurement processes are cost and time. In this method, there is no paperwork, postage fee and other costs associated with the preparation and sending of order documents. It is also faster to send a document electronically as compared to the manual process of sending tender documents through the post office. In addition, it makes tracking and tracing of orders better, for it is much easier to trace the orders and make necessary corrections in case an error is observed in the previous order.

Secondly, there is a reduction in time required to source materials; this reduction in time has been acknowledged as a relevant benefit of e-procurement by Bikshapathi (2006). Bikshapathi (2006) stated that "e-Procurement is a rapid efficient method of finding and connecting new sources, being a lean channel for communication". A lot of time is spent on paper invoicing in terms of writing, filing and postal communication but while in e-Procurement, staff have sufficient time to engage on strategic issues of procurement. The time wasted in moving from one town or country to look for potential contractors is greatly reduced since, with a click of a button, information can be readily gotten from the internet. Thirdly, it lowers administration cost. Rankin et al. (2006) argue that e-procurement results in a paperwork reduction and this leads to lower administration costs.

Fourthly, reduction in procurement staff; since most of the procurement process is done electronically, the number of staff needed to facilitate the process reduces. Eadie et al (2007) noted the reduction in staff is an important way of producing a competitive advantage through reduced costs. Another benefit of e-procurement is an improvement of communication; Eadie et al (2007) argue that e-procurement allows sections of electronic documentation to flow through the supply chain; it improves the speed of returns and contractor price visibility. The study further stated that since it is easier to communicate requirements in a quicker and more accessible manner, it will result in a better understanding of requirements and due compliance besides allowing clients to gauge the state of the market by seeing how much interest is shown in the tender. A reduced operating and inventory cost is also another benefit of e-procurement; this is from the fact that that much if not all paperwork is eliminated. Postage costs are also not incurred, among other expenses associated with sending and receiving documents when sending them by post. Other benefits are enhanced inventory management, increased accuracy of production capacity and negotiated unit cost reduction (Subramarian & Shaw, 2002). There have been some studies related to e-procurement across continents, some have even highlighted the benefits of e-procurement but with a limited focus on the entire procurement process in the construction industry. Perhaps, none has also been done in recent time to establish derivable benefits of e-procurement even though its deployment is still limited to date. This raises the question of whether the benefits are understood by concerned construction industry stakeholders, hence this study.

3. METHODOLOGY

A quantitative research design was adopted for the study and it was based on the set objective of the study, which is, to evaluate the benefits of e-procurement to the construction industry. Following the review of related literature, various benefits of e-procurement were identified and presented in a well-prepared questionnaire and face-validated by respected academics. Through the administration of the well-structured questionnaires, the data required for achieving the objective of the study was attained. The eighty-four construction organisations (construction and consultancy) identified in Ondo State which is the study area formed the population for this study. Therefore, since the population was manageable, census survey of the eighty-four (84) construction organisations was adopted in this study. . The choice of the population for this study is based on the fact that construction organisations are key in the construction industry and they greatly influence and are influenced by changes in the construction industry. Data was collected from construction professionals in the organisations, such as; Architects, Quantity surveyors, Builders and Engineers. The respondents were asked to express their level of assessment of the benefits of e-procurement on a 5-point Likert scale of 1 to 5 with 1 being "very low" and 5 being "very high". At the end of data collection, a total of 53 copies were completed, returned and deemed fit for analysis which represent 63% of the total population set for the study. Mean Item Score was used in ranking the forms of e-procurement while the Kruskal-Wallis test was employed in assessing the difference in the view of the three categories of respondents on the benefits of e-procurement. The possibility of a disparity in perception of benefits of e-Procurement by different firm sizes inspired the classification of responses and analysis into small, medium and large firms. CSES (2012) and Ward & Rhodes (2014) defined micro-businesses as business organisations with 0-9 employees, small-sized enterprises are businesses with employees between 10 – 49 employees and medium-sized enterprises are businesses with 50 – 249 employees, while large enterprises have above 249 employees. It should be noted that some of the organisations that responded have branches outside Ondo State. The score "3.5" was selected as a reference benchmark (decision rule) for mean item score interpretation.

4. PRESENTATION AND DISCUSSION OF FINDINGS

4.1. Benefits of e-Procurement to the Construction industry

Respondents ranked the benefit of e-procurement on a Likert scale of one to five, with one being "very low" benefit and five being "very high" benefit. The result is presented in Table 1. From Table 1, it is evident that the Small size firms ranked all benefits higher than 3.5 and the highest-ranked benefit is "cost and time saving" with an MIS value of 5.00. The Medium size firms also ranked all benefits higher than the 3.50 benchmark and the highest-ranked is "less paperwork" with an MIS value of 4.71. The Large size firms also ranked all benefits high, the highest-rated is "cost and time savings" with an MIS value of 4.74. For overall firm rating, all factors ranked higher than 3.50 and the top most ranked is "cost and time savings" with an MIS value of 4.68. Kruskal-Wallis test showed that all factors have a significant p-value of above 0.05 (ranging from 0.058 - 0.907) except one (supply chain visibility) which has a significant p-value of 0.031. 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 16 benefits of e-procurement. However, there is a significant difference in the view of the respondents as regards the benefit of "supply chain visibility" of e-Procurement in construction organisations.

Table 1: Benefits of E-procurement to Construction Firms

Factor	Micro/Small Size Firms		Medium Size Firms		Large Size Firms		Overall		Kruskal Wallis
	MIS	RK	MIS	RK	MIS	RK	MIS	RK	Sig.
Cost and time savings	5.00	1	4.43	4	4.74	1	4.68	1	0.058
Increased flexibility	4.80	2	4.57	2	4.68	2	4.66	2	0.217
Less paper work	4.40	4	4.71	1	4.47	8	4.53	3	0.075
Profitability on firms activities	4.20	5	4.43	4	4.62	3	4.53	3	0.212
Effective communication	4.60	3	4.36	5	4.59	4	4.53	3	0.466
Increased quality	4.20	5	4.50	3	4.53	6	4.49	4	0.598
Reduction in corruption	4.60	3	4.36	5	4.53	6	4.49	4	0.663
High return on investment	4.80	2	4.29	6	4.53	6	4.49	4	0.443
Faster and automated transaction	4.60	3	4.50	3	4.44	9	4.47	5	0.511
Simplified tendering process and period	4.60	3	4.36	5	4.50	7	4.47	5	0.504
Reduced entry in tendering	4.60	3	4.29	6	4.53	6	4.47	5	0.212
Reduction in errors	4.40	4	4.21	7	4.56	5	4.45	6	0.090
Eliminate geographical barriers	4.60	3	4.21	7	4.53	6	4.45	6	0.300
Supply chain visibility	4.40	4	4.07	8	4.59	4	4.43	7	0.031*
Efficient purchasing process	4.40	4	4.36	5	4.47	8	4.43	7	0.907
Improved inventory management	4.20	5	4.36	5	4.44	9	4.4	8	0.663

4.2. Discussion of Findings

The quantitative result shows that cost and time savings, increased flexibility and less paperwork are the most important benefits of adopting e-Procurement to professionals and organisations. Eadie et al (2007) stated that e-procurement saves cost and time, and this aligns with the result of this study. E-Procurement is believed to ensure cost-effectiveness, less paperwork and less waste from paper use, as well as less space being occupied with papers. In addition, its ability to provide flexibility implies that practitioners adjust and coordinate procurement activities with much freedom and ease to achieve procurement objectives. These findings also corroborate the findings of Croom and Brandon-Jones (2007) which described the benefits of adopting e-Procurement to include; savings in purchasing and transaction cost, less paperwork, fewer mistakes and a more efficient purchasing process. In addition, the quantitative result strongly underpins the submission of Ibem et al., (2016). Ibem submitted that the decision to consider e-procurement by organizations in the Nigerian Building Industry (NBI) is dependent on perceived benefits such as the promotion of efficiency in project delivery, elimination of geographic barrier to participation in procurement activities and improvement of effective communication among project team members. The results also correspond with the

previous studies of Issa et al., (2003); Rankin et al., (2006); and Eadie et al., (2007) which identified the perceived benefits of e-procurement to include cost/time savings and reduction in paperwork. It is worthy of note that the three groups of respondents only significantly differ on one of the listed benefits of e-procurement (supply chain visibility). This outcome signifies a pleasant level of consensus.

Profitability of construction, increased quality, improved inventory management is the least rated benefits by respondents from small-sized firms, even though the variable were all rated highly. Submissions from medium-sized firms showed that reduction in error and elimination of the geographical barrier is the least ranked. Also, the large-sized firm respondents supply chain visibility and efficient purchasing process as the least rated benefits. It is worthy of note that although these variables were ranked low, they all had a mean item score above 4.00 out of a possible maximum of 5.00. It is expected that how benefits are perceived will determine the level of adoption of a system or a practice. The fact that all variables are highly rated should encourage stakeholders in the construction sector to earnestly appraise and consider a significant implementation of the e-procurement system. Based on the current public health challenge of the world that has given rise to remote working in different sectors, there might not be a better time to advocate for the deployment of e-procurement. Though not focused on the construction industry but generally on the public sector, Ash and Burn (2006) also outlined the benefits of e-procurement to include increased invoicing accuracy, better pricing as a result of a reduction in working capital, improved tracking and lower total cost of ownership. There appears to be a huge alignment between the benefits of e-procurement in the construction industry as well as the public sector generally. To achieve or improve the listed benefits, Atmaja and Sferianto (2021) recommended the existence of a quality system and procedures, quality information and quality service in the e-Procurement applications and processes.

5. CONCLUSION AND RECOMMENDATIONS

In this paper, the benefits of e-procurement in the Nigerian construction industry was examined using data derived from an industry-based survey. From the result, it is evident that small-sized, medium-sized and large-sized firms ranked all benefits high. From the overall result, “cost and time savings” was ranked as the topmost benefit of e-procurement in the Nigerian construction industry. To enhance the good prospects and maximise the benefits of e-procurement use in the Nigerian construction industry, the following recommendations have been put forward. Stakeholders should display a renewed interest in e-Procurement adoption going by the high rating attached to benefits by the respondents. Stakeholders should examine the perceived benefits and embrace e-procurement beyond the purchase of materials and equipment but also for the entire project procurement process, irrespective of the cost and technical issues. On the limitation of the study, subsequent studies may use more strategies in gathering complimentary or much more reliable data on e-procurement benefits. In this study, the questionnaire was well utilized, but using several methods will make the results more comprehensive and perhaps more revelatory. Methods such as interview as well as comparative studies should be considered.

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AN IDIOGRAPHIC APPROACH TO ASSESSING RISK FACTORS IMPACTING ON CONSTRUCTION CONTRACTORS' CASH OUT FORECASTS

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ABSTRACT

Purpose: Research has shown that construction contractors face challenges when attempting to manage their present and future financial requirements via cash flow (CF) forecasting and/or the use of cash flow forecasting (CFF) models. Consideration for risk factors impacting on CF forecasts/CFF models has also been identified as a key issue affecting contractors' application of CFF models. This study assessed the risk factors prevalent in the idiographic setting ofrenovations of primary health care buildings in Kaduna state Nigeria.
Design/Methodology: A list of risk factors that impact on CF forecasts were identified through the review of existing literature. The identified risk factors were then investigated in relation to the likelihood of occurrence and the impact on CF forecasts, if they occur. Data was collected via a questionnaire survey of contractors who had been engaged in carrying works of renovating primary health care (PHC) buildings in Kaduna state Nigeria. The questionnaire survey focused on determining the likelihood of occurrence/impact of thirty-one (31) risk factors on cash-out forecasts. Contractors were asked to rank on a scale of 0 to 5 the likelihood of occurrence/impact of the risk factors. The responses obtained were subjected to analysis with the use of IBM SPSS (version 21) software. The mean, standard error and standard deviation were computed. The computed means were used to rank the likelihood of occurence/impact of the factors in decending order.
Findings: Nineteen (19) risk factors were found to significantly impact cash-out forecasts- "change in management", "non-inclusion of project in yearly budget", "increased duration of the project", "change in currency exchange rates", "high cost of materials", among others.
Research Implications: The findings from the research imply that several risk factors have different degree of occurrence on cash-out forecasts in, and different degree of impacts on cash-out forecasts in the Nigerian construction industry.
Originality/Value: Construction contractors carrying out renovation works in Kaduna state Nigeria should expect positive variations to their "cash-out" forecasts during the execution of projects. Major recommendations include; contractors should carefully consider the nineteen (19) risk factors affecting "cash-out" before embarking on any construction renovation project.
Keywords: Forecast, Cash-out, Risk, Factors, Construction, Kaduna state.

1. INTRODUCTION

The management of cash out forecasts is an essential component of financial management in construction. Cash out in construction contracts is concerned with the timing of payments, receipts of payments and the consequent balance of cash remaining due to these transactions. Construction Contractors know that there can be a significant

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lapse in time from the point at which they are granted a project, incur labour, material and other costs, to the time they are actually paid for completed work. Consequently, an inability to properly plan for the outflow of cash during the life span of a project may well result in the abandonment of the project (Kenley, 2003).

Factors that contribute to cash out Forecasts in construction projects include (i) duration of the project (ii) retention conditions (iii) times for receiving payments from employers (iv) credit arrangement with suppliers, equipment rentals etc. and (v) times of payment to subcontractors (Park, Han &Russel, 2005). Other factors affecting cash out forecasting include the type of client, size of the project, the procurement route, type of the project etc. (Kaka and Khosrowshahi, 1996). Thus, the need for forecasting the cash out requirement of a project at the right time, in order to determine when and where to borrow or redirect funds cannot be over emphasised.

Researches have shown that there are two basic approaches to dealing with cash flow management and risks assessment in the construction industry. The nomothetic approach and the idiographic approach. The nomothetic approach aggregates groups of projects in order to develop a single standard model. The nomothetic approach failed to clearly address issues concerning the uniqueness of construction projects in relation to factors affecting their cash flows- grouping of projects was done without consideration for differences in these factors. Consequently, researchers changed their focus to the idiographic approach, which seeks to, as much as possible, address the problem of uniqueness of projects by studying individual projects having similar characteristics. A major consideration of the idiographic approach is the choice of a single client/financier as a major factor to consider in developing a model. It is pertinent to note that the attitude of particular client(s) has considerable diffusing effect on other factors that affect cash flow to a contractor (Kaka and Price, 1991; Kaka and Khosrowshahi, 1996; Boussabaine and Elhag, 1999).

Authors (Ogunsemi, 2000; Ogunsemi and Jagboro, 2006; Aibinu and Jagboro, 2002; Olawale and Ming, 2009) have linked project abandonment to cash out management problems. According to these authors, factors like availability of credit facilities, interest rates, retention rates, project type, and type of client (public or private) etc., contribute to project failures. Abdulrazaq, Ibrahim and Ibrahim (2017) drew up a list of thirty-one risk factors that influence cash-out forecasts for projects executed in Nigeria.

However, cash out risk assessment studies that are available for Nigeria did not consider aggregating the factors towards the attainment of the idiographic argument. The studies failed to group projects according to unique characteristics that have been shown to affect cash out forecasts crucial to projects. The purpose of this study is to assess the risk factors impacting on renovation works carried out in Kaduna state, Nigeria.

2. LITERATURE REVIEW

2.1. Idiographic approach to cash-out forecasts

The idiographic approach seeks to aggregate projects with similar characteristics in order to study and bring out generalisable conclusions based on the similarities they possess. Attempts by researchers to follow the idiographic argument have yielded the desired results as the accuracies of models developed to predict cash flow forecasts using the approach have been found to be more accurate than the homothetic approach (Honoabu, 2005; Odeyinka, 2003; Ojo, 2010). Mishkawi (1989) developed a

mathematical model based on practices in the petrochemical industry. The curves derived from Miskawi's formula were found to be unlikely to be of much use in the construction industry as no consideration for models in existence in the construction industry. Betts and Gunner (1993) performed a polynomial regression on sets of data for 73 projects that they classified into different categories. They introduced and rejected previous models either because they were not "favourable to the data gathered in the region under study" or "were evaluated and found to be inappropriate". According to Kaka (1996), previous models did not incorporate enough variables to predict cash flows with enough flexibility. Kaka's study developed a model which incorporated over fifty variables including risk factors associated with cash flow forecasting based on individual contracts with a consideration for their separate cost categories. Hence, emphasizing the individuality and uniqueness of projects.

A follow up on Kaka's argument as to individuality of projects was made by Evans and Kaka (1998). Evans and Kaka (1998) collected historical data on construction of twenty (20) food retail stores to analyse the accuracy of standard/average value curves. The samples were chosen for their consistency in Architectural design and specification. Data collected were associated with costs and contract durations. The result of the analysis suggested the use of cost commitment curves rather than value curves to generate accurate s-curves.

Boussabaine and Elhag (1999) developed a model targeted at the idiographic (project-specific) nature of construction project cash-flow curves, by introducing the fuzzy theory and applying it to cash flow profiles. Boussabaine *et al*. (1998) developed a cost flow forecasting model based on Artificial Neural Network (ANN). The researchers collected data from 50 projects with 100% completion, with duration ranging between 1 and 2 years and carried out under the Institution of Civil Engineers Standard Conditions of contract. Forty cases were used to train the ANN while the remaining 10 were used to test and validate the model developed. The results obtained showed consistency and more accuracy than previous models developed with less consideration for similarities.

More emphasis was laid on collecting data on projects of similar characteristics when Kirkham et al. (2002) collected data on the consumption of electricity in a National Health Services (NHS) acute care hospital building in the UK. Their aim was to demonstrate a methodology for forecasting the cost of electricity in an NHS building. They found that by using expert judgement alongside statistical tests, an increase in accuracy of projection was achieved. The researchers also found that the underlying distribution of electricity costs were mostly that of the Weibull distribution. The Authors concluded that the result could be used in whole life cycle cost model for forecasting electricity cost. Blyth and Kaka (2006) developed a multiple linear regression model for forecasting S-curves at the pre-tender stage of a project. They collected and standardised activities for 50 construction projects. The projects were classified into various criteria based upon project function. Logit transformation and linear regression was then used to develop the proposed model. The research was able to define its idiographic approach (emphasis on individual rather than grouped projects), the classification of the projects using 20 criteria emphasised the need for more specific classification of projects for the purpose of obtaining more accurate forecasts.

2.2. Risks in Cash Flow Forecasts

While the emphasis in aggregating projects of similar projects in order to attain high level of accuracy in forecasting costs continued to grow, the problem associated with defining and capturing risk factors in the proposed prediction models began to manifest.

Researchers in the construction industry have attempted to define risk and suggest management strategies for containing risks. Healey (1982) defined risk as "an exposure to economic loss or gain arising from involvement in the construction process". However, Moavanzadeh and Rossow (1976) regarded risk as "an exposure to loss" only. Perry and Hayes (1985) defined risk as "the chance of exposure to the adverse consequences of future events". It is generally recognised that participants within the construction industry are continually faced with a variety of situations involving many unknown, unexpected, frequently undesirable, and often unpredictable factors (Fong, 1987). Flanagan and Norman (1993) asserted that risks are associated with uncertainties but uncertainties, in contrast to risks, might be defined as situations in which there are no historic data or previous history relating to the situation being considered by the person making a decision. The more the thought that is given to risks and uncertainties, the more the inclination to accept risk as the more important term in the building industry (Flanagan and Norman ,1993). The aim of a construction firm should be to identify, analyse, evaluate, and operate on risks. Risk, if contained properly in businesses, can be used as an instrument for gaining advantages (Khosrowshahi, 2000).

In forecasting cash flows, the major problem that construction managers face involves both the risk and ambiguity surrounding cash flows expected on projects. Factors that are responsible for variation in project cash flows can be grouped under five main headings- contractual, programming, pricing, valuation and economic factors (Lowe, 1987). In spite of the several attempts at modelling construction cash flow curves, accurate forecasts have been a difficult thing to achieve due to risks inherent in construction projects (Odeyinka, Lowe & Kaka, 2008). Flanagan and Norman (1993) concluded that certainty, as opposed to risk, does not happen frequently in the construction business. Bennett and Ormedo (1984) also concluded that uncertainty is a major characteristic of construction and needs to be explicitly recognised by construction managers. Researchers' interest in risks associated with cash flow forecasts became more inherent when it became obvious that ignoring the risks associated with forecasting cash flows was a fundamental reason why inaccuracies were continuously obtained from cash flow forecasting models (Odeyinka, 2003). Thus, efforts have been made to investigate and report risk and associated factors that are responsible for variations between forecast and actual cash flow forecasts.

Buerteyet *al.* (2010) developed a model for predicting construction cash flow in Ghana through a case study of a group of flats under construction by the government. Analysis of data gathered through a questionnaire survey of consultants, contractors and client's representatives 18 frisk factors were identified as significantly affecting cash flow forecasts for contractors in Ghana. The factors include contractual specification for maximum amount valuation, availability of credit facility, advance payments, interval between two certificates, period of honouring certificates by client, rate of retention, interest rates, front/back end loading, accuracy of measurements etc.

Mbachu (2011) investigated the sources of contractors' payment risks and cash flow problems in the New Zealand construction industry. Data was collected from project teams as to their perception of the risks contributing to payments in New Zealand. The result identified payment delays, high interest rates, inflation, government regulations, complexity of projects and claims as significantly impacting on cash flows. An analysis of the impact of negative cash flow on construction performance in Dubai carried out by Al-Jabouri*et al.* (2012) showed that there were negative cash flows for up to 70% of project duration as a result of the presence of risk factors.

Odeyinka*et al.* (2013) identified eleven significant risk factors impacting on cash forecasts for contractors in the UK. By studying 26 risk factors via a questionnaire survey of contractors, the researchers were able to conclude that the eleven factors impacted cash flow forecast more in UK's "stable" economy. The study revealed a regional dimension to risks in cash flow forecast. Hoseini, Andalib and Gatmiri (2015) developed a stochastic, simulation-based framework for forecasting construction projects cash flow at the bidding stage, considering the effect of delay in payments, a major risk factor in most construction projects. The authors performed a Monte Carlo simulation to extract the cumulative probability distribution ns of maximum required finance and financial costs. Application of the model in a real-life highway contract proved its efficacy as there was variation between the model's performance and the contractor's initial forecast.

Abdulrazaq, Ibrahim and Ibrahim (2017) concluded that sixteen risk factors significantly impact cash-out forecasts for contractors in the Nigerian construction industry. These factors include "increased Duration of the Project", and "charging of land dues by locals (illegally)", among others. A close look at the significant risk factors can be classified thus: client-related, Environment–related, market-related and contractors-related. Omopariola and Windapo (2019), however concluded that in the South African construction industry, delay of release of advance payments was a major risk factor affecting cash out forecasts. Even as the practice of advance payments is not widespread in the country's construction industry.

Aris, Sokat and Sahari (2020) found that the net cash flow in investing activity of construction firms operating in Malaysia is significantly affected by Government ownership. They concluded that although Government has an authority to influence the economic activity in the market, its interference in their capital structure does not effectively affect the firms' performances.

Mahmoud, Ahmed and Behery (2021) argued that while there were models that aim to assess and forecast risks in the construction industry, none present a technique to include the impact of the risks on a project cash flow. The study thus uncovered 44 risk factors that have the tendency to impact construction cash flow. A consolidation of these factors via factor analysis and Delphi technique resulted in a cash flow risk index (CFRI) from an owner's perspective. The CFRI is able to measure the impact of different risk factors on a typical construction project's cash flow.

Liam, Ashuru and Li (2021) developed a new forecasting model which took cognisance of the Design-Build Procurement method. Major research finding is that even at the early procurement phase of a Design-Build project, when exact quantities and detailed cost estimates have not been fully developed, the combination of conceptual project information and local construction market indicators avails us the ability to predict the future.

3. MATERIALS AND METHODS

The thirty-one risk factors identified by Abdulrazaq, Ibrahim and Ibrahim (2017) were adopted for this study. The idiographic approach was adopted in the study. A deliberate attempt was made to identify contractors who executed projects that have as much similar characteristics as possible; renovation projects of Primary Health Care centres in Kaduna State, hence creating a homogeneity amongst the projects studied. A total number of ninety (90) contractors were found to have updated their registration with the ministry of works Kaduna state as at March 2020. In order to obtain reliable data for

the study, all the ninety registered contractors were approached for data collection as suggested by Cochran's (1977) for categorical data.

The questionnaire was divided into two parts (sections A and B). This was done to make the questionnaire easy to understand and very clear to the respondents. Section "A" requested general information from the respondents. These include mainly information about the respondents such as name of organisation, type of projects commonly executed, position of the respondent in the organisation, the average duration of projects executed, average value of project executed, the procurement route commonly adopted in projects executed, the annual turnover of the organisation and the nature of the client served. The provision of the 'other (please specify)' option was included to each category of the questions to reduce rigidity which may artificially constrain the responses (Fellows and Liu, 1997). These pieces of information were to enable the grouping of the responses provided by the respondents.

In section B of the questionnaire, 31 risk factors derived from literature as potentially affecting cash-out flow forecasts were listed. Respondents were then requested to provide opinions regarding the likelihood (i.e. probability) of each factor occurring and the likely impact should the factor occur. Respondents were asked to score their opinion on a 0-5 Likert type scale, zero being included so as to accommodate the instances where the risk factor was not applicable (Holton and Burnett, 1997). The highest likelihood of a risk factor occurring and maximum impact was each assigned a score of 5.

4. PRESENTATTION AND DISCUSSION OF RESULTS

Table 1 shows that majority of the respondents (37.23%) were Project Managers who were involved in their firm's projects. Twenty-one of the respondents, representing 15.33% were Directors in the firms. This was followed by 12 Administrative Managers (8.76%), 19 Quantity Surveyors (13.87%), 9 Project Engineers (6.57%), 6 Managing Directors (4.38%), 8 Architects (8.76%), 9 Project Suoervisors (6.57%) and 2 Project Directors (1.46%). The combination of respondents shows a participation of several management cader of the organisations with the requisite knowledge on cash flows into and out of the organisations.

Table 1: Position of the Respondents in their Respective Organisations

Position	Frequency	Percent
Administrative Managers	12	8.76
Architects	8	5.84
Directors	21	15.33
Managing Directors	6	4.38
Project Directors	2	1.46
Project Engineers	9	6.57
Project Managers	51	37.23
Project Supervisors	9	6.57
Quantity Surveyors	19	13.87
Total	**137**	**100**

Table 2 shows that majority of the repondents had experience of over thirty years. The mean experience of the respondents is 34 years. This suggests that the respondents have the requisite experience in building projects.

Seven factors involved in the study were considered to be statistically and significantly different by the respondents. These factors include :"Change in Management/Government", "Non inclusion of project in yearly budget", "increased duration of the project", "Poor communication amongst Parties", "Poor Design", "Shortage of Key Skilled Labour" and "Under Measurements". "Change in Management/Government"which ranked 1st overall, ranked very high for the two categories of client. This implies that the impact of the risk facator is very critical. "Non Inclusion of Project in Yearly Budget" and "increased Duration of the Project" also ranked 1stoverall . This suggests thatthe impact of the factors is highly critical. "Variations" ranked 4th overall, This gives a picture of consistency of the risk factor as highly impacting of cash-out forecasts. The "shortage of key plant items" ranked 5thfor renovation works in Kaduna state, implying that the risk factor has very high impact on cash-out forecasts when it occurs.

Table 2: Construction Experience of respondents

Years	Frequency	Percent
1-10	18	13.14
11-20	17	12.41
21-30	39	28.47
Over 30	63	45.99
Total	**137**	**100**

4.1. Discussion of Results

Several risk factors that can be associated with a client or client organisation have been discussed by previous researchers (Odeyinka *et al.*, 2013; Shehu *et al.*, 2014; Zayed and Liu, 2014), however, non-inclusion of a project in a yearly budget is not one of them. This implies that the risk factor is unique to the present client which empasises the idiographic argument of previous reaeearchers. Non-inclusion of a project sounds lke an intentional attempt by the client to refrain from considering payment(s) to the contractor on the project. Perhaps due to non vailability of funds and /or prioritisation of projects to be considered for payment as a result of dearth of government funds. Other departure from previos studies include that from the study by Odeyinka *et al.* (2013) where identified "changes to initial design", "inclement weather", and "variation to works" as the 3 top-most risk factors occurring. The same factors ranked 12th, 10th, and 16th, in the present study. Incidentally, "Client's insolvency", "Labour Strikes", and "Civil Disturbance" ranked very low in both studies. This implies that the civil unrests and labour strikes rarely impacts on the cash-out forecasts by contractors in both the UK and Kaduna state. A similar survey carried out by Shehu *et al.* (2014) revealed that in Malaysia "late payment from contractor to subcontractors and suppliers", "dispute between contractor and subcontractor', "late payment from client to contractor" and "bureaucracy in government agencies" are crucial factors affecting contractor's forecasts. The present study has some similarities with that carried out in Malaysia. "Delay in payment from client" and "increase in the duration of the project" also ranked very high as in the study in Malaysia.

Table 3: Likelihood of Occurence of Risk Factors Affecting cash out Forecasts

Risk Factor	Mean	Rank
Change in Management/Government	4.51	1
Non-inclusion of project in yearly budget	4.51	1
Increased Duration of the Project	4.51	1
Variations	3.87	4
Shortage of Key Plant Items	3.77	5
Replacement of Defective Works	3.73	6
Delay in Payment from Client	3.68	7
Delay in Settling Claims	3.60	8
Poor communication Amongst Parties	3.24	9
Inclement Weather	3.21	10
Inflation	3.17	11
Changes to Initial Design	3.15	12
Under-estimating Project complexity	3.13	13
Charging of "Land Dues" by Locals (illegally)	3.10	14
Over Measurements	3.10	14
Delay in Agreeing Variation/Day Works	3.05	16
Contractor/Owner Dispute	3.05	16
Shortage of Key Skilled Labour	2.85	18
Long Period of Honouring Certificates by Client	2.64	19
Bad Relationship Between Main and Sub Contractor	2.45	20
Strikes, Internal and External Military Actions	2.41	21
Under Measurements	2.36	22
Civil Disturbance	2.20	23
Change Orders	1.82	24
Poor Design	1.43	25
Problem with Foundation	1.36	26
Client's Insolvency	1.22	27
Compliance With New Regulations	1.17	28
Failure of Subcontractors	0.91	29
Geotechnical Issues	0.82	30
Archaeological Remains	0.17	31

Field Survey (2020)

None of the factors highlighted by Zayed and Liu (2014) was found to be significant in the present study. Zayed and Liu (2014) emphasised on the impact of location on factors affecting cash flow forecasts. Data for the study was collected from North

America and China. Result from the survey showed a significant difference in the impact of the following risk factors in the two locations- "contractor's personal relation with the consultant team", "contractor's personal relation with the owner", "lack of skilled labour", "change of progress payment duration", "change of labour and staff wages", "delay of making payments to suppliers", and "number of claims".

Table 4: Impact of Risk Factors on cash-out Forecastsfor Primary Health Care Projects

Risk Factors	Mean	Rank	**F** F STAT	**Sig.** (P.Values)
1. Change in Management/Government	4.15	1	3.340	.021*
2. Non-inclusion of project in yearly budget	4.51	1	3.733	.013*
3. Increased duration of the Project	4.51	1	5.006	.002*
4. Poor communication Amongst Parties	3.24	9	4.608	.004*
5. Poor Design	1.43	25	4.883	.003*
6. Shortage of Key Skilled Labour	2.85	18	9.432	.000*
7. Under Measurements	2.36	22	4.599	.004*

Source: field survey, 2020. Note- *= significant at 5% Level of significance.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This paper contributed to cash flow management in the construction industry by identifying risk factors significantly impacting on the cash out forecasts of contractors operating in Kaduna state, Nigeria. It can be concluded that seventeen risk factors significantly impact cash out forecasts for contractors carrying out renovation works within Kaduna state of Nigeria.

"Change in Management/Government" has the highest impact for both types of projects. A new risk factor "non-inclusion of project in 'current' budget'" has impact on projects executed for the state Government. Majority of the factors contributing to the risks of forecasting cash flow by contractors carrying out weorks in Kaduna state are client-related.

5.2. Recommendations

i. Construction contractors involved in renovation works for Kaduna stategovernment should plan considerably against positive variations to their "cash-out" forecasts arising from non inclusion of project in budgets subsequent to the base year.

ii. Construction contractors in Kaduna state should carefully consider the seventeen (17) significant risk factors affecting cash-out before embarking on any renovation project in Kaduna state.

iii. Further studies should be carried out to determine the effect of procurement route on the risk factors impacting on cash flow forecasts for renovation works.

6. LIMITATIONS OF THE STUDY

The model developed in this research can only be used to forecast risk impacts on cash flows for projects that are governed by payment conditions, retention agreement, procurement route, duration of contract, and other conditions applicable to renovation works of Primary Health Care Projects in Kaduna state, Nigeria. The research was conducted through the administration of questionnaires to contractors in the Nigerian construction industry. The accuracy of the information obtained depends largely on the accuracy of the judgement of the contractors.

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ENERGY EFFICIENCY ASSESSMENT OF HIGHER EDUCATION BUILDINGS IN BAUCHI, NIGERIA

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ABSTRACT

Purpose: Energy efficiency, often referred to as efficient energy use, is aimed at reducing the amount of energy required for cooling, heating, ventilation and lighting in buildings to create desirable thermal comfort conditions. Global energy and climatic challenges have necessitated new ideas and investments in developing energy-efficient strategies in the building industry. The building sector is responsible for over 40% of total primary energy consumption across the globe and almost 30% of the world's total Carbon Dioxide (CO2) emissions and therefore plays a critical role in addressing global energy and climate change issues. Retrofitting is needed in buildings to make them more energy efficient. This study investigates energy efficiency in higher education buildings with a view to developing a conceptual energy efficient framework for sustainable higher educational building design in Nigeria.

Design/Methodology: The emphasis is on the Building envelope and shading in higher educational buildings. This research adopts a mixed research method, it collates and analysed data on the perception of users and designers, in inculcating sustainable design solutions. Interviews were conducted and questionnaires distributed, analysed using the Likert scale grading system to test the relationship between users' perception of energy efficient buildings and amounts of energy conserved.

Findings: The findings validated perceptive benefits of the passive and sensible cooling loads to the Primary and Total Energy Demand of educational buildings in Nigeria. The study also indicates the lack of conscious consideration to the environmental and socio-cultural impact of buildings on the environment but more attention seems to be focused on building costs, labour and materials in Nigeria.

Originality/Value: The results of the study also form part of a conceptual Energy Efficiency Framework to which Architects are expected to adhere to as a rule guiding their design for energy efficient Higher Education buildings.

Keywords: Architecture, Buildings, Energy Efficiency, Higher Education & Sustainable Design.

1. INTRODUCTION

Global energy and climate debate necessitate new ideas and investments in energy efficient strategies in the building industry (Garkuwa, 2017). The building sector consumes over 36% of overall primary energy consumption across the globe

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(International Energy Agency, 2015). Also, the building sector is responsible for about 40% of the world's overall Carbon Dioxide (CO_2) emissions and therefore plays a critical role in addressing global energy and climate issues (International Energy Agency [IEA], 2015). The use of energy in buildings has increased in recent years due to the growing demand in energy used for heating and cooling in buildings. Without energy, buildings could not be operated or inhabited (Löhnert et al., 2007). According to Baird et al., (2018) improvements have been made in insulation, plant, lighting and controls which are significant features that help towards achieving an energy efficient building.

Increasing energy demand and reduction in available energy are leading to mandatory energy efficiency strategies in every sector globally (Petersen & Svendsen, 2010). It was noted by Nielsen & Mortensen (2016) that energy consumption by the building sector calls for an increased attention towards energy efficiency measures. According to Sadineni, Madala, & Boehm (2011) accepting appropriate energy efficiency strategy can meaningfully decrease energy consumption in buildings. Hence, efforts in the previous decade have centred on reducing buildings' share of carbon emissions through energy efficiency and conservation measures (Kumar & Raheja, 2016). Both governments and scientists across the globe have discovered the need and the potential for energy efficiency in buildings (Sadineni et al., 2011). This has led to numerous mechanisms and policies proposed and implemented especially in developed countries towards an energy conscious building design and development (Jason, 2004; Yuksek & Karadayi, 2017).

Presently, higher education buildings in Nigeria have an important role in the reduction of greenhouse gas emissions from our built environment and in assisting the mitigation and adaptation of our society to climate change (Oyedepo, Leramo, Adekeye, Kilanko, Babalola, Balogun, & Akhibi, 2015). Nonetheless, operating and managing the building infrastructure of organizations such as universities is complex because their diverse infrastructure and non-uniform building conditions can make it difficult to prioritize the resources needed to upgrade particular buildings and systems (Oyedepo et al., 2015). Large institutions such as universities consume huge amounts of energy on daily basis (Oyedepo et al., 2015). Oyedepo et al. (2015) also establish that improving energy practices at higher education buildings can decrease their environmental impacts.

Amongst the most critical challenges facing the society is influence of man's activities on climate change and its consequences for economies and communities (Parkinson & Birgitta, 2010). Although the impact of climate change may well prove irreversible according to many authorities, the risks to society may be reduced by accepting adaptation and mitigation strategies (McMichael, 2003 Sing, 2012). This can be deduced from the views expressed by intergovernmental Panel on Climate Change (Climate Change 2007) which urged world leaders to act immediately by reducing greenhouse gas (GHG) emissions.

Having a clear understanding of how the surroundings of higher education buildings perform will enhance the economic, social, environmental, and operational performance of the Nigeria higher institution of learning (Akadiri, Chinyo, & Olomolaiye, 2012). As such. this research seeks to increase the understanding of the energy performance of higher education buildings and surroundings by planning and developing a decision support framework to better facilitate the energy assessment of educational buildings.

An important benefit also applies when the focus is placed on buildings used for higher education because these enhancements can play a major role, not only as described above, but also when the buildings are used as an instructive tool to educate and teach students, staff, and the broader community about sustainability (Rohwedder, 2004).

According to Rohwedder (2004) properly designed educational buildings can showcase economic, water and energy savings, reductions in GHG and social responsibility by employing this to demonstrate to students that educators care about their future well-being. Acceptable and comfortable indoor conditions are essential to improve the health, performance, and learning of university students, and staff (Corgnati et al., 2007; Sharaidin et al., 2012). However, most of the existing higher education buildings in Nigeria today are generally designed at a time when the sustainability and comfort of the occupants were not the priority, thus, the design naturally leaves a lot of room for inefficient operation with resultant frequency of failure to provide acceptable thermal comfort for the occupants throughout the year (Machar, 2017). Furthermore, universities typically operate a diverse collection of buildings with wide-ranging performance issues that affect them to different degrees, which is why a general approach is likely to be required when assessing the extent to which university building can be made more sustainable and comfortable (Okolie, 2011). In essence, considering the building as a whole component when an upgrade of the already exiting educational buildings is to be undertaken in form of retrofitting, there is a need of an established framework to guide the process of a decision making which is complex.

The acceptance of energy efficiency technologies and systems has been identified as one of the most cost-effective ways of reducing GHG emissions (Energy White Paper Task Force, 2004), as well as providing energy security, and economic, climate and social benefits (Steuwer, Rosenow, & Jahn, 2019). In many European countries, Asia and Austrialia, retrofitting existing commercial buildings during the next decade is seen to save about 1.4 billion a year (Climate Works Australia, 2010), reduce building emissions by 30% and generate 27,000 jobs (Langdon, 2009).

Research established that, to decrease energy consumption in buildings, design professionals need to come up with design that consume less energy. Energy performance has emerged as an important concept that must be inculcated in design process due to high consumption of building sector (Petersen & Svendsen, 2010). Such smart buildings significantly decrease building energy consumption, operational cost and lower Green House Gas emission. From 40% - 60% compared to the conventional new buildings. Good building envelope design as argued by Latha, Darshana, & Venugopal (2015) can yield good result in lowering heating and cooling load in buildings. Passive design technique as asserted by Gustafsson (2017) as the best sustainable strategy to energy demand in buildings. Previous studies (Yuichiro, Cook, & Simos, 1991; Givoni, 1994) have proposed passive and low energy as the most efficient way of reducing buildings energy consumption. This paper proposes a framework for design of an energy efficient higher education building in Bauchi Nigeria using passive design techniques and application.

1.1. Statement of the problem

Izael & Edward (2011) found that insufficient consideration has been accorded to the poor design and energy performance of Institutional buildings. Educational institutions are amongst the major consumers of energy in any country most of which is utilized within buildings for lighting, cooling, heating and other services. A thorough critique of the building system is necessary to reduce energy wastage in such buildings through adoption of sustainable design strategies in Lecture spaces in Bauchi. This is essential in other to reduce energy consumption in the daily running of these buildings.

As it was asserted by Oyedepo et al., (2015) unlike major economic sectors (industrial, commercial, transportation), very few campus energy potential studies had

been carried out in recent past in Nigeria. In his study, Unwachukwu (2010) assert there is an absence in potential identification of energy conservation measures, achievement of thermal comfort in lecture halls through a holistic approach of the design and composition of the building fabric. When this is implemented on campus, it can improve the indoor environmental air quality thereby making the energy usage more efficient and less expensive. The need to link this important gap is of immense benefit to research in higher education buildings in Nigeria and the global demand for energy efficiency.

1.2. Aim and objectives of the study

The aim of this paper is to investigate the energy efficiency in Higher Education buildings in Bauchi Nigeria with a view to provide a sustainable conceptual framework for adaptation in Nigeria. In other to achieve this aim, the objectives will be;

i. To identify passive building design strategies to improve and reduce energy consumption in Higher Education buildings.
ii. To identify sustainable shading strategies for retrofits in the façade of existing Higher education buildings in Bauchi Nigeria.

1.3. Hypotheses

Null and alternative hypotheses were formulated to guide the study and these hypotheses will be tested at a 0.05 level of significance.

Null Hypothesis:

H_0: A design framework to assess energy efficiency of higher education building in Bauchi Nigeria would not be an effective tool in the creation of sustainable buildings.

Alternative Hypothesis:

H_1: A design framework to assess energy efficiency of higher education building in Bauchi Nigeria would be an effective tool in the creation of sustainable buildings.

2. LITERATURE REVIEW

A building is a physical structure whose fundamental purpose is to provide shelter for some activity that could not be carried out as effectively, if at all in the natural environment. Such activities may involve people, a mix of people and machines. All such activities require some degree of protection from external elements and may require a specific range of environmental conditions and a specific set of service facilities if they are to be carried out successfully (Izael & Edward, 2011). Institutional buildings like Universities are therefore required to provide a conducive environment for the conduct of educational services such as delivery of lectures to students, computer laboratories, libraries for study, and offices for lecturers, etc. All these require a thermally and visually comfortable environment. Sustainable building design have similar definitions which according to the U.S. Green Building Council defines it as a building's total economic and environmental impact and performance, from material extraction and product manufacture to product transportation, building design and construction, operations and maintenance, and building reuse or disposal (USGBC, 2013).

Energy is very important in the daily activities of humans and every human endeavour require the use of energy and similarly, no country can develop without efficient energy use (United Nation Environmental Programme [UNEP], 2009). Access to ample energy is the dividing line between the poor countries and the rich countries (Karekez, McDade, Boardman & Kimani, 2012). This explains why the developed countries of the world have and consume more energy than the developing and underdeveloped countries. As such, there is need for energy efficiency; in residential

homes, agricultural settings, industries, educational and other commercial buildings (Ochedi & Taki, 2016)

Energy efficiency measures are meant to reduce the amount of energy consumed while maintaining or improving the quality of services provided in the building. According to the United Nations Industrial Development Organization, (2015) amongst the benefits likely to arise from energy efficiency investments in buildings are:

i. Reducing energy use for space heating and/or cooling and water heating;
ii. Reduced electricity use for lighting, office machinery and domestic type appliances;
iii. Lower maintenance requirements;
iv. Improved comfort;
v. Healthy indoor and outdoor air quality;
vi. Enhanced property value.

2.1. Energy use in building

There is insufficiency of reliable data on energy consumption in buildings, partly due to poor metering of mains electricity and also due to the fact that most buildings also generate electricity using petrol and diesel generators which complicates assessments in Nigeria (Ochedi et. Al., 2016). In late 2014, it has been estimated that 55% of Nigerian electricity users are not metered (Energy Commission of Nigeria, 2008). This is accepted as a major barrier to energy efficiency, and efforts are underway to ensure appropriate meters are installed. Energy use in building is one of the most noteworthy means of energy consumption and greenhouse gas emissions, thereby creating negative impact on the environment. Energy use can be linked with the emission of greenhouse gasses which is responsible for global warming and consequently climate change. Pérez-Lombard, Ortiz & Pout (2008) reported that there has been a steady increase in the global energy consumption of buildings which steadily emit greenhouse gasses; this has reached figures between 20% and 40% from both residential and other public buildings in developed countries.

Cooling and heating energy have been recognised as the most leading source of energy use in building which is also referred to as operational energy Adegbie (2016). Buildings are responsible for a considerable proportion of global energy use Ashden, (2014) and UNEP (2009) acknowledged that building sector consumes up to 40% of global annual energy and contributes up to 30% of annual greenhouse gas emissions. Cooling loads accounts for approximately 40% of the electricity consumed in the building, while lighting and powering of appliances accounted for 12% & 48% respectively (Batagarawa, 2013). Adoption of energy efficiency strategies in buildings will drastically reduce energy demand and consumption.

2.2. The need for low energy building

Adapting buildings to low-energy is one of the ways to make it energy efficient. Ashdeen (2014) stated that low-energy buildings use a mixture of passive and active systems to deliver a comfortable environment with lowered energy use and related greenhouse gas emissions. Low-energy buildings have decreased energy demands and without deterioration of the indoor climate condition. Low-energy designs in buildings is the inventive use of the basic form and enclosure of a building to save energy while enhancing occupants' comfort as stated by the U.S Federal Energy Management Programme (2001).

Low-energy building design combines energy conservation strategies and energy-efficient technologies which result in absolute reduction in the use of fossil- fuel based power. Further, building operational energy cost can be saved from low-energy buildings. This savings can be achieved through integrated design solutions. A low-energy building has fabric energy efficiency that is effective in minimizing the energy needed for cooling and space heating (Adegbie, 2016). Low-energy design strategies make use of the building fabric or envelope such as wall, windows, floors and roofs through appropriate design, materials and construction methods to minimise buildings energy consumption, enhance environmental performance and the economy (Adegbie, 2016). It is essential to consider low-energy principles at the inception of a building design because it has been recognised as the cheapest way to cut greenhouse gas emissions (UNEP, 2009). Low-energy buildings should consume significantly less energy than the level specified in the building regulation and the key objective of such buildings is energy-efficient design in which minimal energy is consumed throughout the building life cycle (Ashdeen, 2014)

2.3. Retrofits potential for energy reduction in Nigerian higher education buildings

In Nigeria, there seems to be an overall lack of awareness about the direct link between building design and technologies, and their impact on energy efficiency in the state-of-the-art building design. Traditional building materials and concepts responding to local climatic conditions are usually considered unprogressive, while modern materials and building designs from abroad are preferred, leading to designs that consume a large amount of energy, especially for cooling and lighting (Ley, Gaines & Ghatikar, 2015).

There are a series of well-tested and advanced strategies available that would suit the climate which can include the adoption of phase change materials, activation of thermal mass, retrofitting existing buildings, and these measures are not well established, as there is no local precedent available (Geissler, Österreicher & Macharm, 2018). The acceptance of energy efficiency retrofits for existing buildings has been identified as the most cost-effective solution available for reducing energy consumption in buildings (Energy White Paper Task Force, 2004).

3. RESEARCH METHODOLOGY

This study employed the use of measurements, case studies, and questionnaires to investigate the perception of a population on a prevailing phenomenon. A total of a hundred (100) questionnaires issued to Architects and students within the study area. To minimise the impact of time, finance and human resources, the study is limited to selected higher educational buildings in Bauchi, usually referred to as Bauchi State to distinguish it from the city of Bauchi. One amongst the selected buildings in Abubakar Tafawa Balewa University and The Federal Polytechnic Bauchi was chosen for this study. 90% of distributed questionnaire were received and analysed for this study. It is purely based on aggregation of facts observed from stated opinions since the possibility of experimentation would not be feasible. The questionnaire was divided into sections and questions were asked and the expected responses were either “Yes” or “No”. The other section anticipated response which were measured on a five-point scale format which ranged from “Highly Significant”, “Significant”, “Slightly Significant”, “Insignificant”, and “Highly Insignificant”. The scale was assigned numerical values of 5, 4, 3, 2, and 1 respectively from positive expression to negative opinion. T-Test was adopted for analysis of the subjective responses to determine the difference and level of

significance between the variables under study. Amongst the items considered in the survey questionnaire were existing issues in higher educational energy demand and use; these include thermal comfort, building energy use, components of the building fabric, sustainable design consideration, institutional appliances as well as retrofitting existing buildings.

4. PRESENTATTION AND DISCUSSION OF RESULTS

This study focuses on energy efficiency in buildings as a tool to harness energy conservation hence questions were asked broadly on energy performance of buildings and also the social consciousness of the user's perception of the building components towards efficient usage of energy.

4.1. Gender distribution

It was recorded from returned questionnaires of architects that 87.5% were male while 12.5% were females while the student respondents 80.5% were male while 19.5% were females that the distribution.

4.2. Age range of the respondents

The sample for this study was relatively matured in age with almost 62.5% between 40-60 Years. This observation suggests that respondents experience and maturity will give a certain degree of reliability to the study since their huge expertise will supply benchmark for the framework. They youngest respondents that make up 32.5% are between the ages of 35-40 years are also relevant as their age classification lend a good degree of credibility. Purposive sampling in the distribution of the questionnaires for students in context was drawn from 400 level and above. The sample had almost 58.5% between 25-29 Years. This observation suggest that respondents age group and level of study will ensure a certain degree of reliability also to the study since their knowledge gained from 100 level will supply a yard stick for the framework.

4.3. Design approach

Building design is an exceptional means of decreasing energy demand and consumption by buildings. Furthermore, sensible building design will aid thermal comfort and people's wellbeing. Numerous studies substantiated this position (Heiselberg, 2002; Allard & Ghiaus, 2012; Gratia & De Herde, 2007). GIZ (2015), stated that the Nigerian building sector is categorized by the post-modern buildings of the 1990's and the sprawling new Nigerian architecture that is taking shape due to the introduction of new building materials mainly imported from Asia. The concept of energy efficient bioclimatic architecture adapted to the site as used in traditional architecture seems to have lost its usage as many of the design in the urban areas are not a resolution of the climate and environmental conditions but by designs from abroad.

Respondents in the survey as shown Table 1 and 2 in study area indicate that from existing buildings the design approach adopted, building materials and construction techniques used are not appropriate for the microclimate and contribute to thermal discomfort. To realize the benefits of building design with regard to energy, comfort and other factors, building design should be based on the site microclimate. Conversely, the data from professionals and the observational survey showed that most of the buildings in the study area were designed without considering the microclimate. Building morphology and envelopes do not reflect the features that will stabilize the environmental factors.

Challenges with the design of buildings, use of building materials that are not responsive to the microclimate and lack of awareness on energy efficient buildings are predominant.

Meanwhile poor design can contribute greatly to energy consumption and thermal discomfort in buildings. Designers need to be sensible in their design of buildings bearing in mind the microclimate and other relevant factors. This will make life better for building users.

Table 1: Energy Conservation Measures

	Yes	**No**
Energy need	19 (47.5%)	21 (52.5%)
Energy consumption	13 (32.5%)	27 (67.5%)
Thermal comfort	18 (45%)	22 (55%)

Source: Authors Survey (2021)

Table 2: Design approach to higher educational buildings

	Highly Insignificant	Insignificant	Slightly Significant	Significant	Highly Significant	**Mean**	**Remark**
Functional spaces	3	3	15	14	3	**3.29**	**S**
Building elements (substructure and superstructure)	0	3	8	16	11	**3.92**	**S**

Source: Authors Survey (2021)

Key: 1.00 - 3.00 = Insignificant (I)
3.01 - 5.00 = Significant (S)

4.4. Retrofitting

There are energy efficiency codes and guides suitable to new buildings than existing buildings. Existing buildings have limited measures for enhancing thermal comfort and energy consumption of building occupants within. Building retrofit has been identified as one of the effective ways of improving comfort in existing buildings and reducing the energy usage, thereby adapting to the changing climate (Porritt, Cropper, Shao, & Goodier, 2012)

Survey results in Table 3 from which particularly addresses objective which all respondents agree that retrofitting the facades of existing higher education building in Bauchi Nigeria to enhance their shading ability is a solution to achieving better cooling and thereby enhancing thermal comfort in existing lecture and other training spaces. In the aspect of static and dynamic facades for shading lecture spaces, 92% believe that the deployment of dynamic shading devices on the building envelope will perform better to static shading device. Nonetheless the static shading devices which also help in achieving thermal comfort is mostly absent in 80 % of the buildings. A lot of technology and studies need to be carried out in the aspect of dynamic shading device in this part of the world before adopting its use which is deemed better because of the varying and harsh weather condition in Bauchi, Nigeria.

Table 3: Facade Classification best suites Bauchi Nigeria climate

	Highly Insignificant	Insignificant	Slightly Significant	Significant	Highly Significant	**Mean**	**Remark**
Static façade	0	10	8	9	8	**3.43**	**S**
Dynamic façade	0	0	4	6	28	**4.63**	**S**

Source: Authors Survey (2021)
Key: 1.00 - 3.00 = Insignificant (I)
3.01 - 5.00 = Significant (S)

Analysis of a Design Framework for higher education building in Bauchi Nigeria:

Hypotheses considered for this study test the effect the provision of framework as design guide for higher education buildings in Bauchi Nigeria.

Null Hypothesis:

H_0: A design framework to assess energy efficiency of higher education building in Bauchi Nigeria would not be an effective tool in the creation of sustainable buildings.

Alternative Hypothesis:

H_1: A design framework to assess energy efficiency of higher education building in Bauchi Nigeria would be an effective tool in the creation of sustainable buildings.

The T test is a type of inferential statistics used to determine whether there is a difference between the means of two groups which are most at times related with certain features. It is one of the many test used for hypothesis testing. Having the t as the calculated t-statistics from the data. The df gives the degree of difference between the Means of the two observed population. The t-test used the responses gotten from the architects with a total of 40 architects from the study area and their response was used to test these hypotheses and the results are presented on Table 4.

From the T-test Table 4, the p-value (Sig (2-tailed)) has a value of 0.000. Since the p-value (0.000) is less than the level of significance (0.05), we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1) to conclude that a design guide for higher education building in Bauchi Nigeria would be an effective tool in the creation of sustainable buildings.

Table 4: T-Test

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Do you think a design guide for higher education building in Bauchi Nigeria would be an effective tool in the creation of sustainable buildings?	20.113	39	.000	3.450	3.10	3.80

Source: Authors Survey (2021)

Time, finance, available space and human resources always place constraints on any research project, forcing adjustments between coverage and level of detail. During the survey of existing higher educational buildings, the indoor air temperature and humidity of one of the five buildings selected in the study area was measured to support the understanding on thermal comfort condition in indoor spaces and presented for the purposes of analysis in this study. Table 5 shows the indoor temperature and humidity measured during the survey. Amongst information in Table 5 include the date and time measurement and the presence or absence of mechanical cooling device used in the buildings. "Yes (Y)" or "No (N)" were recorded as symbols to indicate whether windows were opened during the time of measurement or not. Similar approach was adopted to indicate whether mechanical ventilation was in use during the measurement or not.

Table 5: 500 Capacity Lecture Hall, Federal Polytechnic Bauchi

Date	Time	Average Indoor Temperature (°C)	Average Humidity (%)	Window opened during Measurement (Y/N)	Mechanical Ventilation in Use or Not during Measurement (Y/N)	Type of Mechanical Ventilation
3/1/2020-27/1/2020	13.10/16.40	35.5	23	Y	Y	FAN/AC
1/2/2020-26/1/2020	9.20/16.00	35	21	Y	Y	FAN/AC
3/2020-27/3/2020	10.10/15.30	37.8	19	Y	Y	FAN/AC
2/4/2020-25/4/2020	9.00/16.30	40	19	Y	Y	FAN/AC
4/5/2020-28/4/2020	10.20/15.20	36	17	Y	Y	FAN/AC
1/5/2020-29/5/2020	9.00/16.30	35	39	Y	Y	FAN/AC
2/6/2020-30/6/2020	10.05/17.20	35	51	Y	Y	FAN/AC
2/7/2020-30/7/2020	9.30/16.10	31.5	61	Y	N	FAN/AC
4/8/2020-29/8/2020	9.20/16.10	30.5	75	Y	N	FAN/AC
20-29/9/2020	9.10/14.10	29.5	70	Y	Y	FAN/AC
1/10/2020-28/10/2020	9.50/17.05	33	63	Y	Y	FAN/AC
2/11/2020-30/11/2020	08.40/15.40	33.5	30	Y	Y	FAN/AC
2/12/2020-30/12/2020	08.20/16.35	33	28	Y	Y	FAN/AC

Source: Authors Survey (2020)

The result of survey shows also that most of the respondents were slightly comfortable only during the morning hours of lecture periods even though the indoor temperatures were 28^0C-30^0C.

The Temperature Humidity Index according to Windchill Metrology (2010) in the United States is the combination of temperature and humidity that is a measure of the degree of discomfort experienced by an individual usually in warm weather. The index is essentially an effective temperature based on air temperature and humidity. It equals 15 plus 0.4 times the sum of simultaneous readings of the dry and wet bulb temperatures. Based on the measurement so far in the study area the dry bulb temperature is 95°F (35°C) and wet bulb is 50°F (10°C).

The discomfort index is hence calculated as 15 + 0.4(145) = 73°F

Most humans are comfortable when the index is less than 71°F. It is recommended that even if the discomfort sensation is not obvious, adequate protection measures should be taken. Hence there is an urgent need to seek cooler internal environment by sensible and passive design methods to cool the lecture spaces. All buildings surveyed rely on ceiling fan and AC for cooling. Notwithstanding the use of ACs and fans, indoor temperatures measured in all buildings during the survey were still high ranging from about 30 - 42^0C. This is due to obvious air leakages from open windows which is not

supposed to function with open fenestration. User occupant sensitisation is key even with the best design consideration followed in generating these lecture spaces. There is need for a policy framework that will guide the operationalisation of these lecture spaces

Figure 1: 500 Capacity Lecture Hall, Federal Polytechnic Bauchi
Source: Authors 2021

The lowest temperature occurred in September at 29^0C while the highest indoor temperature recorded was in the month of April at 40.5^0C. The mean indoor temperature for the building was 40.20^0C which is slightly above the average highest temperature during the hot (dry) season of about 40.10^0C (Machar, 2017). Survey results examining variables affecting thermal comfort as seen earlier in the discussion show that building occupants are not always comfortable in their buildings without mechanical cooling systems. Hence, building occupants depended largely on mechanical cooling systems which is Ceiling Fans and Air conditioning systems. It is also worthy to note that effort through achieving a good energy performing building which will ensure comfort for the occupant and reduce energy consumption which is also a scarce resource in Nigeria as a whole cannot be overemphasized as these mechanical systems are prone to breakdown and most of the time vandalism hence the need for a passive approach to designing of these facilities.

Observational Survey:

The observational survey of the existing buildings was carried out bearing in mind the following; building elements and landscaping which is to ascertain what is required in design, material specification and the approach to the construction of higher educational buildings in Bauchi Nigeria in order to provide data for the production of the proposed framework. The building elements observed were the floor, external wall, windows, ceiling and roof.

The result of the survey of the building in terms of landscaping, window types, floor materials seems to point to the need for massive advocacy for proper landscaping around buildings, as this is relevant to achieving thermal comfort and increasing the energy performance of higher educational buildings. Appropriate window sizes and ceiling materials deployed in this building will also go a long way in achieving a good energy performing building. Most professionals in the built environment and architects in the study area supported this view.

Findings:

From the analysis so far, the lowest annual average operative temperature for case study is 29.5^0C. The study of the selected buildings exposed that there are no substantial differences between them in terms of thermal comfort. The annual operative temperature for the case studies shown above affirms this. The measurement of climatic data established the level of thermal discomfort in buildings leading to overdependence on mechanical cooling systems, especially ceiling fans and Air Conditioners. The mean indoor temperature for the building was 35.90^0C. The results of the analysis of case studies have confirmed thermal discomfort in buildings, the need to improve comfort level in Higher Educational buildings and reduce energy demand due to too much reliance on mechanical cooling systems. There were no thoughtful decisions during design on building orientation based on passive design strategies. Consequently, this research investigation confirms the assertions above on the low level of knowledge and information in Nigeria.

By implication this proposes that the built environment professionals are not likely to apply the most appropriate features for the production of sustainable buildings. A key basis of buildings' orientation by design professionals were based on the availability of space within the department of interest were building will be constructed and major access road to the facility as most buildings were designed to face the major access road. Solar radiation has been observed to be an important parameter in determining the cooling load in a building. All the buildings depend on mechanical cooling systems for thermal comfort. The study also shows that building retrofits can be conducted not just for reducing energy consumption by HVAC and lighting systems but to improve thermal comfort within buildings and can be done affordably to benefit institutional buildings whom are not so much a revenue generating agency hence the need for low cost intervention for maintenance of its structures. All higher educational buildings in the study area lack adequate landscaping to enhance cooling of interior spaces which will allow the building to perform better in term of energy consumption for cooling. This brings to fore a massive necessity for proper landscaping around buildings to aid thermal comfort. The observation of the building envelope calls for improvement in design, material selection and construction approach to improve energy consumption and downsize energy demand. Some areas of concern include choice of paint finish, choice of roofing materials, geometry of roofing structure to aid hot air exit from buildings, window and glazing type, shading devices and other wall finishes

Passive cooling in buildings is another means of making our buildings sustainable. It can be said to be removal/restriction of heat from/to the building environment by using the natural process of rejecting heat in the ambient atmosphere by convection, evaporation, and radiation or the adjacent earth by conduction and convection which is cheaper to execute. Cool outdoor air properly harnessed through conscious design efforts, can be effective in cooling buildings in the tropics with little need for mechanical cooling. Cooling through convection by surrounding air, which serves as a heat sink has been used to achieve comfort condition indoors in hot humid locations. Architects and planners should endeavour to apply passive design strategies at the design stage, to increase building performance and encourage sustainability in new construction. Self-regulating policies by the government, to include sustainable building retrofit option for adaptation in existing buildings to the changing climate conditions. Natural ventilation requires a driving force, and sufficient number of window openings to produce air flow (Harvey, 2008). Wind is the driving force for passive cooling. Hence, the building orientation should take advantage of the prevailing winds to achieve cooling.

Solar shading is a significant approach in developing countries because it is cost effective and easy to implement (Kamal, 2011). Shading of buildings and outdoor spaces can lower temperatures during hot periods, improves comfort and save energy by blocking up to 90% of the heat generated by direct sun from heating the surface of buildings. Shading devices such as overhangs on roofs and windows, awnings, louvers shutters, pergolas, proper length of shading all devices which can be part of the building or placed close to the building, can serve as efficient means of achieving passive cooling. A proper site analysis will aid the placement of shading devices to minimise heat gain and storage.

5. CONCLUSION

This study investigated the use of sustainable design in reducing the total energy consumption in higher educational buildings in Bauchi Nigeria. It was discovered that most buildings pervading the built environment lack the basic facilities to make them self-sufficient in the conservation of energy for heating/cooling/lighting/ventilation which was ascertained from response gotten from the questionnaires. Building retrofits can be conducted as seen not just for reducing energy consumption by HVAC and lighting systems but to improve thermal comfort within lecture spaces and can be done in a low cost form to the government who are the major owners of these institutions. There are two important ways we can approach the efficient use of energy, the first one is the technological approach while the second is the behavioural approach which can only be achieved by having adequate information on best practices in conserving energy in running of buildings. There is urgent need for policy makers to invest into energy awareness creation on energy efficient buildings stating the importance in terms of environmental, economic and social factors

Architects and planners should ensure they apply passive design strategies at the design stage, to improve building performance and promote sustainability in new construction. Independent policies should be added to the Building Code for Nigeria by the government, to include building retrofit as an option for adapting existing buildings to the changing climate. Significant development has been made in the area of Energy Balancing of buildings using the principles of Building Physics which will serve as a guide to draft policy in future energy regulations documents.

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CRITICAL SUCCESS FACTORS ASSOCIATED WITH TOTAL QUALITY MANAGEMENT (TQM) IMPLEMENTATION FOR CONSTRUCTION PROJECTS IN NIGERIA

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ABSTRACT

Purpose: The study identified critical success factors associated with TQM implementation for construction projects in south-south Nigeria and explored their underlying factors by categorising the critical success factors using principal component analysis (PCA)
Design/Methodology: Anchored on quantitative questionnaire survey approach, 91 copies of the structured questionnaire were distributed while 50 valid responses were retrieved giving a response rate of 55%. Data were analysed using descriptive statistics, Mann-Whitney U-test, and principal component analysis.
Findings: Findings revealed that customer satisfaction, top management commitment to quality processes, benchmarking, maintaining quality culture and design quality management were ranked top five (5) CSFs associated with TQM implementation for construction projects by respondents in the study while factor analysis conducted produced 7 components. The hypothesis postulated for the study was accepted because the p-value was greater than 0.05 which meant that there was no significant difference in the perception of respondents on the CSFs associated with TQM implementation practices between Akwa Ibom and Rivers States.
Research Implications: It was recommended among others that, construction companies as well as stakeholders should take strategic measures in ensuring that customer satisfaction, top management participation and commitment to quality process and maintaining quality culture were given priority as they were the key CSFs for implementing TQM practices.
Original Value: The study produced a model of critical success factors which was the first in the south-south geopolitical zone of Nigeria.
Keywords: Success factors, quality management, factor analysis, Nigeria.

1. INTRODUCTION

Globalisation of market economies has triggered the need for all corporations in all sectors to concentrate on maintaining a sustainable competitive edge which is directly related to the upkeep of quality both in terms of services and productivity. This is only possible if an organisation engages in operations that are able to effectively compete in the market (Kothari, 2004). Market today is characterised by stiffening competitive

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nature and ever changing customer expectations and demand. An organisation must come up with unique competitive strategies and produce goods and services that continuously meet and exceed these demands and expectations (Salaheldin, 2009). Along with quality, cost, delivery, and flexibility, customer focus is another competitive priority to adapt filling operation strategies proactively in changing environments (Nair and Boulton, 2008).

Successful businesses today ensure that customer satisfaction is of primary focus. This has resulted to the exercise of value creation. Therefore, with the concept of value, customer value has become a source of sustainable competitiveness and companies here adopted different platforms for value creation such as: mass production, streamlined supplier networks, value in design, lean construction/ production, six sigma and Total Quality Management (TQM). TQM is one of the management approaches used to achieve continuous coordination of efforts directed at improving customer satisfaction, increasing employee participation, strengthening supplier partnerships, and facilitating an organisational atmosphere of continuous quality improvement.

According to Arditi and Murat (1997), management commitment to quality and continuous quality improvement is very important concept in construction industry as professionals are well aware of the importance of quality training. Most companies try to satisfy their customer's needs and expectations by improving product quality, increased customer satisfaction and continued improvement towards world class organisations. These challenges have forced companies around the globe to change their old traditional quality systems and implement new quality approaches to deliver high quality goods and services. Although methods to improve and manage quality are numerous, it can be said that TQM has become one of the most successful practices in helping companies enhance competitiveness and prosperity through ensuring sustainability growth (Osayawe and McAndrew,2005).

However, in developing a total quality culture in construction, one important step is to develop a construction team of a main contractor, subcontractors, and suppliers who would commit to the quality process and develop a true quality attitude (Kasongo and Moono, 2010). Therefore, firms have adopted various managerial approaches to cope with any current or future challenges and some organisations have adopted TQM as one of the managerial and organisational methods to achieve long term profitability, sustainability and competitiveness (Bani and Loiy, 2012). TQM implementation in the construction industry gained government attention in different countries such as the United Kingdom and United States. Several reports including Latham Report (1994) and Egan Report (1998) were published to help construction companies to implement TQM and tackle controversial issues facing the industry. These reports have emphasised the attitudes of quality in a company as demonstrated by partnering, team building and employee empowerment. Although, this has been a good start, there are still barriers to the successful implementation of TQM in construction industry. Construction companies are adopting TQM to improve their performance but they still lag behind other industries in the implementation of TQM and one of the main reasons is their inability to determine customer requirements accurately in terms of critical success factors and transform this knowledge into a complete practical reality.

The issue of quality has become of great importance especially with the ever growing concerns and demands from various players in the market (Kothari, 2004). These demands arise due to the increased number of reported quality issues like the frequent collapse of structures leading to injuries and death. In Nigeria, for instance, a number of buildings have been reported to have collapsed due to quality issues, like poor

supervision, poor quality materials, poor construction procedures and poor inspection (Adenuga, 2013). To respond to these failures, most organisations and even the government have resorted to adopt and implement operations management strategies that have been seen to work elsewhere in as much as quality management is concerned. Due to the importance of construction industry in the Nigerian economy and the highly competitive environment in the construction sector, firms are required to adopt TQM approach in order to compete locally and globally by improving their quality system to facilitate and increase their market share and client relation. Thus, the construction sector has to be developed in different areas starting with adoption of a formal quality approach, having a clear understanding of TQM approaches and key business processes, employee training and observation and performance measurements (Dahlgaard, Kristensen, Kanji and Gopal, 1992).

While most studies on TQM have focused on the manufacturing industry, a vital construction sector that contributes more than 16% to the nation's GDP and which is adjudged to be the largest employer of labour in Nigeria has been largely ignored. In Nigeria, most studies are on implementation of quality culture (Bello, Soyingbe and Akinwanide, 2012), factors affecting Quality (Adenuga, 2013) and the impact of TQM application in construction industry (Iruobe, Ojambati, and Akinpade, 2012). The study in this paper seeks to fill the gap by examining the critical success factors for TQM implementation as part of a two part research aimed at examining TQM practices for construction projects in south-south Nigeria.

1.1. Objectives of the Study

Given the background above, the specific objectives are to:

i. Identify critical success factors associated with TQM implementation for construction projects in the study area.

ii. Categorise the critical success factors (CSFs) associated with TQM implementation for construction projects using principal component analysis (PCA).

The outcome of the study is expected to create awareness on the critical success factors associated with TQM implementation, thereby enabling the stakeholders and construction companies to pay close attention to these factors so as to enhance elimination of rework and promote defect-free projects.

2. LITERATURE REVIEW

2.1. Concept of Total Quality Management

TQM is an integrated process involving both management and employees with the ultimate goal of managing the design, development, production, transfer and use of the various types of products and services in both the environment and market place (Johnson, 1987). It is also a continuous improvement approach to doing business through a new management model. The TQM philosophy evolved from the continuous improvement philosophy with a focus on quality as the main dimension of business. Emphasizing the quality of product or service is predominating under TQM. It expands beyond statistical process control to embrace a wider scope of management activities of how we manage people and organisations by focusing on the entire process. According to Oakland and Marosszeky, (2006), TQM is a comprehensive management system which;

- Focuses on meeting owners'/customers' need by providing quality services at a cost that provides value to the owners/customers.
- Is driven by the quest for continuous improvement in all operations
- Recognizes that everyone in the organisation has owners/customers who are either internal or external.
- Views an organisation as an internal system with a common aim rather than as individual departments acting to maximize their own performance.
- Focuses on the way tasks are accomplished rather than simply what tasks are accomplished.
- Emphasizes teamwork and a high level of participation by all employees.

In the construction industry, TQM is one of the approaches that contribute towards ensuring that projects are being delivered to the stakeholder requirements. According to Faroogui, Masood and Aziz (2008), construction sector globally is considered to be a basic industry on which the development of a country depends. To a great extent, the growth of a country and its development status is generally determined by the quality of its infrastructure development and construction projects. Quality is contained in the tripod of construction management and it does not only impact appearance and durability but also the performance of a project (Jackson 2004).

According to Peter (2001) TQM of a project is the accomplishment of project through the application and integration of the TQM process of initiation, planning, execution, monitoring, controlling and closing. It integrates these functions progressively through the project life cycle with the aim of achieving the desired project performance and to satisfy the stakeholders.

2.2. Critical Success Factors Associated with Implementation of TQM

Saraph et al. (1989) defines critical success factors for TQM as critical area of managerial planning and action that must be practiced to adhere to effective quality management in business enterprise. The construction industry has lagged behind other industries in implementing reform through total quality management. It has not followed manufacturing industry in the implementation of TQM. The success of TQM philosophy in manufacturing and other industries is forcing construction organisations to adopt TQM. Below are the 10 critical success factors of TQM for construction industry.

Top Management Commitment: Research suggests that most quality tools associated with TQM do not generally produce an advantage, but a certain behavioural feature such as executive commitment can produce an advantage. Many a time TQM initiatives have failed to fulfil their potentials due to lack of senior management commitment to the quality process. Thus, for TQM, commitment by the management is essential. Without it, there is no need to proceed further (Jaafreh et al., 2013).

Quality Culture: The factor like use of information for improvement, authority equal to responsibility. Job security, climate of fairness, compensation based on equality, teamwork, collaboration, learning and involvement, ownership, and development from an organisational culture, which then tends to increase in productivity, quality and customer and employee satisfaction. Failure of the TQM is attributed to a lack of developing and sustaining a quality oriented culture and mismatch of organisational culture. In a sense, TQM fundamentally requires a new culture. In the construction industry, company culture and project culture both co-exist and need integration (Saraph et al., 1989).

Strategic quality management: Strategic quality management concepts must be put into practice by the inclusion of quality objectives in the strategic planning process and through strategic planning frameworks, like Quality Function Deployment (QFD), which provide specific instructions for approaching, executing and evaluating the development of strategic concepts. Internal issues develop a long-term road-map with the incorporation of core competencies concepts and emphasize the adoption of new technologies. External issues are the response of the organisation to the economic swings in the industry, the impact of new market opportunities or existing business practices and protection against competitors (Prayugo and Sohal, 2006).

Design Quality Management: Superior designs result in distinct competitive capabilities such as fast delivery and flexibility. In construction projects, new designs are thoroughly reviewed before construction and experimental design is used extensively in structure design. Clarity of specifications and avoidance of frequent redesign is emphasized. Detailed design, schedule and cost estimate, design evaluations, constructability in design, control of design activity are part of design quality management. Thus, good design quality management results in an excellent quality of core service that positively influences customer's perceptions of quality and an important aspect of TQM (Gadenne and Sharma, 2009).

Process Management: This focuses on managing the construction process so that it operates as expected, without breakdowns, shortage/missing materials and tools (Black and Porter, 1996). It is needed to reduce rework and waste due to mis-specification of processing parameters. This provides clarity of ownership and less reliance on inspection. In the context of construction, specific activities like planning the sequence of field tasks, analysis of layout, access, temporary facilities, innovative use of construction equipment and tools and the use of pre-assembly or pre-fabrication items are carried out. Also, constructability is included in the contract document. Pre-work, demobilization and execution are part of process management (Juran, 1998).

Supplier Quality Management: Supplier quality management includes fewer dependable contractors, enhance on suppliers' process control, storing inter dependence of supplier and customer, purchasing policy, emphasizing quality rather than price, supplier quality control and supplier assistance in quality development. Materials are often a major source of quality problems and affect buyer satisfaction. Instead of relying on tools such as acceptance sampling to establish the quality of incoming materials and component parts, it is preferable for constructors to purchase from a move limited number of qualified or certified suppliers (Powel, 1995).

Education and Training: Education and training forces employees to not only possess the adequate knowledge and skills to perform the jobs, but also to possess specific values, knowledge, and skills associated with TQM issues of appropriate training and inadequate knowledge. Thus, employees will be motivated to engage in quality-oriented behaviour when their roles and the relevance of their training to overall quality goals are clarified (Saraph, 1989).

Empowerment and Involvement: Empowerment and involvement enhances the individual self-esteem and improves his/her ability to solve problems and to make low-risk decisions. Workers motivation, responsibility, and accountability are generic concepts that can benefit any business organisation. The causes of ongoing quality problems like lack of team work, conflict and lack of worker involvement are overcome by personally participating in quality improvement activities, which leads to the success of TQM (Garvin, 1998).

Information and Analysis: Information and analysis consist of evaluation for various policies and strategies, quality audit, analysis of quality costs, department/function performance evaluation, and employee and supplier performance evaluation. If there is inferior dissemination of the generated information, quality techniques like benchmarking tool will be rendered ineffective. To maintain a true customer focus, an organisation must ensure prompt feedback of customer survey results to appropriate functional areas for effective actions (Saraph, 1989).

Customer Satisfaction: A construction organisation may outperform the competition by being able to anticipate and respond quickly to customers' demands with new ideas and technologies and to produce constructed facilities that satisfy or exceed customers' expectations. Despite the use of the latest process improvement techniques and capable management, a firm's neglect of its customers may lead to disaster. It is argued that without customer focus, the TQM programme will lack the foundations on which to build further (Barkley and Saylor, 1994).

Other critical success factors identified from the literature include benchmarking, business result, impact on society and environment, resources, and statistical process control Saraph (1989) and Oakland (1993).

3. RESEARCH METHODOLOGY

3.1. Research Design

This study adopted quantitative survey design and exploratory approach. It focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon. It will involve the use of structured questionnaire to illicit response from target respondents.

3.2. Area of the Study

The areas of study are Akwa Ibom and Rivers states. Uyo became the capital of the Akwa Ibom state on September 23, 1987 following the creation of Akwa Ibom State from erstwhile Cross River State. Akwa Ibom State has a population of 3,920,208according to the 2006 census and is largely a civil service state. Akwa Ibom is one the states that make up the Niger Delta region in Nigeria. Port Harcourt is the capital of Rivers State and has an estimated population of 5,185,400 inhabitants according to 2006 census. It is the largest city in the Niger Delta and oil capital of Nigeria as major international oil services and exploration companies are located in that city. The two states share large portion of massive construction activities carried out by state government, federal government, Niger delta development commission (NDDC) and some private sectors in the south-south geopolitical zone of Nigeria on account of increased allocation coming into the two states.

3.3. Population and sample

Population is the collection of all items which may include people or objects or of events that are to be considered in a given problem situation (Udofia, 2011). The population for this study included all the construction companies both indigenous and multinational in the two states, Akwa Ibom and Rivers state. Target respondents who are representatives of the contractors included project managers, site supervisors, and quality control managers. Efforts were made to ensure that only those who have specific knowledge of how their companies handled issues of quality management especially with regards to TQM practices for their projects were used for the study.

The formula provided by Yamane (1967) was used to generate the sample size as follows:

$$n = \frac{N}{1 + N(e)^2} \qquad Equation\ (1)$$

Where n = sample size, N = Population size, e = level of precision = 0.05 at 95% confidence level.

The formula was adopted because it takes care of the confidence level as well as the level of precision required to accommodate the probable sample error. For instance, it enables the researcher measure the compliance level of TQM practices in order to be 95% confident that the probable error of using a sample rather than the entire population will not exceed 5%. Tables 1 shows how the formula was applied to generate the sample size for the study.

Table 1: Sample frame of construction companies used for the study

State	Sample frame	Sample	Valid response
Akwa Ibom	46	41	27
Rivers	57	50	23
Total	103	91	50

Sampling technique has two major types; the random or probability sampling technique and the non-probability sampling technique. Probability sampling refers to all forms of sampling in which the items sampled are selected according to some known laws of chance such that every item in the population has a known chance (equal or unequal) of being selected (Saunders et al., 2009). This study adopted stratified random sampling, simple random sampling and purposive sampling techniques. Stratified random sampling divides the population into series of relevant strata in such a way that each of the strata is represented proportionally within the sample. The stratified random sampling was used to divide the construction companies into Akwa Ibom and Rivers states while simple random sampling was used to select sample of construction companies from each state.

3.4. Data Collection and analysis

Data for the study were collected mainly through a structured questionnaire. The questionnaire was divided into two parts. Section A captured the respondents' demographic data (company category, educational qualification, job description, working experience and company location). Section B contained structured questions on critical success factors associated with TQM implementation while respondents were asked to rate their levels of agreement with the 15 factors using a scale of 1=strongly disagree, 2=disagree, 3=moderate, 4=agree and 5=strongly agree. Responses of the respondents from the questionnaires were gathered, coded and processed using the SPSS (Statistical Package for Social Sciences) software. Data collected were analysed using descriptive statistics and principal component analysis.

4. PRESENTATTION AND DISCUSSION OF RESULTS

4.1. Personal Information

The frequency tables for personal data are displayed in the Tables 2, 3, 4, 5 and 6. For category of company, 26 of the respondents were from contracting companies, 21 were consultants and 3 were clients. In terms of Academic qualification, it can be seen

that none of the respondents was below HND/BSC and this shows how reliable this information is. Majority of the respondents are Engineers (19), followed by Builders (13), then Quantity surveyors (8), Architects (6), Estate managers (2) and Quality managers (2). Under working experience, only 9 of the respondents were within '0-5yrs' category, the rest have been in the business for 6 years and above. 27 of the respondents were in Akwa Ibom state while 23 of them were in River state.

Table 2: Category of company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Contractor	26	52.0	52.0	52.0
	Consultant	21	42.0	42.0	94.0
	Client	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

Table 3: Academic Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NCE/ND	0	0.0	0.0	0.0
	HND/BSC	31	62.0	62.0	62.0
	MSC	18	36.0	36.0	98.0
	PhD	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Table 4: Job description

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Architect	6	12.0	12.0	12.0
	Builder	19	38.0	38.0	50.0
	Estate Manager	3	6.0	6.0	56.0
	Quantity Surveyor	8	16.0	16.0	72.0
	Engineer	11	22.0	22.0	94.0
	Others	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

Table 5: Working experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5yrs	16	32.0	32.0	32.0
	6-10yrs	18	380	38.0	70.0
	11-15yrs	10	20.0	20.0	90.0
	16-20yrs	5	10.0	10.0	100.0
	Total	50	100.0	100.0	

Table 6: Location of company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Akwa Ibom State	27	54.0	54.0	54.0
	Rivers State	23	460	46.0	70.0
	Total	50	100.0	100.0	

4.2. Critical Success Factors Associated with TQM Implementation

The objective two of this study was achieved by rating the 15 CSFs derived in the literature review by the respondents who are construction experts. They were specifically asked to rate the level to which the CSFs are associated with TQM implementation using scale of 1 = strongly disagree, 2 = disagree, 3 = moderate, 4 = agree, 5 = strongly agree. Result of the analysis is shown in Table 7.

Table 7: *Mean scores and ranking of Critical Success Factors for TQM*

S/N	CRITICALSUCCESS FACTORS	AKWAIBOM		RIVERS		COMBINED	
		Mean	Rank	Mean	Rank	Mean	Rank
1	Customer satisfaction.	4.00	2	4.17	1	4.08	1
2	Top management commitment to the quality process.	4.07	1	3.96	3	3.96	2
3	Benchmarking	4.00	2	3.74	10	3.88	3
4	Maintaining quality culture.	3.96	4	3.78	8	3.88	3
5	Design quality management.	3.78	7	3.96	3	3.86	5
6	Information and analysis.	3.74	9	4.00	2	3.86	5
7	Resources	3.70	12	3.96	3	3.82	7
8	Statistical process control	3.85	6	3.74	10	3.80	8
9	Business result	3.93	5	3.61	15	3.78	9
10	Empowerment and involvement.	3.70	12	3.83	6	3.76	10
11	Impact on society and environment	3.70	12	3.83	6	3.76	10
12	Education and training.	3.74	9	3.74	10	3.74	12
13	Strategic quality management.	3.78	7	3.70	14	3.74	12
14	Supplier quality management.	3.59	14	3.78	8	3.68	14
15	Process management.	3.56	15	3.74	10	3.64	15

The result in Table 7 shows that the five top CSFs associated with TQM implementation were "customer satisfaction" (mean =4.08), "top management commitment to quality process" (3.96), "benchmarking" (mean = 3.88),"maintaining quality culture" (mean = 3.88) and "design quality management" (mean = 3.86). However, the three least rated CSFs by respondents were "process management" at 15th(mean = 3.64), "supplier quality management" at 14th (mean = 3.68), and "strategic quality management" at 13th(mean = 3.74).

Testing of Hypothesis

In order to the level of similarity of opinion of respondents across the two states used for the survey, a hypothesis was postulated to guide the study. It states that there is no significant difference in the perception of respondents on the CSFs associated with TQM implementation practices in the study area. Mann Whitney U test was used to test the hypothesis. It is a non-parametric tool used to compare means for two independent groups and to find out if the distribution of an independent variable is the same for the two groups and therefore from the same population. The decision rule is that the null hypothesis is accepted for all p-values greater than 0.05 (5% level of significant difference), otherwise the hypothesis is rejected and the alternative hypothesis accepted**.** The results of analysis are presented in Tables 8 and 9.

Table 8: Mean Ranks result from Mann Whitney test analysis

	Study Areas	N	Mean Rank	Sum of Ranks
Perception of respondents on CSFs associated with TQM practices	Akwa Ibom State	15	15.77	236.50
	Rivers State	15	15.23	228.50
	Total	**30**		

Table 9: Mann Whitney U test statistics result

	Perception of respondents on CSFs associated with TQM practices
Mann-Whitney U	108.500
Wilcoxon W	228.500
Z	-.168
Asymp. Sig. (2-tailed)	.866
Exact Sig. [2*(1-tailed Sig.)]	.870

The result indicates that Mann-Whitney U is 108.5 while p-value is 0.866 (p>0.05). The hypothesis is therefore accepted because the p-value is greater than 0.05. This means that there is no significant difference in the perception of respondents on the CSFs associated with TQM implementation practices between Akwa Ibom and Rivers States.

4.3. Categorisation of CSFs Associated with TQM Practices

Factor analysis by PCA was used to explore the hidden relationships among the critical success factors using Varimax rotation. Factor extraction determines the factors through principal component analysis; while at the second stage, factor rotation eliminates medium loadings by maximizing the number of high and low loadings to make factor interpretation more accurate (Udofia, 2011).

Kaiser-Meyer-Olkin (KMO) measures sampling adequacy and Bartlett's test of sphericity is used to test for the appropriateness of the sample from the population and

the suitability of factor analysis. The result in Table 10 shows a chi-square of 119.474 and a significant level of 0.008, which is an indication that the sample is adequate. KMO is also an index for comparing magnitudes of the observed correlation coefficients of all pairs of variables. It is small when compared to the sum of square correlation coefficient. A KMO value of 1 represents a perfectly adequate sample. A KMO value of 0 represents a perfectly inadequate sample. The KMO value in Table 4.12 is 0.609, which shows that the sample is reasonably adequate.

Table 10: KMO and Bartlett's Test Result

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.609
Bartlett's Test of Sphericity	Approx. Chi-Square	119.474
	df	105
	Sig.	.008

Table 11 shows the initial Eigen value, the extracted sum of squared loading and rotation sum of squared loading presented as total variance explained. It indicates that 7 components accounted for 73.017% of total variance explained while remaining 26.983% of the variance of the variables is accounted for by extraneous factors which are unique to the variables.

Table 11: Result of variance explained by the 15 factors

	Initial Eigen values			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.634	17.557	17.557	2.634	17.557	17.557
2	2.047	13.645	31.202	2.047	13.645	31.202
3	1.569	10.462	41.663	1.569	10.462	41.663
4	1.393	9.288	50.952	1.393	9.288	50.952
5	1.256	8.376	59.328	1.256	8.376	59.328
6	1.047	6.982	66.309	1.047	6.982	66.309
7	1.006	6.708	73.017	1.006	6.708	73.017
8	.788	5.251	78.268			
9	.712	4.749	83.017			
10	.698	4.656	87.673			
11	.600	4.000	91.673			
12	.421	2.808	94.481			
13	.372	2.480	96.961			
14	.232	1.546	98.507			
15	.224	1.493	100.000			

Tables 12 and 13 shows the rotated component matrix and factor categorisation with factor loading distribution.

Table 12: Rotated Component Matrix Varimax

	Component						
Variables used in Factor Analysis	1	2	3	4	5	6	7
TMCQP	.814						
MQC	.716						
SQM	.514						
DQM					.658		
PM			.759				
SQM			.690		.502		
E&T					.801		
E&I				.663			
I&A				.855			
CS	.614						
BM			.562				
BR		.763					
IS&E						.748	
RS							.898
SPC		.794					

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 10 iterations

Table 13: Factors categorization with loaded items and values

Factors	Items loaded	Loading values
Top management	Top management commitment to quality process	0.814
	Maintaining quality culture	0.716
	Strategic quality management	0.514
	Customer satisfaction	0.614
Process control	Statistics process control	0.794
	Business results	0.763
Process management	Process management	0.759
	Benchmarking	0.562
	Supplier quality management	0.690
Information and Employee involvement	Information and analysis	0.855
	Empowerment and involvement	0.663
Training and quality management	Education and training	0.801
	Design quality management	0.658
	Supplier quality management	0.502
Impact on environment	Impact on society and environment	0.748
Resources	Resources	0.898

Factor 1: Top management

Top management commitment to quality process 0.814
Maintaining quality culture 0.716

Strategic quality management 0.514
Customer satisfaction 0.614
Factor 2: Process control
Statistics process control 0.794
Business result 0.763
Factor 3: Process management
Process management 0.759
Benchmarking 0.562
Supplier quality management 0.690
Factor 4: Information and employee involvement
Information and analysis 0.855
Empowerment and involvement 0.663
Factor 5: Training and quality management
Education and training 0.801
Design quality management 0.658
Supplier quality management 0.502
Factor 6: Impact on environment
Impact on society and environment 0.748
Factor 7: Resources
Resources 0.898

Result in Table 13 indicates that 'Resources' loaded the most with 0.898 although categorized under factor 7 which has the lowest percentage variance compared to the first 6 factors. Judging from the rotation sums of squared loading, the relative importance of the 7 factors is equalized, the management of construction companies in south-south zone of Nigeria should ensure that top management are committed to quality process, quality culture are maintained by making sure the that the right resources are used for production processes, the right information is accessed at the right time and proper education and training of employees to achieve quality production void of defects at first attempt.

4.4. Discussion of Findings

Findings reveal that customer satisfaction, top management commitment to quality process, maintaining quality culture and benchmarking has the most ranked CSFs for the two states. For individual state, top management commitment to quality process, customer satisfaction and benchmarking ranked top three CSFs for Akwa Ibom state while customer satisfaction, information and analysis, and top management commitment to quality were ranked top three CSFs for Rivers state. This is consistent with the finding of Saraph (1989) that CSFs of TQM practices are critical areas of managerial planning and action that must be practiced to adhere to effective quality management in business unit. This also shows that managements in construction companies in south-south Nigeria is committed to implementing TQM practices and as such, they encourage the employees on the steps to effectively practice TQM.

The findings revealed that 7 components accounted for 73.017% of the total variance explained while the remaining 26.983% was accounted for by extraneous factor. Varimax rotation was employed which converged in 10 iterations. A total of seven (7) factors were extracted which were grouped and summarized. Factor 1 (Top management) has four items loaded in it. The loadings are; top management commitment to quality process, maintaining quality culture, strategic quality management customer satisfaction with loading values of 0.814, 0.716, 0.514, and 0.614 respectively. Factor 2 (Process

control) has two items loaded on it which are; statistical process control with loading values of 0.794 and business results with loading value of 0.763. Three items were loaded on factor 3(Process management) which includes process management (0.759), benchmarking (0.562) and supplier quality management (0.690). Factor 4 (Information and Employee involvement) has two items loaded namely; information and analysis (0.855) and empowerment and involvement (0.663). Three items loaded on factor 5 (Training and Quality management) were education and training (0.801), design quality management (0.658) and supplier quality management (0.502). Only one item was loaded on factor 6 and factor 7 (Impact on environment and Resources) which are impact on society and environment (0.748) and resources (0.898) respectively. Findings also show that resources, information and analysis, top management commitment to quality process, and education and training were highest loaded items individually irrespective of the factors grouping, with loading values of 0.898, 0.855, 0.814 and 0.801 respectively.

5. CONCLUSION AND RECOMMENDATIONS

The study investigated CSFs associated with TQM implementation; explore the underlying relationships within the factors using factor analysis. Findings reveal that customer satisfaction, top management commitment to quality process, benchmarking, maintaining quality culture and design quality management were ranked top five CSFs associated with TQM implementation for construction projects by respondents. It was therefore concluded that construction companies in south-south, Nigeria, need a lot of improvement in their practices towards TQM in order to enhance their quality standards to meet and align with ISO 9000 series of TQM practices.

From the study, it was evident that customer satisfaction, top management commitment to quality process, and maintaining quality culture were the top critical success factors in implementation of TQM practices for construction companies as responded by the respondents. This study therefore recommends that construction companies as well as stakeholders should take strategic measures in ensuring that customer satisfaction, top management participation and commitment to quality process and maintaining quality culture are given priority as they are the key CSFs for implementing TQM practices. This study further recommends that top managements should commit themselves in providing leadership and key resources needed in quality management. Organisations should train their employees on TQM practices regularly and at all levels in the organisations so as to enhance knowledge of TQM Practices. Quality managers and project managers should develop appropriate, effective and flexible communication systems that allow free flow of quality information at all levels in the organisation.

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STRENGTH PERFORMANCE OF CONCRETE MADE WITH AGGREGATES MINED FROM IBIONO IBOM, AKWA IBOM STATE

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ABSTRACT

Purpose: This paper assesses the suitability of aggregate obtained from Use Ikot Amama and AfahaItiat both in Ibiono Ibom Local Government Area of Akwa Ibom State for concrete production. The paper also compared the evaluated engineering properties of these gravels with conventional granite from Akamkpa in Cross River State.
Design/methodology/approach: The study examined three samples of aggregates; two unwashed gravels from Use Ikot Amama and AfahaItiat both in Ibiono Ibom Local Government Area and crushed granite from Akamkpa in Cross River State. Concrete mix 1:2:4 with water to cement ratio of 0.55 was adopted and the specimens prepared tested up to curing age of 28 days. Particle size analysis, aggregate crushing value and Aggregate impact, water absorption, compressive strength and flexural strength tests were conducted on the concrete cube specimens. Concrete cube of 150mm were cast for each test and three specimens in each case were tested up to 28 days.
Findings: The results indicated the mean compressive strength of 24.07N/mm² for AfahaItiat follow by 19.56N/mm² for Use Ikot Amama compared to the crushed granite which gave 26.96N/mm² at 28days. It furthers indicated that AfahaItiat gravel has the highest Impact value while Use Ikot Amama had the highest crushing value.
Research limitations/Implications: The challenge facing the usages of these aggregates is adequate strength characterization.
Practical implications: The result of the study revealed that the minimum compressive strength from both Use Ikot Amama and AfahaItiat were greater the minimum limit of 17 N/mm² specified by ASTM 330 for lightweight concrete at 28days.
Originality/value: The study concluded that gravels obtain from AfahaItiat performed better and suitable for structural normal weight concrete applications.

Keywords: Gravels, Strength, Concrete, Coarse Aggregates

1. INTRODUCTION

Concrete is a composite material which is made up of cement, fine aggregate, coarse aggregate and water. The quality of concrete is influenced among others by the choice of coarse aggregate used in its production (Olajunoke and Lasisi, 2014). Aggregates occupies about 60-70% of total volume of concrete mix and add to the improvement of

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the concrete such as, workability of a fresh concrete, controls shrinkage, prevent cracks, stabilize the volume and minimise void (Alexander and Mindes, 2005; Bamigboye, et al., 2016a).

Economically, the material constituents' cost of concrete is highly influenced by the cost of the aggregates (Bamigboye, et al., 2016b, Shi et al., 2018) and therefore, the availability of aggregates is critical to the economical sustainability of concrete. The need for locally sourced and abundantly available coarse aggregate for concrete production is essentially a promising strategy in construction cost reduction.

Naturally occurring aggregates are abundant in many parts of Nigeria, for instance its vast deposit in Ile-Ife area of Osun state, are mined and used for concrete production (Olajumoke and Lasisi, 2014), vast deposit of gravel is available in some communities of Akwa Ibom State particularly in Use Ikot Amama, AfahaItiat in Ibiono Ibom Local Govt. Area and in some communities in Ini Local Govt. Area of the State. However, gravel deposits are characterized by some geographical and climatic characteristics of the locality (Poole and Sims, 2003).

2. LITERATURE REVIEW

2.1. Overview of gravels aggregate concrete.

Several studies have been conducted on the use of gravels as coarse aggregate in concrete. Tiwari et al., (2016) estimated gravels to make up one half of the total concrete coarse aggregates used in the North America. Bamibgoye et al., (2016) exploited the economic benefits of gravel as a substitute to granite in concrete production. Their study revealed that higher composition of gravel significantly improves compressive strength of concrete. Gideon et al., (2016), assessed the strength characteristic of concrete made from locally sourced gravel aggregate from south-south Nigeria and reported that the concrete made with washed gravel has the highest compressive strength than that of unwashed gravel at 5-20mm size. Aginsm, et al., (2013) studied the strength of concrete made from three different types of coarse aggregate namely, crushed granite, washed gravel and unwashed gravel at 20mm maximum size. They proposed that concrete made from crushed granite gives the highest value followed by concrete from washed gravel and then unwashed gravel which leads to the conclusion that the strength of concrete depends on the internal structure, surface nature and shape of aggregates. Sulymon, et al., (2017) posited that the sources of gravel mostly influenced the compressive, flexural and split-tensile strength of concrete. Jimoh and Awe (2007) conducted a test on two samples mix of quarry dust with granite of 20mm maximum, gravel of 28mm aggregate sizes and sand, they concluded that the use of quarry dust and granite of 20mm maximum size combined with gravel of 28mm aggregate size and sand improved the concrete strength by 34% over the strength of concrete. Nduka et al., (2018) comparative analysis of concrete strength utilizing quarry-crushed and locally Sourced coarse aggregates recommended sieving and washing of gavel aggregates prior to usage as well as further investigation on strength enhancement.

The challenge facing the usages of some locally sourced coarse aggregate like gravel is the strength characterization, as their sourced affects their strength properties (Sulymon et al., (2017). Many studies have been conducted on the use of locally sourced gravel in concrete from different part of Nigeria, but literature is scarce on the use of gravel from Use Ikot Amama and AfahaItiat in Ibiono Ibom hence this study.

3. MATERIALS AND METHODS

The gravel (coarse aggregate) used to produce the concrete was sourced from quarry sites (unwashed) at Use Ikot Amama (U) and AfahaItiat (A) both in Ibiono Ibom Local Government Area of Akwa Ibom State in Nigeria. These locations were selected due to the deposits of these stones in abundant quantities. The conventional granite (coarse aggregate) used for comparison was obtained from Akamkpa in Cross River State. Sharp sand was used as fine aggregate. The ordinary Portland cement (Dangote brand) conforming to BS EN 197-1 specification was used as the binder. Portable tap water fit conforming to BS EN 1008 specification was used in mixing and curing of the concrete. Preliminary investigation such as particle size distribution, aggregate crushing value and aggregate impact value were conducted on the coarse aggregate samples to ascertain their conformity to relevant standards. Mix proportion of 1:2:4 with 0.55 water to cement ratio by weight was adopted. The mixture was thoroughly mixed to a concrete of uniform consistency. The wet mixture was cast in 150mm cube mould in accordance with BS 1881: Part 108 (2011) and covered with jute bag. The specimens were demoulded after 24 hours and cured in water at a temperature of 28 degree Celsius and thereafter tested for water absorption and compressive strength at ages up to 28 days as per the provision of BS 12390-3(2009) while the flexural strength was obtained empirically from its compressive strength proposed in BS 8110 (1995) $Fr = 0.60 \sqrt{F_c}$. Where F_r = modulus of rapture (Flexural Strength) at 28days in N/mm^2. F_c = cubes compressive strength at 28days in N/mm^2.

4. PRESENTATIONAND DISCUSSION OF RESULTS

4.1. Particle Size Analysis

The result for granite, Use Ikot Amama and AfahaItiat gravels are shown in the particle size distribution curve in Figure 1 showing the grading relationship between the three samples. For granite 25.3% and 73.1% passed size16mm and 4.75mm respectively. Samples from Use Ikot Amama recorded 39% and 85.3% while AfahaItiat had 2% and 81% for 16mm and 4.75mm respectively. The particle size distribution curve in Figure 1 showed that the from Use Ikot Amama were very simple to the conventional granite grading while samples from AfahaItiat deviated from the grading trend. Similarly, the coefficient of curvature (Cc) and coefficient of uniformity (Cu) results for granite, Use Ikot Amama and AfahaItiat gravel were 9 and 3, 6 and 2.8, 4 and 2 respectively, indicating that the samples are generally uniformly graded satisfying BS EN 933-1(2012).

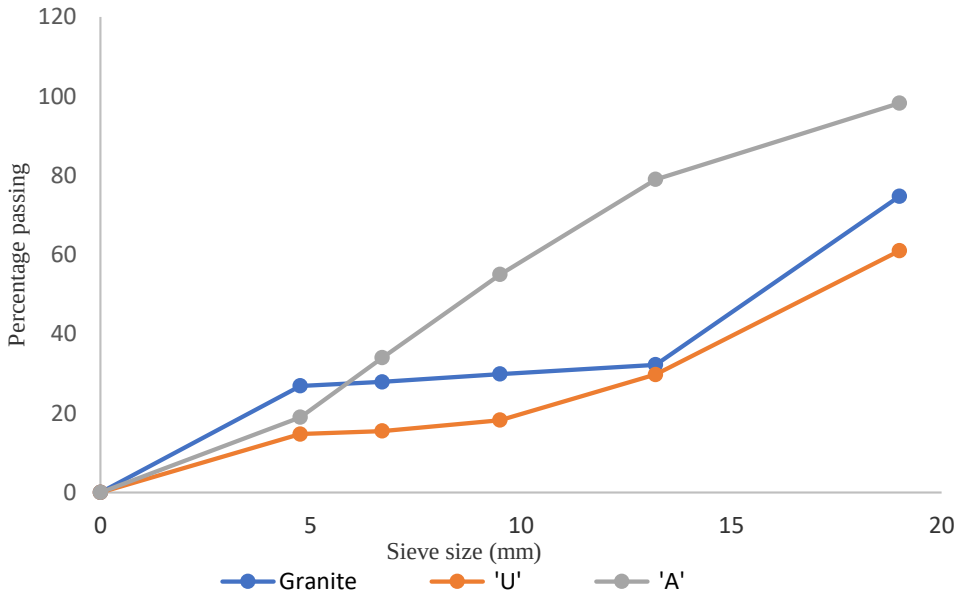

Figure 1: Particle size distribution curve

4.2. Aggregate Crushing Value (ACV)

Aggregate crushing value is expressed as a percentage of the original mass of the aggregate samples. The lower the value, the stronger the aggregate, that is greater the ability to resist crushing. From the result as shown in Figure 2, the study reveals that the ACV of samples obtained from Use Ikot Amama and AfahaItiat are within the permissible range for normal concrete, hence, they are suitable for concrete production. The value lies within maximum prescribed value of 45 % for normal concrete usage (BS 882-1992).

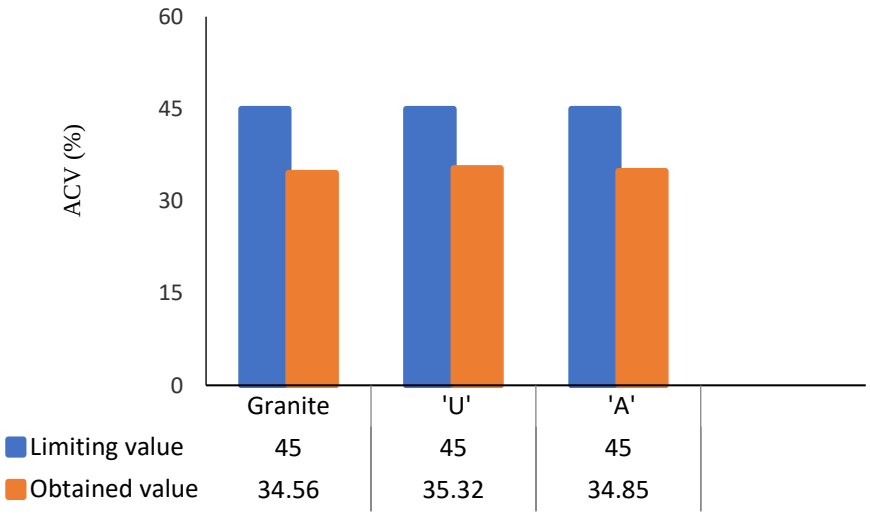

Figure 2: Aggregate crushing value chart

4.3. Aggregate Impact Value (AIV)

The Aggregate impact value obtained for all the samples passed marginal limits proposed by most standards with values less than the maximum 30% suitable for general purpose concrete works (ASTM: C33; BS 812-112) as shown in Figure 3.

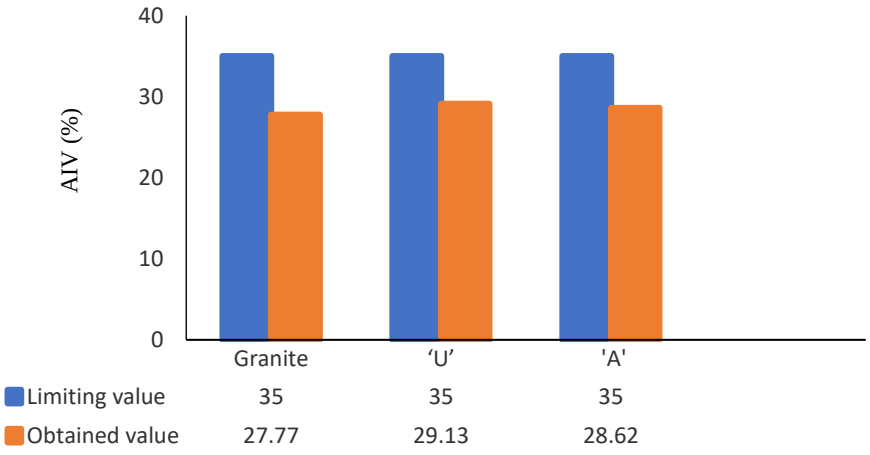

Figure 3: Aggregate impact value chart

4.4. Water Absorption

The results of mean water absorption of the concrete specimens produce with different coarse aggregates are presented in Table 1. The results indicated that Use Ikot Amama had the least percentage of water absorption while values obtained from AfahaItiat samples were very similar to conversional granite samples used as control in all curing ages. The increased water absorption observed with AfahaItiat samples are quite similar to the treads reported by Nduka et al, (2018). Generally, the values obtained were well lower than 10% proposed by Sulymon, et al, (2017) for a good concrete.

Table 1: Mean water absorption of concrete specimens

Days	Granite	'U'	'A'
7	3.03	1.27	3.73
14	5.78	2.70	5.87
28	8.05	6.33	8.46

4.5. Compressive Strength

The compression strength of the samples is shown in Figure 4. It can be observed that samples from AfahaItiat had the highest compressive strength after 28 days with 24.07 N/mm² followed by Use Ikot Amama with 19.56 N/mm². However, their respective compressive strengths are less than the control specimen's compressive strength of 26.96 N/mm² after 28 days. In all the samples the compressive strength trend increased with increase in curing age as observed by Raheem and Bamigboye (2013). since the differences is not much, it can be used in place of granite in some engineering works. The values obtained for both Use Ikot Amama and AfahaItiat samples were far greater than an average of 15.93N/mm^2 compressive strength for concrete made with unwashed gravel across southern regions in Nigeria by Nduka et al, (2018). Furthermore, these values were greater the minimum limit of 17 N/mm² specified by ASTM 330 for lightweight concrete at 28days, hence suitable for normal weight concrete applications.

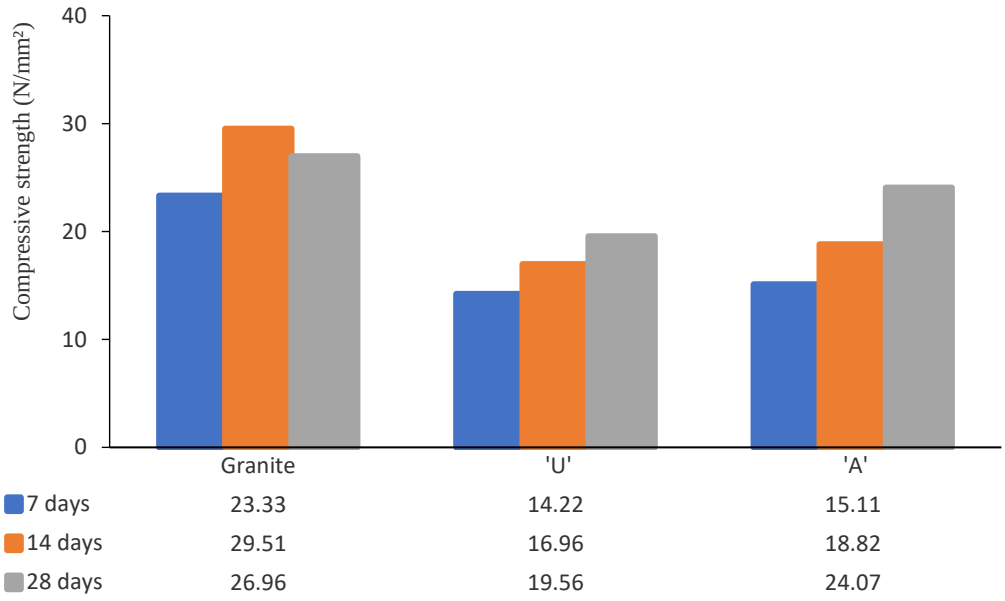

Figure 4: Compressive strength variation against the curing ages for each aggregate

4.6. Flexural Strength

The flexural strength of concrete produced with Granite, Use Ikot Amama and AfahaItiat gravel are shown in Table 2. It can be observed that the concrete with AfahaItiat gravel had a flexural strength value of 2.94 N/mm^2 at 28 days. The value obtained from Use Ikot Amama samples was 2.65 N/mm^2 just slightly lower than 2.67 N/mm^2 reported Olajunoke and Lasisi, (2014) for washed gravel. Generally, all fall within the permissible values flexural strength values reported by Sulymon, et al, (2017).

Table 2: Flexural strength of concrete at 28 days curing age

Sample	Compressive strength (N/mm^2)	Flexural strength (N/mm^2)
Granite	26.96	3.12
'U'	19.56	2.65
'A'	24.07	2.94

5. CONCLUSION

This study assessed strength performance of concrete made using unwashed gravel as coarse aggregates sourced from Use Ikot Amama and AfahaItiat, both in Ibiono Ibom Local Government Area and compared the results with the conventional granite as control. The following conclusion was drawn from the study.

- The coefficient of curvature and uniformity from the sieve analysis showed that the aggregates are generally uniformly graded.
- The study reveals that the aggregate crushing value (ACV) of samples obtained from Use Ikot Amama and AfahaItiat are within the permissible range for normal concrete, hence, they are suitable for other normal weight concrete production.
- The Aggregate impact value (AIV) obtained for all the samples passed marginal limits proposed by most standards with values less than the maximum 30% suitable for general purpose concrete works.

- The results indicated that Use Ikot Amama samples had the least percentage of water absorption while values obtained from AfahaItiat samples were very similar to conversional granite samples used as control in all curing ages. It can be observed that samples from AfahaItiat had the highest compressive strength after 28 days with 24.07 N/mm² followed by Use Ikot Amama with 19.56 N/mm². these values were greater the minimum limit of 17 N/mm² specified by ASTM 330 for lightweight concrete at 28days, hence suitable for normal weight concrete applications.
- It can be observed that the concrete made with AfahaItiat gravel had the highest flexural strength of 2.94 N/mm² after 28 days.

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FACTORS AFFECTING PRIVATE HOUSING DEVELOPMENT IN ABUJA, NIGERIA

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ABSTRACT

Purpose: Housing demand in most part of the world, especially Africa surpasses housing supply. The population is trending in geometric progression compared with arithmetic progression in housing provision. It is on this note that this study examined the factors responsible for the large gap created between demand and supply of housing.
Design/Methodology: The Both primary and secondary sources of data were utilized for the study. The study analysed 250 returned questionnaires administered to registered developers under Real Estate Developer association of Nigeria (REDAN). The information relating to interest rate on real estate financing in Nigeria was sourced from Federal Mortgage Bank of Nigeria (FMBN), Land cost and building cost per meter square were sourced directly from registered estate surveyors and quantity surveying firms respectively. The study utilized both descriptive and inferential method of analysis.
Findings: The result revealed that inadequate finance and cost of building materials were major factors affecting private housing development. Furthermore, the result of revealed that building cost/m2, land cost/m2 and interest rate on real estate finance jointly influenced variation in private housing development by 85%.
Originality/Value: The study assesses relationship between land cost (/msq), building cost (/msq) and interest on real estate finance.
Keywords: Factors, private housing, development, real estate sector.

1. INTRODUCTION

Land is a prerequisite for effective housing provisions and its accessibility is vital to sustainable housing delivery. More so, land issues for housing development are interpreted as land accessibility for housing development, as well as the nature of government intervention in the use and control of land. Land accessibility therefore entails the process of land possession for the sole purpose of immediate or future use and control. The intention of individuals seeking access to land is to have the opportunity to develop properties. In the same vein, Olaore, (1991) noted that land accessibility determines the form in which housing is offered as a commodity for consumption. In other words, land accessibility determines the extent to which housing development can take place. By implication, where there is ease of land acquisition then housing development can take place with much dexterity and vice-versa. According to Omirin (2002), Land accessibility involves land tenure security, land affordability, land availability and the ease with which land is acquired. It has been observed that access to land for housing development remains

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a huge problem most developing countries including Nigeria are being faced with today. This has subjected majority of urban residents to live in slums and squatter settlements characterized by lack of secured tenure, basic services and general poor housing conditions harmful to human, physical and economic development. Shelter has been basic need since the beginning of civilization and has been central to man's struggle (Ibrahim and Kwankur, 2012). According to Israel (2008), shelter is internationally ranked as the most basic need of man after food. However, the problem of providing adequate housing has long been a concern, not only to individuals but to the government. In most of our urban centres, the problem of housing is not only restricted to quantity but to the poor quality of available housing units. The establishment of Abuja as the Federal Capital Territory of Nigeria has led to a variety of real estate developments spanning from residential, commercial, industrial, agricultural, institutional and recreational developments. Abuja the Federal Capital Territory has witnessed an unprecedented growth both in population and infrastructure as a result of rapid influx of people not only from all over the country, but indeed all over the world. (Ibrahim and Kwankur, 2012). It is clear that the factors affecting private residential housing development in Abuja is enormous before the investors; However, the need to examine factors that affect the developers has remained an issue that requires prioritized attention.

2. LITERATURE REVIEW

Babalakin (2006) posited that the real estate sector is fraught with a number of challenges.From the legal point of view, he explained the listed government policies and planning constraints as the major issues facing real estate development in Abuja. However, Jinadu (2007) and Eleh (2010) cited lack of access to land, shortage of long term funds, development control issues, poor development of infrastructure and increasing cost of building materials as some of the challenges of housing development in Nigeria.

Housing demand in most part of the world, especially Africa surpasses housing supply. The trend in arithmetic progression in housing provision compared to the geometric progression in population growth has created a large gap that can only be solved through radical approach (Ukabam, 2007). This has led to acute shortage of adequate housing in urban centres and has continued to attract global attention in most developing countries. The regulatory aspect according to Egolum (2002) includes the use of regulatory instruments such as the Zoning and Building Regulations. Moreover, one of the most challenges facing the developers is the approval of building plans, according to Ajoku and Nubi (2009) described it as a "slow planning approval process" which has not helped matters, rather has accelerated slum formation for reasons which include high cost of approval, administrative corruption and ineffectiveness.

Egolum (2002) described Zoning as the most commonly used local instrument for regulations and direction on land use. It involves the division of municipalities into Districts (Zones) for certain uses such as residential, commercial, industrial and agricultural. Jinadu (2007) opined that it incorporates the building type permitted in an area which may include block of flats, bungalows or high – rise buildings. By implication, the use is prohibited if it does not conform to the designated use for the zone. It specifies the height of structures, minimum allowable plot size, minimum setback from the streets or property line and allowable density (low, medium and high densities) for development. Obabori, Obiuwevbi and Olomu (2007) opined that Zoning regulations featured in the official city plan but actually, thereby providing specifications that is expected to be strictly adhered. It normally specifies the uses to which property may be legally put and

the intensity of development allowed. It serves as "police power" for communities, as they adopt it as a measure for controlling urban land uses and densities including the restriction of many other uses such as developments in hazard – prone areas and to separate conflicting land uses. Although zoning has been considered effective in land uses planning and control, the effect is seen to be negative as it prevents land owners, developers and households from acting freely in the land under their control as well as burdening the public with an ill – suited development. However, for effective operation, it requires highly well trained bureaucrats and strong enforcement arm.

Building Regulations define the way new structures are to be built and the materials to be used. They ensure safety, resistance of the building to natural disasters, sanitation and aesthetics; restrictions on positioning of building on plot, setbacks, the height and depth or use of the building after erection. Jinadu (2007) noted that building regulations are generally enforced through the use of Building and Housing Codes. While Housing codes are designed to prevent overcrowding, unsanitary condition, inadequate heat and structural hazards**,** building regulations involve other control measures which include height control, setbacks, car parking standards and density control. It is unarguable that the concept of Building regulation has a positive effect on the environment and protects the inhabitants but it equally has an adverse effect on housing development as strict adherence or enforcement to these regulations often discourage developers. For instance, window opening areas which are not reasonable when considering relationship between one house and another are stipulated by the building code. Similarly, there are building codes that does not allow for modest new houses usually the narrow ones. Again, the cost at which building materials are sold significantly affects housing development in Nigeria. Ordinarily, the higher the cost of building materials and housing construction, the fewer the number of people who can afford to own houses. According to Agbola and Olatubara (2007), planning authorities specify the types of building materials to be used for housing development (for instance, mud and wood houses are not permitted in certain urban areas). This implies that developers must use conventional building materials which are very expensive such as sandcrete or iron rods as stipulated by the planning authorities which makes housing development unaffordable. It is obvious that, the existing building regulations are archaic and wasteful. In addition, the application of these standards has been a major factor impeding housing provision due to the excessive cost of erecting standard housing units. Therefore, the high, costly and stringent standards, for instance, curtail the rate of production and supply of housing in Nigeria.

Finally, Abosede (2008) emphasized that the success level or performance of any Development Control by the Planning Authority depends on the level of implementation or enforcement. The implementation or enforcement of Planning regulations and standards is therefore imperative to secure orderliness and preservation of the Master Plan. It can be achieved using the enforcement notice which may include Notice of contravention, Notice to stop work, Notice to quit, Notice to seal up and Notice of demolition. The enforcement notices are used by the planning authority to checkmate the activities of developers on site. This implies that developments that do not conform to the stipulated land uses are discouraged with the use of any of the above mentioned enforcement notices.

Ibrahim and Mbamali (2013) in a study carried out in Abuja, revealed that out of all the available sources of housing financing funds, only the mortgage banks were frequently utilized while all other sources of finance had low patronage frequency. However, with the problems fraught in the mortgage banks, one cannot help but imagine what the situation is like when it comes to securing loan finance for housing development. The problem of

building materials is identified as one of major constraints impeding adequate housing provisions (Onibokun, 1986; Onibokun and Agbola, 1990; Agbola, 1993 and Agbola, 1998). It arose from colonial exposure, with the introduction of western housing values and the development of modern housing designs. The high cost came from high import dependence, of the sector. Despite the increasing cost of building materials, its importance remains paramount to housing development.

Aluko (2004) added that Nigeria as a country relies heavily on imported building materials as most building materials industries are almost non-existent and poorly developed. Ayeduni and Oluwatobi (2011) identified Building materials and components as one of the major challenges militating against efficient housing development while noting that they are import dependent which makes them very expensive in the face of the value of the country's currency (Naira) and global inflation. Oluwatuyi and Olayemi (2012) noted that the high cost of importation of heavy machines needed for manufacturing is another factor responsible for the hike in the cost of building materials. This problem of inflation also contributes largely to the increasing costs of building materials.

3. RESEARCH METHODOLOGY

The population study for this research work comprises of developers and Private developers who are registered members of the Real Estate Developers Association of Nigeria (REDAN) in the Federal Capital City. There are 270 registered private real developers in Abuja and based on the relatively small number of developers, the study utilized census sampling, The study administered 270 questionnaires through simple random sampling across the registered developer and 250 questionnaires while the remaining 20 questionnaires were not returned. The utilized both descriptive and inferential method of analysis. Descriptive analysis includes mean, variance and standard deviation and inferential method which includes regression.

Mean = $\sum$ FW/N

Where f-frequencies, w-weight (VH-Very High(5), H-high(4), Indifferent(3), L-Low(2) and VL-Very low(1) and N-total number of samples.

Regression equation:

TOTALDEV = c + β ACBM + β LAND/m^2 +β INT RATE

Where the c =intercept, β = coefficient, ACBM = average cost of development, LAND/M^2 = cost of land /m^2 , INT RATE = interest rate on real estate finance.

4. PRESENTATTION AND DISCUSSION OF RESULTS

Figure 1 shows the trend in number private housing development from 2010 to 2020. The trend showed steady and consistent movement over the period, this indicates there was consistency in the level of development not until 2020 when the number of developments fell drastically due to covid-19 restriction of movement.

Table 1 showed the summary of residential property development carried out by developers in Abuja between 2010 and 2020. The study revealed that majority of private housing developments are Bungalow, flat and duplex. The bungalow accounted for 33.39% of residential housing developments; flats accounted for 23.68% of housing development while duplex accounted for 22.45% were duplex.

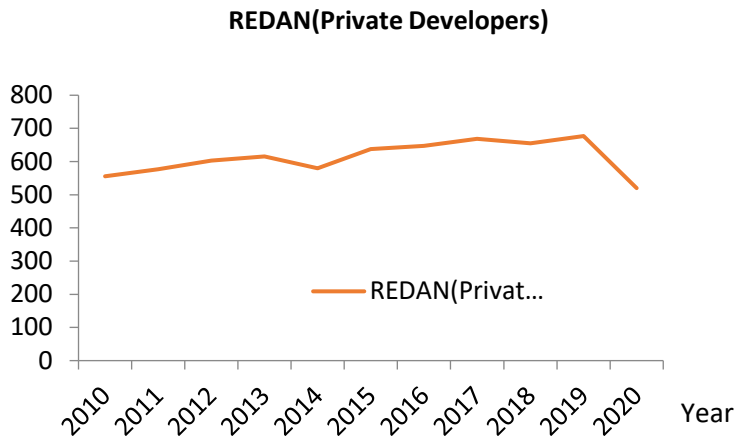

Figure 1: Trend in Private Residential Housing Development in Abuja
Source: Field survey, 2021

Table 1: Summary of types of private residential housing development (2010-2020)

Housing Types	Private Sector REDAN	Percent
Tenement	143	1.92
Bungalow	2487	33.39
Flats	1764	23.68
Duplex	1672	22.45
Terraced	721	9.68
Maisonette	230	3.09
Condominium	431	5.79
Total	7448	100

Source: REDAN, 2021

Table 2 shows the trend in the number of applications made for development and number of approvals given by federal capital territory authority (FCDA) and the total number of developments carried over given period. There is a wider gap between the approval given and number of developments.

Table 3 gave an average number of applications and approval granted, over the period under study, an average of 1,589 of application were submitted with average of 960 of approval were granted. The degree of variation in the number of applications submitted was 312 with 244 approvals.

The analysis of challenges was based on five-point likert scale (VH-Very High, H-high, Indifferent, L-Low and VL-Very low) as presented in Table 4. From table 4 shows the average mean and relative mean of the opinion on challenges of residential property development in the FCC, inadequate finance is the most challenge associated with majority of the developers in FCC, followed by high cost of building materials. These two challenges have been hindering the effective development of residential property in the study areas.

Table 2: Analysis of Residential Applications Received and Approvals Granted

Years	No. of Application	No. of approval (permit)	Total residential development
2010	1049	624	600
2011	1255	712	623
2012	1291	756	632
2013	1424	823	671
2014	1586	915	716
2015	1659	927	675
2016	1447	879	724
2017	1570	901	765
2018	1934	1181	758
2019	1860	1045	755
2020	1975	1336	780

Source: FCDA, Abuja.

Table 3: Descriptive Analysis Of Number of Application and Approval Granted

Residential Applications received	**Residential Approvals granted**
Mean	1589	959.7
Median	1578	908
Standard Deviation	311.90	243.90
Minimum	1049	624
Maximum	2018	1417
Quartile 1(Q1)	1324.30	772.80
Quartile 3(Q3)	1915.50	1147

Table 5 shows the trend in residential development and it market determinant factors over a given period. The table showed average cost of building material sourced directly quantity surveying firms in Abuja and the cost of land per meter square that is sourced directly from registered estate firm and interest on real estate finance is sourced from central bank of Nigeria.

The analysis of regression result shows that independent variables explained change in residential development by 89.1% as presented in Table 6. This means that independent variables considered have explanatory power in forecasting the dependent variable. Average cost of building material (ACBM) predicted 2% increase as a unit residential development is developed, this means any successful unit increase in number of resident properties in the market, increases the average cost of building/m^2 by approximately 2%.Cost of Land per sqm (CL/M^2) is predicted 44% increase as the unit increase in residential property is developed, this means that a unit increase in residential development increases cost of land per square meter by approximately 44%. Finally interest rate is negatively related because any successful increase in interest rate decreases rate of residential development, in other words, number of residential developments in FCC is decreased by approximately 6 units as unit of interest rate increase. The f-statistic at 21.77 is significant p-value less 0.05 level, this means that the model is fit for purpose of prediction.

Table 4: Opinions on Challenges of Residential Property Development in the FCC

Challenges of Residential Development	VH	H	ID	L	VL	Sum	Average Score	Relative Index	Rank
Inadequate development finance	500	324	177	20	0	1021	4.09	0.82	1
High Cost of Building Materials	505	288	159	38	5	995	3.98	0.80	2
Inadequate Access to developable Land	495	280	150	42	10	977	3.91	0.79	3
Restriction by Development Control	430	372	123	40	10	975	3.90	0.78	4
Poor State of Infrastructure	480	312	120	54	9	975	3.90	0.78	4
Lack of developed housing market in Nigeria	345	280	174	80	13	892	3.57	0.714	5
Inadequate housing statistics	335	236	183	94	16	864	3.46	0.692	6
Poor economy condition	305	200	252	90	10	857	3.43	0.686	7
Poor state of Public – private partnership arrangements.	285	240	210	104	11	850	3.40	0.68	8
Inadequate effective mortgage system	300	196	165	100	36	797	3.19	0.638	9
Poor capital market system	245	252	150	120	28	795	3.18	0.636	10
Construction methods	280	180	150	68	31	709	2.84	0.51	11

Source: field Survey, 2021

Table 5: Trend in Total Residential Development and Its Market Determinant Factors.

YEARS	Total development (TOTAL DEVE)	Average Cost of building/m (ACB)	Cost of land/^{m2} (LAND/M)	Interest rate on real estate finance (INT RATE)
2010	600	4120	2500	18.02
2011	623	4432	2650	24.5
2012	632	4554	2690	19.71
2013	671	5000	2685	20.72
2014	716	5600	2696	17.43
2015	675	6300	2725	17.12
2016	724	6510	2765	15.97
2017	765	7120	2790	17.34
2018	758	8651	2813	19.23
2019	755	8945	2855	17.23
2020	780	9534	2895	16.25

SOURCE: Total development-FCDA, ACB-Quantity surveyors' firms, LAND/M-Estate surveyor'firm and INT RATE-CBN

Table 6: Regression Results …..

Predictor	Coef	St. Dev	T	P	VIF	F
P						
Constant	-433.5	228.0	-1.90	0.094		21.77
0.000						
ACBM	0.02067	0.03418	0.60	0.562	1.2	
CL/M^2	0.44852	0.07245	6.19	0.000	1.3	
INT RATE	-5.687	3.604	-1.58	0.153	1.3	

S = 24.98 R-Sq = 89.1% R-Sq(adj) = 85.0%

Computed from Table 4.15

The equation: TOTALDEV = - 434 + 0.00207 ACBM + 0.449 LAND/M - 5.69 INT RATE

5. CONCLUSION

The study therefore understood that there was wider gap in between the approval for private housing development and total development, in other total development significantly fall short approval granted. The study thereby investigate factors affecting private development, it was understood that inadequate finance is the most challenge associated with majority of the developers in FCC, followed by high cost of building materials. These two challenges have been hindering the effective development of residential property in the study areas. Further analysis of market determinant factors sourced from professionals and government agency proofed that 85 variation in total private development is attributed changes in cost of building material, land cost and interest on real estate finance. Thereby, the research concludes inadequate finance, cost of building materials and cost of land per meter square predict residential development, and buck of residential development in FCC is developed by private sector, the most emphasised constrain is inadequate finance followed by cost of building material. The

study recommends that private developers need government intervention to address the general inflation associated with development cost.

6. LIMITATION OF THE STUDY

The study is limited to two analytical techniques mean and regression analysis and three important market factors that affect the private housing development were identified for this study. These factors provided information on time series and were adopted. This study could also be improved upon by identifying more time series factors that affect private housing development.

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A REVIEW OF THE PAST, PRESENT AND FUTURE OF CONCRETE ADMIXTURES

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ABSTRACT

Purpose: Sustainable environment could be achieved with constructions using concrete that generates little heat. One way to achieve this is by using water reducing admixtures. More so, there is coming a time in some parts of Nigeria where normal strength concrete will be less required due to unavailable land space and high-rise buildings will require high or ultra-high strength concrete, produced with the aid of water reducing admixtures. Therefore, this paper reviews the past, present and future of concrete admixtures (water reducing admixtures) and the need to develop effective eco-friendly (natural) admixtures.

Keywords: Admixture; Water Reducers; Superplasticizer; Compatibility; CNSL.

1. INTRODUCTION

Concrete is a composite material consisting of a mixture of cement, sand, granite/gravel, water and/ or admixture. It has a historical background similar to concrete admixture. It has a historical background similar to concrete admixture. The history of concrete has always hinged on producing concrete with significant strength and to overcome some difficult situation such as hot or cold weather placements, pumping requirements, early-strength requirement or very low water-cement ratio specifications (Oladiran *et. al.,* 2012), during use of the concrete.

For instance, according to Radic, *et. al.,* (2008), around 10,000 BC in Israel, there was a reaction between limestone and oil shale during a spontaneous combustion to form a natural deposit of cement compounds. Similarly, evidence of burning gypsum was found at Cata Huyuk, Asia around 9000BC. In addition, in Egypt, about 3,000BC, meteorite, the oldest findings of iron was discovered. Evidence showed that ancient Egyptian used mud mixed with straw to bind dried bricks. Ancient Egyptians also used gypsum mortars and mortars of lime in the construction of the pyramids (Radic, *et. al.,* 2008). Greeks, Cretans and Cypriots used lime mortars which were much harder than the Romans' mortar. The Chinese Great wall was built using cementitious materials, the Babylonians and Assyrian used bitumen as binding agents during road construction (Burn, 2005).

Studies such as Dodson (1990); Rixom & Mailvaganam (1999); Ramachandran (2002); Nevile & Brooks (2010) and Aiicin & Flatt (2016) believed that the earliest recorded use of modern concrete was during Roman periods spanning between 300BC to 476AD a range of more than 700years. The Romans used pozzolana cement from

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Pozzuoli, Italy, near Mt. Vesuvius to build the Appian Way, Romans bath, the coliseum, Pantheon and the Pan du Gard aqueduct in southern France. They used lime volcanic ash (a pozzolana materials) and admixtures such as Animal fat, milk, eggs and blood to improve the properties of concrete.

2. LITERATURE REVIEW

2.1. History of Cement

During the first industrial revolution, between 1760 to sometimes around 1840 in Europe and United States, Portland cement was discovered. In Europe, the hydraulic lime and volcanic ash first developed by John Smeaton in 1765 when he erected the Eddystone, Lighthouse, off the coast of Plymouth, Dewn, England (Dickinson, 1939). Also, in the United States, cement known as natural cement/ Rosendale natural cement was in used (Aiicin & Eberhardt, 2016).

Thereafter, at about 1800 in France and England, a material obtained by burning modules of clayey limestone was used. The invention of Portland cement is attributed to Joseph Aspdin of Leeds, Yorkshire, England, who in 1824 took out a patent for a material that was produced from a synthesis of clay with limestone. It was called Portland cement because the products resemble a Portland stone obtained in Portland (Courtland, 2011). The adoption of Portland cement spread to all countries like wide fire and by the end of 20^{th} century, it was used world over. China and India became the leading manufacturers as at 21^{st} century (Nick & Kenton, 2013).

2.2. History of Admixture

According to Aiicin & Eberhardt (2016), a faulty bearing of a grinding mill had been releasing some heaving oil which resulted in the discovering of the beneficial effect of air entraining admixture (Mindess *et.al.*, 2003). The discovery originated from the use of American Naturally occurring materials called Rosendale Natural cement. American cement had been in used since 1818 after natural cement rock was discovered by Convass White in Fayettevile, New York. This cement was produced from Marl limestone or argillaceous limestone (a limestone containing clay) which were burnt between 800 and $1100^{o}C$ before the wide spread use of Portland cement across the world nearly put the Rosendale Natural cement out of use because it hardened too fast (Eckel & Burchard, 1913). Due to freezing and thawing cycle in the New York state, it was observed that salt scaling does occurred on the concrete produced using Portland cement. This led to the degrading of the concrete overtime (Jackson, 1944), whereas structures produced using Rosendale cement remained unchanged with adequate strength.

An engineer named Bertrand H. Wait, started experimenting on blends of Portland cement in 1933. He was able to make concretes with a scaling resistance against freezing and thawing using salt solution that was 12 times greater than that of concrete made from pure Portland cement (Holbrook, 1941).

According to Aiicin & Eberhardt (2016), the reason for the greater resistance of these blended cements against freezing and thawing was not clear. However, it could have been a consequence of the natural cement itself or of the fact that one out of the two Rosendale cements that were used in the New York contains a small amount of beef tallow as a grinding aid. At the end of the 1930s, the Portland Cement Association initiated intensive studies on the effect of introducing small amounts of tallow, fish oil, and stearate resins as air-entraining agents.

The second story of admixture discovery according to Dodson (1990), an Engineer from the Department of Transportation (DOT) wanted to mark the middle of the first three concrete lanes in the United State to avoid an accident on the highway. The DOT Engineer instructed the contractor to do the marking; however, the Engineer was not impressed with the black carbon used. The Engineer therefore instructed the dispersion of the black carbon. After some time, the Engineer discovered that the chemicals (polysulfonate salt) used for the dispersion, had improved the strength and durability of the portion of the road where the chemicals were applied.

2.3. History of Water Reducing Admixture

The earliest known use of water-reducing admixture involved the use of small amount of organic materials to increase the fluidity of cement in 1932 (Rixom & Mailvaganam, 1999). The organic materials adopted were polymerized naphthalene formaldehyde sulfonate salts. This was followed by the use of Lignosulfate in the 1930s to early 1940s. The Lignosulfates formed the basis of almost all the available water reducing admixture until 1950s when the Hydroxycarboxilic acid salts were developed.

High Range Water Reducing Admixture also known as superplasticizers were first developed in Japan by Kenichi Hattori in 1964. The superplasticizers produced contained beta naphthalene sulfonates and modified lignosolphonate. In the same year, the Melamine formaldehyde condensate in Germany (Jerath & Yamane, 1987) was developed. After a decade, the use of superplasticizer reached the American continent in 1974 (Sidney, 2011). In the year 1987, the latest generation was introduced to North America market called Poly carboxylate ether (Jayasree *et. al.,* 2011).

2.4. Water Reducing Admixture

The water-reducing admixtures allow a reduction in the water cement ratio at a given workability without significantly affecting the setting characteristics of the concrete. In practice, this effect can be utilized in three ways:

i. By the addition of admixture with a reduction in the water-cement ratio, a concrete having the same workability as the control concrete can be obtained with unconfined compressive strengths at all ages which exceed those of the control.
ii. If the admixture is added directly to a concrete as part of the gauging water with no other changes to the mix proportions, a concrete possessing similar strength development characteristics is obtained, yet having a greater workability than the control concrete.
iii. A concrete with similar workability and strength development characteristics can be obtained at lower cement than a control concrete without adversely affecting the durability or engineering properties of concrete (Rixom & Mailvaganam, 1999).

Water reducers consist of Ca, Na, or NH4 salts of lignosulfonic acid, Na, NH4 or triethanolamine salts hydroxycarboxylic acid, and carbohydrates. Lignosulfonates containing (OH), (COOH) and (SO_3H) groups are more widely used than others. Hydroxycarboxylic acids such as citric acid, tartaric acid, salicylic acid, heptonic acid, saccharic acid and gluconic acid based admixtures contain (OH) and (COOH) groups. Gluconic acid-based admixtures are used extensively. Carbohydrates include glucose, sucrose or hydroxylated polymers obtained by partial hydrolysis of saccharides (Collepardi, 1994).

The role of water reducers (normal, accelerating or retarding) in terms of their effect on the hydration of cement is similar to that of accelerators and retarders (Ramachandran, 2002). The water reducers used in 1930s when the lignosulphate was discovered still remain in use till today, although, several others have been discovered. They include acrylates, methacrylate, polymers, styrene copolymer, ethylene, pentene, digested product of cellulosics, sulfite yeast mash based products (waste product from fish oil processing) corn cobs, straw and sunflower treated with sulfuric acid (Flatt and Schober, 2012).

In 20th century, according to Ramachandran (2002), the water reducing admixture in used are prepared from hydrolysis of polysaccharide or oxalic acid, dicylo-pentadiene derived acrylic resins condensation product with Na-carbazol disulfonate + calcium chloride, maleic anhydride styrene copolymer and alkoxylated alcohol or phenols. Many patents on water reducer in the 21st century have been produced from synthesized lignosulphate salts combined with other earlier discoveries.

2.5. High Range Water Reducing Admixture

Superplasticizers belong to a class of water reducers chemically different from the normal water reducers and capable of reducing water contents by about 30%. The admixtures belonging to this class are variously known as superplasticizers, superfluidizers, superfluiddiers, super water reducers, or high range water reducers (Ramachandran, 2002). Superplasticizers are used for the following;

i. To produce concrete having very low water cement ratio to attain high early and ultimate strengths at much reduced permeability to moisture and salts.
ii. To produce concrete having very high flowability where the admixture is added to the mix with no alteration in water-cement ratio to produce slumps more than 180mm (Rixom & Mailvaganam, 1999).

The superplasticizers are broadly classified into four generations: sulfonated melamine-formaldehyde condensate (SMF); sulfonated naphthalene-formaldehyde condensate (SNF); modified lignosulfonates (MLS); Polycaboxylic ether (PCE); and others including sulfonic acid esters, polyacrylates, polystyrene sulfonates, etc. Blends of different superplasticizers have also been developed (Jayasree *et. al.,* 2011).

Examples include, Naphthalene sulfuric acid-isocyanuric acid condensates, micropellets containing unsaturated dicarboxylic and anhydride, copolymer of styrene and maleic acid graft polymerized with a conventional lignin or Naphthalene Sulfonic acid/ Naphthalene sulfonic acid copolymer and condensate of melamine formaldehyde condensate (Ramachandran, 2002).

From the late 20th century to the end of 20th century, the superplasticizer developments have focused on producing formulation to control slump loss (a problem of compatibility), increase in fluidity, and strength of concrete. The formulation includes; azo type superplasticizers, indene carboxylic acid copolymer product from isobutylenes maleic anhydride copolymer and laurylamine. Other formulations produced up to date are synthetic (Ramachandran 2002; Aiicin & Flatt, 2016).

2.6. The Current Trend in Concrete Admixture

Compatibility Issues

Since the early 1960s when superplasticizer was first introduced (Evangeline & Neelamegam, 2015), there has been a problem of incompatibility between cement and the admixture. It can either be cement and superplasticizer incompatibility or incompatibility between superplasticizer and other admixtures or incompatibility between

superplasticizer and supplementary cementitious materials and cement (Tiji & Liji, 2016).

According to Tiji & Liji, (2016), incompatibility is a term used to describe the adverse effect on performance when a specific combination of cement and superplasticizer is used. It could be due to the effect of the chemical structure of superplasticizer, admixture type and dosage, cement composition and fineness, the effect of calcium aluminates in cement, role of calcium sulphates, and role of alkali (Jayasree *et.al.*, 2011). The factors affecting the compatibility between cement and superplasticizer are discussed below:

i. Effect of Chemical Structure of Superplasticizer: The chemical structure of the superplasticizer affects the ability of the superplasticizer to blend with cement. For instance, the type and dosage, degree of polymerization, degree of sulphonation, the position of functional group in the benzene ring, the molecular weight distribution of the polymer, the addition rates and the time of addition of superplasticizer affect its interaction with cement (Tiji & Liji, 2016).
ii. Admixture Type and Dosage: There are different types of superplasticizers, each having its chemical composition and structure. The reaction of lignosulphonate will be different from sulphonated melamine and as well different from sulphonated naphthalene formaldehyde, and polycarboxylate ether (Jayasree, 2011). Aiicin (1998) and Agullo *et.al*.,(1999) stated that for all superplasticiers, the rate of increase of fluidity of the paste or workability of concrete decreases as the dosage increases until there is no significant increase in the fluidity. This dosage point is often refers to as saturation point and it is unpredictable when there is a presence of pozzolana or other admixture type (Aiicin & Flatt, 2016)
iii. Time of Addition of Superplasticizer: According to Uchikawa *et. al.*, (1992) and Aiad (2003), the delayed addition of sulphonated melamine formaldehyde and sulphonated Naphthalene helps in retaining its fluidity. The rate of adsorption is reduced when hydration had taking place compared to during or before hydration.
iv. Cement Composition and Finess: Most superplasticizer carries an anionic charge which easily reacts with the celite and ferites compound in cement. Therefore, the higher the celite and ferrite content the better the rate of adsorption of cement. Also, the finer the cement, the higher the specific surface area and consequently the water demanded, given that workability is expected to be higher (Jayasree *et.al.*, 2011).
v. The Role of Calcium Sulphate: In the early stages of cement hydration, the reaction that dominates is those of the Alite (C_3S) compound with the water to produce calcium hydroxide and Calciulm Silicate Hygrate and of Celite (C_3A) with gypsum to produce extringite (Ramachandran, 2002). It is at this stage that the interaction of the superplasticizer occurs. Superplasticizers with Sulphonate compete with calcium sulphonate released from gypsum for reaction with aluminate. When the solubility of the calcium suphonates is low, the superplasticizer molecules tends to get adsorbed first on the aluminate, thus preventing the normal setting reaction involving the formation of ettringite. In other to prevent this, the solubility of sulphonates is important (Jayasree *et.al.*, 2011).
vi. Role of Alkalis: Alkali in cement is essential for accelerating alite hydration. However, excess alkali could have adverse effects, one of them being the alkali aggregate reaction. Cement with high alkali content causes a workability problem

in concrete. The alkali also contributes to the low rheology of superplasticizer and cement (Jayasree *et.al.,* 2011).

The Need for Natural Admixture to Solve Incompatibility

Superplasticizers and cement incompatibility has always been an issue from the time the last generation of superplasticizer has been discovered. Several authors have focused on using chemical superplasticizers (MLS, SNF, SMF and PCE based superplasticizers) to understudy and address incompatibility (Banfill, 1979; Roy & Asaga, 1980; Bjornstrom & Chandra, 2003; Sindhu *et. al*., 2017). However, little attention has been put to using superplasticizer from natural plant.

Table 1: Previous studies on materials used in addressing incompatibility

S/N	Authors Name	Title of Paper	Materials Used	Remarks
1.	Roy & Asaga (1980)	Rheological Properties of Cement Pastes, Effects of Time on Viscometric Properties of Mixes Containing superplasticizers.	Two Cement and SNF and SMF superplasticizer	Portland Cement and Chemical Admixture.
2.	Masood & Agarwal (1994)	Effect of Various Superplasticizers on Rheological Properties of Cement Paste & Mortar.	Cement, Seven Superplasticizer & CNSL Super Plasticizer.	Portland Cement, Chemical and Natural Admixture.
3.	Chiara *et.al.,* (2001)	The Influence of Mineral Admixture on the Rheology of Cement.	SNF, Natural Admixture (Fly ash, Metakaolin & Silica fume) & Cement.	Chemical Admixture, Pozzolana and Portland Cement.
4.	Aiad & Heikal (2003)	Effect of Superplasticizer on the Rheological Properties of Blended Cement Paste Containing Silica Fume.	SNF & PCE. Superplasticizer and Blended Cement of Silica Fume.	Chemical Admixture and Blended Cement.
5.	Bjornstrom & Chandra (2003)	Effect of Superplasticizer on the Rheological Properties of Cements.	MLS, SNF, SMF & PCE Superplasticizer with Cement.	Chemical Admixture and Portland Cement.
6.	Gad *et. al.,* (2005)	Rheological Properties of Different Cement Pastes made with Different Admixture.	PC, SRC & Blended Cement of High Slag& Fly ash and MLS, SNF & PCE.	Blended Cement, PC,SRC& Chemical Admixture.
7.	Olga *et. al.,* (2012)	Commpatibility Between Superplasticizer Admixture & Cement with Mineral Additions.	Blended Cement of Limestone, Fly Ash& Silica fume, MLS SMF, SNF & PCE.	Blended Cement, and Chemical Admixture.
8.	Shah et. al., (2013)	Effect of HRWR on the Properties and Strength Development Characteristics of Fresh and Hardened concrete.	PC & 2PCE.	Portland Cement, and Chemical Admixture.
9.	Tiji & Liji (2016)	Compatibility Studies of an Admixture with Different Cement Brand of Varying Chemical Composition for SCC.	Different Cement Type & PCE	Portland Cement, and Chemical Admixture.
10.	Sindhu *et. al*., (2017)	Studies on Rheological Properties of Superplasticizer on Portland Pozzolana Cement Paste.	PPC (Fly ash) and MLS, SMF, SNF and PCE.	PPC and Chemical Admixture

Masood & Agarwal (1994) compared the rheology of different superplasticizer including the superplasticizer developed from natural plant extract (CNSL). Although, according to Flatt & Houst (2001), Ramachandran (2002) and Marchon *et. al.* (2016), rheology of superplasticizer and cement cannot fully explain the chemistry of relationship between superplasticizer and cement, there is need to study the adsorption and zeta potential together with their performance for full understanding.

Recently, attention has been focused on the benefit of natural additions in form of pozzolana could do in addressing incompatibility (Chiara *et.al.,* 2001; Aiad & Heikal, 2003; Gad *et.al*., 2005; Olga *et.al.,* 2012 and Sindhu *et. al*., 2017). This has led authors into incorporating natural additives (such as fly ash, limestones and silica fume) to cement and superplasticizer, and their rheology, adsorption and zeta potential determined. The results obtained were promising.

However, there is need to study using superplasticizer produced from natural plant and the rheology, adsorption and zeta potential determine accordingly. A research by the author, on the use of naturally developed superplasticizer to address cement superplasticizer incompatibility is underway. Table 1 shows the materials used as admixture and the type of cement used to study cement superplasticizers incompatibility. Only in one case was a natural admixture used. In understanding compatibility, Flatt and Houst (2001) proposes three methods; rheology, adsorption, and zeta potential. The methods used by the ten authors in relations to the proposed are discussed in the Table 2. Only two authors were able to use the three methods.

Table 2: Previous studies on the methods used in addressing incompatibility

S/N	Authors Name	Title of Paper	Methods Used	Remarks
1.	Roy & Asaga (1980)	Rheological Properties of Cement Pastes, Effects of Time on Viscometric Properties of Mixes Containing superplasticizers.	Coaxial Cylinder Viscometer	Rheology Test
2.	Masood & Agarwal (1994)	Effect of Various Superplasticizers on Rheological Properties of Cement Paste & Mortar.	Brookfield DV-II Model Viscometer	Rheology Test
3.	Chiara *et.al.,* (2001)	The Influence of Mineral Admixture on the Rheology of Cement.	Marsh Cone Apparattus & Minislump.	Rheology Test
4.	Aiad & Heikal (2003)	Effect of Superplasticizer on the Rheological Properties of Blended Cement Paste Containing Silica Fume.	Rheotest Cell.	Rheology Test
5.	Bjornstrom& Chandra (2003)	Effect of Superplasticizer on the Rheological Properties of Cements.	Rheology, Adsorption & Zeta potential.	Rheology, Adsorption & Zeta potential.
6.	Gad *et. al.,* (2005)	Rheological Properties of Different Cement Pastes made with Different Admixture.	Rotating Coaxial Cylinder Viscometer.	Rheology Test.
7.	Olga *et. al.,* (2012)	Commpatibility Between Superplasticizer Admixture & Cement with Mineral Additions.	Haake Rheowin Pro RV1 Rotational Viscometer, Total Organic Carbon & Smoluchowski Approximation.	Rheology, Adsorption & Zeta Potential
8.	Shah et. al., (2013)	Effect of HRWR on the Properties and Strength Development Characteristics of Fresh and Hardened concrete.	Nil	No test
9.	Tiji & Liji (2016)	Compatibility Studies of an Admixture with Different Cement Brand of Varying Chemical Composition for SCC.	Marsh Cone Apparatus	Rheology Test
10.	Sindhu *et. al*., (2017)	Studies on Rheological Properties of Superplasticizer on Portland Pozzolana Cement Paste.	Coaxial Cylinder Viscometer(Brookfield DV-II) & Marsh Cone	Rheology Test

2.7. The Future of Concrete Admixture

There is limited resource in virtually all countries around the world and it is a challenge that we have to face this century. Construction consumes about 40% of natural resources, and sustainable construction therefore represents a major societal concern (Aïtcin & Mindess, 2011). Clinker consumption could be made sustainable if effectively used.

However, the quantities of concrete required daily are extremely high. This means that concrete performance must be fully exploited. This infers significant increases in the number and dosage of admixtures used.

In contrast, the use of locally available resources would significantly contribute to this development. Its development will aid the understanding that valuably complements the know-how of enlightened formulators and practitioners.

3. CONCLUSION

This paper has shown the past, present and the future of admixture (that is; water reducers) and concrete in general. It has shown that the discovery of cement has led to insatiable desire to improve it. Admixture has been useful in this regard, which has led discoveries of different type of admixtures and in specific, different generation of superplasticizer. More so, the amount of cement production needs to be reduced, therefore requiring maximum performance whenever concrete is produced. However, this is achievable with maximum and effective use of admixture.

Compatibility has posed a challenge to the maximum and effective use of admixture (superplasticizer). It calls for a new approach to addressing issues of compatibility. One of such new approaches is to encourage researchers into the development of admixture from naturally occurring materials. Sustainable environment is the future and it has begun.

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