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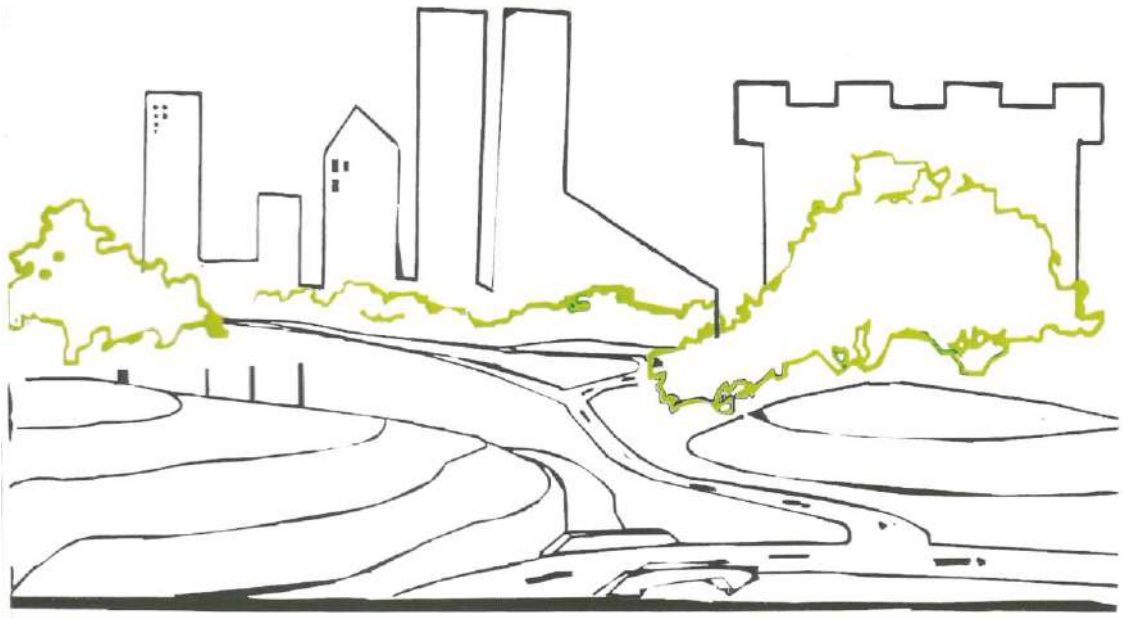

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EDITORIAL COMMENTS

Welcome to yet another volume of the Journal of Environmental Design. Volume 19 of the JED contains several thought-provoking well researched papers on the various dimensions of the built environment. It must be stated that environmental problems in general have become intricate phenomena requiring a wide range of interests and experts in their planning, management and design. The JED continues in its 19th volume to highlight the works of these experts and presents their informed views and cutting edge research findings for the benefits of policy makers and students of environmental studies. The papers have been peer-reviewed and carefully selected to ensure intellectual balance and intelligent discourse.

The views expressed in the **articles** published in this Journal (JED) are those of the authors and Journal of Environmental Design (JED) does not hold itself accountable for such.

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Equations: Make sure that all symbols in equations are clear and that all equations (except those in footnotes) are numbered. Single-letter variables should be italicized. Multiple-letter variables, abbreviations (e.g.,AGE) and functions (e.g., expo min. In) should not be italicized neither should be numbered. Parentheses or mathematical operations, vectors and matrices should be in bold (not italicized).

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DETERMINANTS OF RESIDENTIAL NEIGHBOURHOOD PREFERENCES OF URBAN RESIDENTS IN NIGERIA: A CASE STUDY OF UYO URBAN, AKWA IBOM STATE, NIGERIA

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Abstract
The aim of this study was to assess households' residential neigbourhood preferences determinants in Uyo urban, following the inability of most urban housing schemes to adequately cater for the needs and requirements of many urban residents due to the changing socio-economic, demographic and environmental circumstances. Survey research approach was adopted to gather data from 386 households in 30 randomly selected residential neigbourhoods in Uyo urban. Structured questionnaire and direct field observation were the instruments of data collection. Both descriptive and inferential statistics were applied in data analysis using SPSS. Factor analysis procedure carried out on 24 variables identified 5 dimensions of factors influencing residential neighbourhood preferences. These factors accounted for 75.66% of the total variance in the 24 original variables. The factors were named according to their pattern of loading. These were: neighbourhood quality (35.62%), housing tenure (20%), accessibility (8.47%), distance to place of worship (6.33%) and distance to desired schools (5.15%). The factor scores derived from the analysis, showed spatial variations in the pattern in which residential neighbourhoods in Uyo urban were preferred. The multiple regression analysis which consisted of 3 predictors, (age, income and household size) showed a strong correlation (R=0.705) between households' socio-economic/demographic characteristics (age, income, household size) and residential neighbourhood preferences in the study area. The R^2 which was found to be 0.497 indicated that 49.7% of the variance in the neigbourhood preferences of the residents in the study area was determined by the three predictors. Based on these findings it is recommended that the planning of housing should be approached at the neighbourhood level with strategic spatial planning that is aimed at improving the key factors as a way of improving residential housing quality and the overall living conditions of people living in urban areas.
Keywords: *Residential, Neighbourhood, Preferences, Urban*

1.0 **Introduction**

Diverse reasons determine preferences and choices that people make for housing and residential neighbourhoods over others. Galster (2009) observed that people perceive salient attributes of their physical environment and evaluate them based on certain standards of comparison when choosing a residential district. Examining individual's residential housing preferences as well as the factors underlying these preferences is to maintain and enhance housing-related quality of life. According to Mouratidis (2018) residential satisfaction as a product of preferences is a predictor of quality of life and enhancing quality of life is an important objective in urban planning. More so, apart from enhancing the quality of life, there is no doubt that these preferences also, have serious implications on residential patterns as well as the distribution and management of urban infrastructure. Therefore, the understanding of these factors according to Pinkster *et al.*, (2015) is important in creating mixed, stable and attractive neighbourhoods.

In Nigeria, although land-use planning and control system are known to exert a significant impact on urban housing development in terms of where they are built as well as the design guidance and space standard. However, one of the lingering issues which seems to have dominated the housing sector in recent years is that, the building industry is not particularly responsive to the housing needs and priorities of many urban residents especially, in terms of quality, design, function and acceptable neighbourhood (Kabir and Bustani,2012; Temi and Champika, 2018).

Generally, it could be seen that, while greater emphasis has been placed on providing more and more dwelling units, often times, the real neighbourhood and residential requirements of the occupants have not received adequate attention and as such, very little is known about how urban residents in Nigeria make housing decisions and trade-offs between type, size, price and location in the housing market. Studying residential preferences therefore, can reveal people's aspirations and choices they would make for houses and some residential neighbourhoods over others. Such a study is required to help researchers and developers understand the new trends in housing, and in addition, predict market changes for the near future. An understanding of the factors that facilitate a satisfied or

dissatisfied response can play a critical part in making successful housing policies (Sheyda and Ali 2023).

While there has been a growing interest in integrating users' preferences and needs into the housing design process in many developed countries, not much has been done in developing countries like Nigeria. Although, a number of studies examining the interaction between socio-economic variables, and housing variables to housing choice of Nigerians have been advanced in recent times (Gbakeji and Ojeifo, 2012; Sanni and Akinyemi, 2013; Sakariyau *et al.*, 2021; Olayiwola, and Ajala, 2022) few studies have attempted to quantify their importance relative to each other and as a result of this, very little is known about just how important these factors are to housing consumers in Nigeria. Hence, the The Null (Ho) hypothesis that: There is no significant relationship between neighbourhood preferences and socio-economic/demographic characteristics of the respondents in the study area is formulated for testing in this study.

2.0 Research Problem

Uyo, the Akwa Ibom State Capital is one of Nigeria's fastest growing cities in terms of infrastructural development and size. Like the majority of other cities in Nigeria, Uyo is characterized by great social and economic disparities. The diversity of socio-economic activities coupled with the rising infrastructural profile of the city has generated a inter-mix of population with differing attributes and residential requirements. Obviously, the housing market is characterized by spatial heterogeneity that varies in size, types, prices, location, and neighbourhood quality. Housing consumers on the other hand, have totally different housing needs and their preferences also vary based on their socio-economic compositions such as household size, income, age, marital status, occupation, and level of education which also affect the demand for existing amenities and infrastructure. With the plurality of other attractive features, the housing market in the study area has become one of the most active housing markets in Nigeria (Udoudoh and Ezenwafor, 2010).

Considering the affluent housing market, both public and private developers have emerged to proffer solutions to the housing needs of the people by making more houses available for rent or sale. Since residents in the study area still rely on the market to satisfy their housing needs, it has been observed that one of the problems facing many developers is lack of normative information on residential preferences of residents in the study area. It is worthy of note that the planning and design of new residential housing estates, almost always depend on the subjective experience of designers and developers which often leads to a predetermined quality and standard of houses that are inappropriate to most end users. Preliminary observation of the study area reveals that, the urban neighborhoods of Uyo provide residents with differing living conditions which influence their preferences and choices of the housing environment. Unfortunately, there has been no deliberate attempt to empirically study these variations among housing consumers in Uyo urban with a view to identifying relevant factors influencing their preferences and satisfaction for a given housing. It is in view of these challenges, therefore, is to assess households 'residential neigbourhood preferences determinants in Uyo urban.

3.0 Literature Review

Housing theories, including housing concepts such as residential quality, housing preferences and choices, among others, can help create an understanding of housing complexities (Aliu, 2024). Joao *et al.* (2020) referred to housing preferences as certain features any consumer wants to have in housing (intrinsic attributes or structural characteristics of the property and extrinsic attributes or location characteristics of the property). Housing preferences therefore, reflect desired types of housing situations and encompass many dimensions of housing. However, there is still some controversy over what constitutes housing preferences. Earlier, Tremblay and Dillman (1983) indicated that residential preferences are guided by a set of normative principles that socially prescribed a mix of housing bundles characteristics. These preferences are said to have some socio-economic determinants.

Empirical studies (Sakariyau and Oyetunji, 2021; Sakariyau *et al.*, 2021; Olayiwola, and Ajala, 2022) indicated diverse socio-economic reasons as determinants of residents' preference for some residential districts. Household's socio-economic profiles such as income, educational level, and occupation appear to have been studied to the greatest extent and have been found to be related to housing preferences in several instances (NAHB 2002; Jiboye and Omoniyi 2013; Sakariyau and

Oyetunji 2021; Olayiwola, and Ajala, 2022). Similarly, in another isolated study, Jansen (2020) found personal characteristics (age, household type), preferred attributes of the dwelling and its environment (proximity to shops or recreational facilities) as motivations for residential neighbourhood preferences. In Nigeria, Olayiwola, *et al.* (2006) and Sanni and Akinyemi (2009) identified some socio-economic and cultural factors of residents as well as the physical characteristics of dwellings as determinants of housing preferences.

The second socio-economic variable is the level of education, which to some extent, reflects the internalization of the society's norms. As educational attainment increases, people tend to internalize more of the housing norms. Thus, those with higher education should prefer single family home ownership to a greater extent than those with lower education. A study by Lin (2005) and Jansen (2020) revealed that, there is a significant relationship between the education level of respondents and housing preferences.

The last variable in this category is occupational prestige, which could also influence housing preferences. For instance, blue collar workers who may be forced to live closer to their workplace, because of cost of commuting and long period of work, will prefer to live in multiple family homes in the city, while white collar workers would more likely prefer to reside in a housing environment with single family homes situated in the suburbs (Lin 2005 and Jansen 2020).

Household composition is an important variable to consider with regard to housing preferences. However, empirical evidence as put forward by Fattah (2017); Berndgen-Kaiser *et al.* (2018) and Woo and Hyun **(**2018) confirmed that demographic factors such as age, household size and marital status have significant effects on residential neigbourhood preferences. The influence of socio-demographic characteristics on housing preference is prone to change as the composition of the population changes.

According to Berndgen-Kaiser *et al.* (2018) and Jansen (2020) as people move through the life cycle, they may need different kinds of housing environments or neighbourhoods. For instance, hypothetically, it is assumed that elderly people would more likely want to live in a place close to open space and far from shopping centres. Then, the housing designer should take this into consideration when building a flat or a building for senior citizens. In addition to location, households also tend to cluster in areas with other households of similar age and family structure (Jansen, 2020).

According to Sheyda and Ali (2023), housing cannot be separated from its surroundings and level of satisfaction may be more dependent on where the unit is situated. Community/social and dwelling quality have a direct significant factor on residential satisfaction. Sheyda and Ali (2023) revealed that, households attached much significance to dwelling attributes, neighbourhood quality and security when choosing a residential neighbourhood. Assessing the factors influencing households' satisfaction with residential localities in Uyo urban, Ikurekong (2009) identified social infrastructure, housing facilities, consumers' goods availability, health and leisure, water supply and security service as key determinants.

In the real world, people are looking for houses that are a bundle of residential properties (Andersen, 2011). Various needs that appear due to the problems caused by housing and the neighbourhood in which the house is situated within the realms of physical, psychological and socio-cultural environment together with their surroundings can be said to affect residents' preferences and attitude while directing the overall individual/family and public health, happiness and welfare (Berkoz *et al.,* 2009; Steven *et al.,* 2019). According to Ola (2011), a home should be viewed in the community setting because it is part of a neighbourhood. The physical and social attributes found to be related to neigbourhood preferences include distance from public transport services, nearest health centre, shopping centre, quality local schools, workplace, city centre, neighbourhood amenities and services (Bai, *et al.*, 2020). Others are neatness and attractiveness of the area, safety and security (De Vos and Witlox 2016; Steven *et al.,* 2019; Pfeiffer *et al.,* 2019; Jansen, 2020).

The conceptual framework adopted for this research work is based on Conjoint Model of residential preference and choice as shown in Figure 1. Housing preferences are influenced by the type of household, which is determined by the ages of household members and size of household. Age, marital status, presence and age of children determine the household's stage in the life cycle which subsequently impacts on housing and neighbourhood preferences. Two categories mark housing and neighbourhood preferences; Housing Status (HS) which includes location of housing and neighbourhood, and Dwelling Quality (DQ) including number of bedrooms, number of bathrooms,

number of garage, size of living rooms etc. The impact of socio-economic and demographic variables on housing and neighbourhood preferences as illustrated in the conceptual frame work in Figure 1, are filtered by the housing norms that are present in a culture. These components of housing and neighbourhood preferences and choice constitute the emphasis in this research.

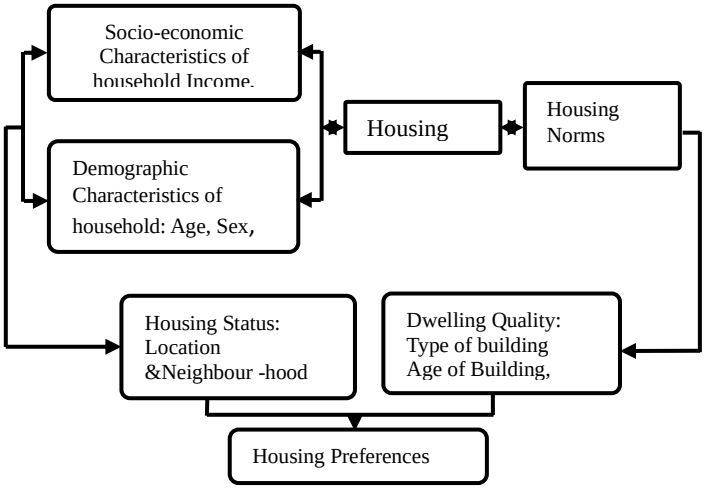

Figure 1: The Conceptual Framework of the Study (Lin, 2005)

4.0 **The Study Area**

Uyo urban is found approximately between latitudes $4^{0}59^{1}$ and $5^{0}\,05^{1}$ North of the Equator and longitudes $7^{0}\,53^{1}$and $7^{1}\,58$' East of the Greenwich Meridian. Uyo urban presently covers a land area of about 284.85km^{2}. With reference to Figure 2, the study area is centrally located within the Akwa Ibom State and it is bounded by Ikono, Ibiono Ibom and Itu Local Government Areas (LGAs) in the North: Nsit Ibom and Ibesikpo Asutan LGAs in the South while Abak and Uruan LGAs cover its west and east respectively.

Some of the advantages of the location of Uyo urban that help it function effectively as the capital city of Akwa Ibom State are centrality, accessibility and expansion potential. Its spatial expansion possibility is limitless except on the Northeastern side where the Ikpa valley popularly known as the Uyo ravine occurs. However, because of the ravine, the area has been declared a conservation area. This in turn, poses a serious setback on residential development in the northern part of the town thus, exerting enormous pressure on the available land in the southern part. This situation could have some implications on residential preferences of residents particularly in terms of residential location.

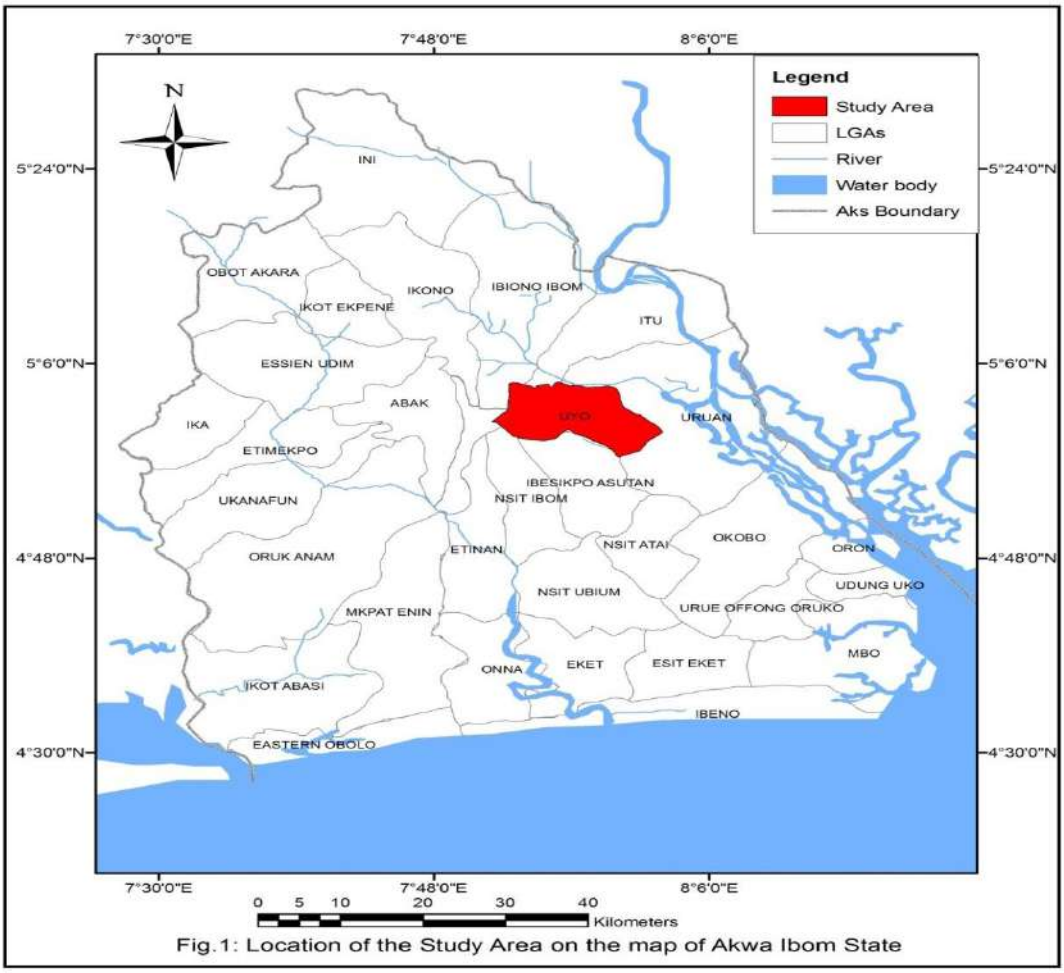

Fig.1: Location of the Study Area on the map of Akwa Ibom State

Figure 1. Uyo Urban on the Mape of Akwa Ibom State, Nigeria

The housing situation in Uyo urban shares the same characteristics with most Nigerian towns as a result of rapid urban growth leading to accelerated social polarization. This in recent times has been accompanied by a number of social problems resulting from the shortage both in quantitative and qualitative terms. The housing provision has witnessed persistent shortage over the years in Uyo urban and its environ; with attendants negative socio-economic effects. Despite the renewed efforts by government and private developers to provide housing for the teeming urban residents, greater proportion of the total population still lives in houses that fall-short of meeting their needs. Even the newly built houses in the study area, still lack basic facilities and good accesses linking the major roads to ease the movement of residents.

5.0 Methodology

5.1 Research Design

A survey design was adopted which involved the use of theoretical and empirical approaches. The theoretical approach is concerned with the review of relevant literature while the empirical aspect dealt with data collection and analysis.

5.2 Population of Study

The population of study was twofold. A total of 98 residential neighbourhoods of the study area comprising a projected population of 178,825persons make up the population of the study. This population consisted of 29,804 households based on an average of 6 persons household size (NPC, 1991).

5.3 Sampling Technique and Sample Size

Thirty (30) residential neighbourhoods were randomly selected using table of random numbers from the 98 neighbourhoods; and 395 household heads (Table 1) were drawn using Stroud and Booth (2007) formula which is given as: S= [N-P (N)]/n,

Where: S= Required Sample Size, P=Expected Value at 70% base, N= the total working population size, n= number of working Neigbourhoods.

1n selecting the houses in each of the neighbourhoods, all the streets were numbered and divided by the total number of the questionnaire to be distributed in a particular neighbourhood. This was done to ascertain the number of houses to be dealt with per street. Then, simple random sampling technique was applied to select the houses in each of the streets for questionnaire administration. A household head was given a questionnaire per house. This method was followed until the entire neighbourhoods were covered.

Table 1: List of Neighbourhoods, Projected Population and Sample Size

S/n	Neighbourhoods	1991 Pop.	Projected pop(2023)	No of Households	Sample SIZE
1	AfahaOffot	2087	4655	931	9
2	Afaha Oku	4127	9207	1841	18
3	Afaha Ube	2516	5613	1122	11
4	Aka Offot	5214	1163	2326	23
5	AtanOffot	6117	13646	2729	27
6	EkpriNsukara	1634	3645	729	7
7	EniongOffot	5214	11632	2326	23
8	Iba Oku	2283	3716	743	7
9	IbiakuOffot	1588	3543	709	7
10	IbokoOffot	5123	1145	2289	22
11	IfaAtai	2204	4694	939	9
12	IfaIkotAkpan	1872	4176	835	8
13	IfaIkotOkpon	1904	4248	849	8
14	IfaIkotUbo	2698	6019	1204	12
15	IkotAkpanAbia	2176	4854	971	9
16	IkotEbido Oku	3147	7021	1404	14
17	IkotNtuen Oku	3414	7616	1523	15
18	IkotObioAtai	2386	5323	1065	10
19	Ikot Okubo	1713	3822	764	7
20	ItiamEtoi	3427	7645	1529	15
21	MbakIkotEbo	2285	5098	1019	10
22	MbakItam	2130	4752	950	9
23	MbiabongAnyanya	1818	4056	811	8
24	MbierebeObio	2375	5298	1059	10
25	Nduetong Oku	2267	5057	1011	10
26	NsukaraOffot	4278	9544	1909	19
27	Nung Oku	2386	5323	1065	10
28	ObioEtoi	2445	5455	1091	10
29	ObioOffot	2106	4698	939	9
30	UyoOffot	7244	16161	3232	32
	TOTAL	**90578**	**178825**	**39514**	**395**

Source: Modified from NPC (1991)

5.4 Methods of Data Collection and Analyses

A structured questionnaire was the instrument of data collection. The questionnaire was distributed to the 395 household heads sampled from the population of study.

Both descriptive and inferential statistical techniques were used to describe and analyse the data. Factor analysis was used to identify the factors which determine residential housing and

neighbourhood preferences of residents in Uyo urban, while Multiple Regression Analysis was used to analyse the relationship between neighbourhood preferences and socio-economic /demographic characteristics.

The dependent variables used in this study consisted of 24 variables of neighbourhood, housing and physical characteristics while the independent variables consisted of 7 households' socio-economic and demographic characteristics as shown in Tables 2 and 3 respectively.

Table 2: List of Dependent Variables

S/No	Neighbourhood and Housing Characteristics	Unit of Data
I	Building Type	Type
2	Number of Bedroom	Number
3	Toilet Facility Type	Type
4	Age of Building	Years
5	Housing Tenure Type	Type
6	Cost of Rent	Naira
8	Personal Security Measure Type	Type
9	Source of Water	Type
10	Availability of Electricity	Type
11	Means of Transport	Type
12	Condition of Access Road	Type
13	Solid Waste Disposal Method	Type
14	Crime Rate	Type
15	Distance to Security Post (Police)	Kilometre
16	Distance to Place of Worship	Kilometre
17	Distance to Market/Shopping Centre	Kilometre
18	Distance to Place of Work	Kilometre
19	Distance to City Centre	Kilometre
20	Distance to Primary School	Kilometer
21	Distance to Secondary School	Kilometer
22	Distance to Health Center	Kilometre
23	Distance to Recreation Centre	Kilometer
24	Distance to Family/Close Friends	Kilometer

Table 3: List of Independent Variables

S/No	Variables	Unit of Measurement
	Socio- economic	
1	Educational attainment	Level
2	Occupation	Type
3	Income	Naira
	Demographic	
4	Age	Years
5	Gender	Sex
6	Marital status	Type
7	Household size	Number

6.0 Presentation of Data and Analysis of Results

6.1 Socio-economic Characteristics of Respondents

The socio-economic characteristics of respondents were assessed based on three variables which include income, level of education and occupation while the demographic characteristics were analysed using gender, age marital status and household size. The results are presented in Table 4.

Table 4: Households' Socio-economic and Demographic Characteristics

Characteristics	Responses	Percentage (%)
Gender		
Male	295	76
Female	91	24
Total	**386**	**100**
Age		
< 30	54	14
30-40	131	35
40-50	134	34
51-60	51	13
>61	16	4
Total	**386**	**100**
Marital Status		
Married	237	62
Single	111	29
Divorced	17	4
Widowed	21	5
Total	**386**	**100**
Household size		
<3	90	23
3-5	200	53
6-8	79	20
>9	17	4%
Total	**386**	**100**
Level of Education		
No Formal Education	19	5
Primary	51	13
Secondary	109	28
Tertiary	207	54
Total	**386**	**100**
Occupation		
Pub/Civil Servant	154	39
Business	172	45
Artisan	37	10
Farming	12	3
Retired	11	3
Total	**386**	**100**
Income		
< N20	107	28
N20- N50	97	25
N51- N100	88	23
N101- N150	48	12
N151- N200	31	8
200 & Above	15	4
Total	**386**	**100**

Source: Researchers' Field Survey (2023)

Table 4 indicates that, 76% of respondents were males while 24% were females. The result revealed that household heads in the study area are dominated by males. This portrays that, households 'residential decision, especially when it has to do with preference and choice of where to live. The household heads in the study area are made up of young and active population. This could be one of the reasons the housing market is very active and dynamic as earlier observed by Udoudoh and Ezenwafor (2010). The data also reveal that, 69% of the household heads in Uyo urban fall within an active age bracket of 30-50 years,14% were less than 30 years, 13% were between the age bracket of 51-60 years while 4% were above 60 years of age. Table 4 also indicates that, 62% of the respondents were married, 29% were single, and 4% were separated while 5% were widowed. There is no doubt

that, the propensity of dwelling sizes vary based on the household size. In Uyo urban the household sizes of respondents reflected a remarkable pattern, that the majority of respondents (53%) had the household size of between 3-5 persons; 23% of respondents had the household size of less than 3 persons; 20% of respondents had the household sizes of between 6-8 persons, while 4% of respondents had the household size of 9 persons and above.

An investigation into respondents' level of education reveals a high literacy rate. Table 4 shows that, the majority of the respondents 54% had tertiary education, 28% had secondary education while 13% had primary education, 5% had no formal education. The occupational distribution of the respondents reflects the economic base of the study neighbourhoods. The data on occupation of respondents in Table 4 indicate that, the majority (45%) of the respondents' occupation was business. This was followed by public/civil servants with 39%, 10% were artisans, 3% were farming, while 3% were retired. In this study, it is believed that occupation could influence housing and neigbourhood preferences. Possibly, the assumption is that, public/civil servants may express higher preferences for housing due to occupational prestige while others may prefer housing and neighbourhoods that support their kind occupation especially in terms of market availability; cost of commuting, infrastructure, security etc.

Income plays a very crucial role in residential and neighbourhood preferences of households in Uyo urban. There is no doubt that, households with higher income are more likely to prefer high quality housing environment while those with lower income are constrained to affordable areas. Table 4 indicates that, the majority (53%) of respondents earned below 51,000, 23% earned between 51,000-100,000, 12% earned between 101-150,000, 8% earned between 151,000-200,000, while only 4% of respondents earned above 200,000. In comparing the income across the study area, neighbourhoods were further grouped into high Medium and low income based on their mean income. From the analysis, it is clear that, Atan Offot, Ikot Akpan Abia, Itiam Etoi, Ikot Okubo, Mbiabong Ayanya and Ifa Ikot Okpon, fall within the high income residential neighbourhoods, while Afaha Offot, Aka Offot, Eniong Offot, Ekpri Nsukara, Nsukara Offot, Obio Offot, Obio Etoi, Ibiaku Offot, Ifa Atai, Ifa Ikot Ubo and Mbierebe Obio constitute the medium income residential neigbourhoods. others which included Afaha Oku, Afaha Ube, Iba Oku, Nduetong Oku, Ikot Ntuen Oku, Iboko Offot, Mbak Ikot Ebo, Nung Oku, Ikot Obio Atai, Ifa Ikot Akpan, Iko Ebido Oku, Mbak Itam and Uyo Offot, fall within the low income residential areas. Spatially, the low income neighbourhoods were prominent in some parts of the core areas and the peripheral localities while the high and medium groups were found to concentrate more within the inter-mediate urban areas.

6.2 Residential Neighbourhood Preferences of Respondents in Uyo Urban

The investigation into neighbourhoods' preferences of the respondents in Uyo urban was never an attempt to over-rule the impossibility of everybody living where they prefer, rather it was to uncover the pattern in which residential neighbourhoods were preferred by residents in the study area. In assessing residential housing and neighbourhood preferences, there was need to elicit the respondents' views on the current housing and neighbourhood preferences. To accomplish this, respondents were asked to rank the 30 residential neighbourhoods in order of preference on a 5 point likert scale, where 1 = very weakly preferred, 2=weakly preferred, 3=moderately preferred, 4=highly preferred and 5=very highly preferred. Table 5 and Figure 4 show the overall pattern of neighbourhood preferences of residents in the study area. From the results, it is evidently clear that, Atan Offot, Ikot Akpan Abia, Itiam Etoi, Ifa Ikot Okpon and Mbiabong Anyanya were among the very highly preferred neighbourhoods in Uyo urban. This was followed by Afaha Offot, Aka Offot, Nsukara Offot, Obio Offot, Obio Etoi, Ekpri Nsukara, Ibiaku Offot, Ikot Okubo, Mbierebe Obio and Ifa Ikot Ubo, as highly preferred neighbourhoods, while the moderately preferred residential neighbourhoods in the study area included Afaha Oku, Afaha Ube, Mbak Itam, Eniong Offot, Uyo Offot, Iboko Offot, Ikot Ebido Oku, Nung Oku, Ikot Ntuen Oku and Ifa Atia. Others such as Iba Oku, Nduetong Oku, Ikot Obio Atai, Mbak Ikot Ebo, and Ifa Ikot Akpan were weakly preferred.

Table 5: Residential Neighbourhood preference's Ranking in Uyo urban

S/N	Neighbourhoods	POP	5	4	3	2	1	sum	index	rank
1	Afaha Offot	386	169	78	66	44	43	1479	3.83	4
2	Afaha Oku	386	131	86	73	30	68	1314	3.40	3
3	Afaha Ube	386	138	77	36	34	81	1315	3.41	3
4	Aka Offot	386	182	101	77	17	9	1588	4.11	4
5	Atan Offot	386	246	114	14	8	4	1748	4.52	5
6	Ekpri Nsukara	386	180	86	39	56	25	1498	3.88	4
7	Eniong Offot	386	95	106	30	72	39	1174	3.04	3
8	Iba Oku	386	13	34	113	120	106	886	2.29	2
9	Ibiaku Offot	386	169	78	66	44	43	1479	3.83	4
10	Iboko Offot	386	142	64	39	56	85	1265	3.27	3
11	Ifa Atai	386	96	105	31	71	39	1174	3.04	3
12	IfaIkot Akpan	386	7	11	16	172	180	651	1.68	2
13	IfaIkot Okpon	386	221	120	21	16	8	1722	4.50	5
14	IfaIkot Ubo	386	168	79	66	44	43	1479	3.83	4
15	IkotAkpanAbia	386	242	116	15	10	3	1742	4.51	5
16	Ikot Ebido Oku	386	144	80	46	40	76	1330	3.44	3
17	Ikot Ntuen Oku	386	142	64	39	56	85	1265	3.27	3
18	Ikot Obio Atai	386	15	19	21	186	145	731	1.89	2
19	Ikot Okubo	386	121	109	76	40	40	1389	3.59	4
20	Itiam Etoi	386	247	109	16	10	9	1748	4.52	5
21	Mbak Ikot Ebo	386	10	21	82	142	131	704	1.82	2
22	Mbak Itam	386	142	64	39	56	85	1265	3.27	3
23	Mbia Anyanya	386	221	120	21	16	8	1722	4.50	5
24	Mbierebe Obio	386	169	76	46	41	36	1459	3.77	4
25	Nduetong Oku	386	13	25	93	149	106	798	2.07	2
26	Nsukara Offot	386	176	94	78	26	10	1552	4.02	4
27	Nung Oku	386	96	105	31	71	39	1174	3.04	3
28	Obio Etoi	386	162	99	82	23	20	1518	3.93	4
29	Obio Offot	386	215	95	32	28	16	1627	4.21	4
30	Uyo Offot	386	141	82	43	43	77	1325	3.43	3

Source: Field data (2023)

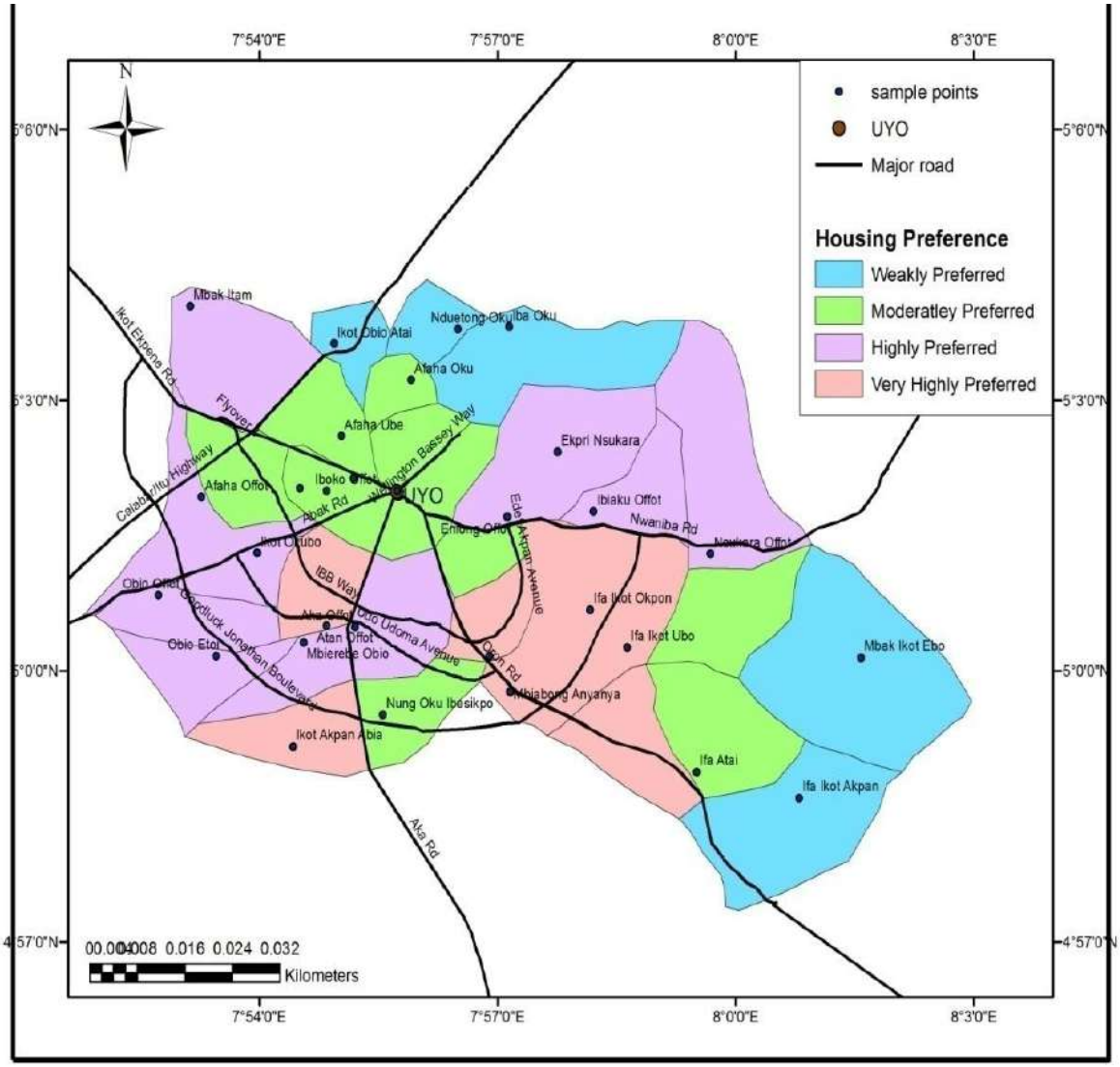

Fig. 5: Neighbourhood Preference Ranking on the map of Uyo Urban

Figure 4: Neighbourhood Preferences Pattern in Uyo Urban
Source: Field Data (2023)

i. Factors that Determine Residential Neighborhoods' Preferences of Residents in Uyo Urban

To identify factors influencing residential neighbourhood preferences of the respondents in Uyo urban, Factor Analysis technique was employed. A total of 24 neighbourhood preference variables which cut across physical characteristics of building, infrastructure, accessibility, mobility and neighbourhood social capital, were used on 30 selected neighbourhoods as presented in Table 6. These variables were all combined to define the residential physical characteristics of neighbourhoods and were converted to factors that determine residential neighbourhood preferences of residents. There was need therefore, to compress the variables into a smaller set which can effectively explain the reasons behind people's housing preference decision in the study area.

Factor Analysis was carried out on a total of 24 variables using varimax with Kaiser Normalization rotated method and this yielded a 5 dimensional solution. Obviously, the communalities which can be regarded as indications of the importance of the variables in the analysis were generally high. This shows that the variables selected for the study, were appropriate and relevant. The 5 factors which altogether accounted for 75.66% of the total variance in the 24 original variables may be regarded as composite indicators explaining the pattern of residential neigbourhood preferences of dwellers in Uyo urban.

Table 6: Rotated Factor Metrix for the Distribution of Neighbourhoods' Preferences Indicators in Uyo Urban

	Loading					
Variables	F1	F2	F3	F4	F5	Communalities
Solide Waste Disposal Methods	.902	-	-	-	-	.870
Condition of Access Road	.900	-	-	-	-	.898
Building Type	.849	-	-	-	-	.890
Cost of Rent	.846	-	-	-	-	.872
Parking Space	.790	.419	-	-	-	.825
Personal Security Measure	.780	-	-	.358	-	.844
Water Supply Sources	.767	-	-	-	-	.747
Distance to Health Centre	.735	-	.433	-	-	.824
Number of Rooms	.676	.569	-	-	-	.844
Transport Means	.663	-.363	-	-	-	.621
Types of Toilet	.655	-	-	.480	-	.713
Availability of Electricity	.650	-	-.402	-	-	.644
Crime Rate	.647	-	-356	-	-.379	.706
Distance to place of Work	.600	.351	-	-	-	.500
Housing Tenure	-	.889	-	-	-	.862
Age of building	-	.828	-	-	-	.801
Distance to City Centre	-	-	.696	.358	-	.780
Distance to family /Friends	-	-	.797	-	-	.667
Distance to primary School	-	-	.687	-	-	.577
Distance to market	.454	.485	.517	-	-	.739
Distance to Place of Worship	-	-	-	.812	-	.703
Distance to Recreation Centre	-	.312	-	.736	-	.681
Distance to Secondary School	-	-	-	-	.920	.873
Distance to Police Post		.497	-	-	.585	.658
Eigenvalues	**8.550**	**4.817**	**2.035**	**1.519**	**1.238**	
Percentage variance	**35.624**	**20.072**	**8.479**	**6.331**	**5.159**	
Cumulative (%)	**35.624**	**55.696**	**64.176**	**70.507**	**75.666**	

Source: Field Data (2023)

ii. Extraction of the Variables and Naming of the Factors

The rotated matrix of the factor loadings was employed to identify the variables and in naming of the 5 dimensions yielded from the analysis. All the variables with the highest loadings were used to name the factors while those with low loadings were dropped. From the analysis, it was revealed that factor 1 which accounted for 35.62% of the total variance was without doubt the most important factor. Of the 24 variables in the analysis, 14 loaded significantly and positively on this factor. These variables were: solid waste disposal method, condition of access road, presence of desired building type, cost of rent, presence of garage/organised parking space, presence of personal security measure (fence), source of water supply, distance to healthcare centre, number of bedrooms, easy means of transportation, type of toilet facility, availability of electricity, crime rate in the neighbourhood, and distance to place of work. Since Factor 1 was predominantly dominated by neighbourhood quality variables which also loaded significantly and positively, it was named Neighbourhood Quality Factor.

Factor 2 accounted for 20.07% of total variance in the original variables and associated with this factor were two variables which loaded significantly and positively. These variables were: housing tenure, age of building. This factor was named Housing Tenure Factor because of the high

and positive loading on this variable. Factor 3 accounted for 8.48% of total variance in the parent variables. Associated with this factor were four variables which loaded significantly and positively. These included distance to family/friends, distance to city centre, distance to desired primary school, and distance to market. Factor 3 loaded significantly and positively on 4 variables. It was thus named Accessibility Factor. Factor 4 was found to account for 6.33% of the total variance in the original data matrix. Associated with this factor were two variables which loaded significantly and these were distance to place of worship, and distance to recreational centre and it was named Distance to Place of Worship Factor. Finally, Factor 5 was found to account for 5.16%. Associated with this factor were two variables which loaded positively and significantly. These were distance to desired secondary school and to police post. Factor 5 was named Distance to Desired Secondary School. This factor had a low eigenvalue of 1.236 indicating that this factor did not received adequate consideration in the residential neighbourhood preference's decision of respondents. This is because the majority of the people believed that, distance is never a barrier to qualitative education for their children. The relative importance of the factors that determine residential neighbourhood preferences of residents in Uyo urban were shown by their eigen values which indicated that factor1 (F1) is more important followed by F2, F3, F4 and F5.

6.3 The Relationship between Residential Neighbourhood Preferences and Household Socio-Economic/Demographic Characteristics

In determining the relationship between residential neighbourhood preferences and socio-economic and demographic characteristics of respondents in the study area, multiple regression analysis which consisted of 3 regressors, namely: age, household size, and income, was used. Table 7 shows the overall statistics of the results obtained from the regression equation. From the result, it is apparent that all the 3 independents variables compositely had significant influence on residential neighbourhood preferences of dwellers in Uyo urban (R=0.700). Also, the R^2 which was found to be 0.489 indicates that 48.9% of the variance in the neigbourhood preferences of the residents was determined by the 3 predictors. Also, a critical examination of the Beta Coefficient revealed that, two of the predictors (age and household size) did not contribute significantly to the model, only one of the independents variables which is income, significantly contributed to the model.

Table7: Multiple Regression Result on the Relationship between Residential Neighbourhood Preferences and Socioe-conomic/Demographic Characteristics of the Respondents in Uyo Urban

Variables	B	Std.Error	Beta	t-Value	Sig.
Constant	2.065	0.946		2.182	0.038
AGE	0.001	0.002	0.037	0.261	0.796
HOUSEHOLD SIZE	0.014	0.151	0.016	0.095	0.925
INCOME	0.019	0.004	0.690	4.242	0.000
R	**0 .700**				
R^2	**0.489**				
R^2 adjusted	**0.431**				
Std. Error	**0.75572**				
F- Value	**8.310**				
Sig.	**0.000**				
Level of Sign.	**5%**				

Source: Field data (2023

6.4 Testing of the Hypothesis

The Null (Ho) hypothesis that: There is no significant relationship between neighbourhood preferences and socio-economic/demographic characteristics of the respondents in the study area was tested. From Table 7, it could be seen that, the relationship between neighbourhood preferences and three socio-economic/demographic characteristics of the respondents is statistically significant as the calculated F of 8.310 is greater than the significant F of 0.000 at 0.05 level of significance. The

relationship is also strong as Multiple R which is 0.700 for the predictors is higher than the average 0.500. From the analysis, the null hypothesis (Ho) is thus rejected while the alternate hypothesis (H_1) that: There is statistically significant relationship between neighbourhood preferences and socio-economic/demographic characteristics of the respondents in the study area is accepted.

7.0 Discussion of Findings

Findings from this study were found to be consistent with Jiboye and Ominiyi (2013); Pfeiffer *et al.* (2019) that age, income, and household size were significantly related to neighbourhood preferences of residents The socio-economic variables explored in this study were the respondent's demographics such as sex, age, marital status, household size, level of education, occupation and their monthly income. The study revealed that, the majority (76%) of the household heads in Uyo urban were males. This finding justifies the general belief that, in Nigerian societies, males generally dominate household heads (Olayiwola, 2006; Jiboye and Omoniyi 2013). The implication of this is that, males are more responsive to issues of housing preferences and mobility than women in the study area. In respect of age, a greater proportion (69%) of the study population was within the active age brackets of 30-50 years. Therefore, this finding presupposes that there is an active and dynamic housing market in Uyo urban.

It was equally evident that, the majority (62%) of the respondents in the study area were married while 29% were singles. It was also observed that, while very many un-married people occupied most of the single room apartments and self-contains located in more central areas of the city, most married people lived in detached and semi- detached flats of two or more bedrooms, situated mostly within the inter-mediate and peripheral areas. Findings of this study confirms the empirical works of Berndgen-Kaiser *et al.* (2018) and Jansen (2020) that, as the stage in life cycle of household shifts from single adult to married couple, the housing norms for space change.

It was statistically discernable that the propensity of dwelling sizes vary based on the household size and that household size creates a differing demand on housing which in turn leads to particular housing preference. In Uyo urban, this was evident in the number of rooms that the respondents occupied with other members of his/her household. The result has shown that greater proportion (53%) of the respondents had the household size of 3-5 persons.

With regard to monthly income, this study has also indicated that, more than half (53%) of respondents in Uyo urban earned below 51000 while only 4% earned above 200,000.Comparatively, it was observed that income was not evenly distributed across the study area and as such households with higher income preferred living in the high quality housing environment while those with lower income were constrained to affordable areas. Equally, those with high income were mostly house owners while the majority of the low income group were tenants. Findings from this study were consistent with the studies of Trembly and Dillman (1983) which found that those people who have high income prefer housing options involving ownership more so than those with lower income.

However, the possible explanation for factors influencing the residential neighbourhoods' preference of residents in Uyo urban was further distilled using factor analysis. Factor analysis procedure carried out on the 24 variables yielded a five (5) dimensional solution which accounted for 75.66% of the total variance in the 24 original variables. From the analysis, neighbourhood quality was identified as the most important factor influencing residential neighbourhoods' choice of residents in Uyo urban. The factor which accounted for 35.62% of the total variance of 75.66% was defined by 14 variables which include methods of solid waste disposal, condition of access road, presence of desired building type, cost of rent, presence of garage/organized parking space, presence of personal security measure (fence), source of water supply, distance to healthcare centre, number of bedrooms, easy means of transportation, type of toilet facility, availability of electricity, crime rate and distance from work place.

8.0 Conclusion

The study revealed a marked variation in respect to housing and neighbourhood preferences in the study area. Among the factors influencing housing and neigbourhood preferences of the residents in Uyo urban were neighbourhood quality, housing tenure structure, accessibility, and distance to place of worship and distance to desired secondary schools. The study has further

established a strong correlation between neigbourhood preferences and households' personal characteristics such as age, household size and income.

9.0 Recommendations

On the basis of the findings the following recommendations are made:

i. Building enough of the right housing in urban areas will not only provide for individual preferences, but also sets the structure of the city, which in turn can affect issues such as the time we spend commuting, the cost of infrastructure, and even the continued concentration of the urban poor at the fringes of the city.
ii. Policy-makers, urban planners, architects, builders, developers and all stakeholders concerned with housing should work harmoniously to ensure coherent and functional residential developments. As a matter of necessity, housing planning must not be done in isolation of the environment in which the structures will be situated as it has always been the case. This is to say that, if residential housing development must meet the needs and requirements of the people in all ramifications, such housing must be planned and designed in an integrated manner.

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COMPRESSIVE STRENGTH OF CONCRETE MADE WITH RECYCLED CRUSHED ASPHALT PAVEMENT FOR RIGID PAVEMENT CONSTRUCTION IN NIGERIA

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Abstract
A large number of flexible pavement structures are demolished in Nigeria and other countries but only small quantities of the demolished wastes are reused. This causes environmental pollution and requires large spaces for dumping. This study assessed the compressive strength of concrete made with recycled crushed asphalt pavement (RAP) in a view to determining its suitability for use in rigid pavement construction. Concrete with mix ratio of 1:1.5:2 was used throughout the experiment. Seven concrete mixes were produced with each containing different types of coarse aggregate combinations. Coarse aggregate combinations in the mixes were; gravel, granite, RAP, gravel + granite, gravel + RAP, granite + RAP and gravel + granite + RAP. A total of 42 concrete cubes were produced, six cubes for each mix. Slump tests and compressive strength tests were carried out on fresh and hardened concrete specimens respectively. The results of tests on concrete with only RAP as aggregate gave a percentage slump of 49%, water absorption of 1.6% at 28 days and an average compressive strength of 12.38 Nmm^{-2} at 28 days. It was generally observed that cubes with only RAP had average strength which was 46.9% and 46.1% lower than those with granite and gravel only, respectively. These percentage differences decreased with the use of RAP as partial replacement of conventional aggregates. The study concluded that the use of RAP in rigid pavement construction as partial replacements for conventional aggregates gave concrete with less workability, higher percentage of water absorption and lower compressive strength. However, it was recommended that further evaluations be carried out to establish ideal processes for treatment of RAP and procedures for the mix design of concrete incorporating RAP to achieve optimum benefits from their use.

Introduction

A highway pavement consists of superimposed layers of processed materials above the soil sub-grade, whose basic function is to distribute the applied load to the sub-grade. The pavement structure should be able to provide a surface of good riding quality, adequate skid resistance, favourable light reflecting characteristics and low noise pollution. The ultimate aim is to ensure that the induced stresses due to wheel load are sufficiently reduced (Saurabh, 2013). The rigid pavement structure consists of a cement concrete slab, below which a granular base or sub-base course may be provided. Providing a good base or sub-base course layer under the cement concrete slab, increases the pavement life and is more economical in longer run (Arvind, 2003). Due to rigidity and high tensile strength, a rigid pavement tends to distribute the load over a relatively wide area of sub-grade.

Concrete is a composite material composed of aggregates (fine and coarse), cement and water. Cement and aggregate remain the most important constituents while aggregates alone constitute a major portion of the volume of concrete. According to (Alexander, *et al*, 2005), between 70-80 percent of the total volume of concrete is occupied by aggregates. It is expected that aggregates will have a profound influence on the concrete properties, production cost and its general performance. Aggregates are normally coarse gravel or crush rocks such as limestone or granite along with fine aggregates such as sand. These are responsible, partly for the durability, quality and strength of the resulting concrete. Most importantly, Portland limestone cement and other cementitious materials such as fly ash and slag cement, serve as a binder for the aggregates, while various chemical admixtures may be added to achieve varied properties. Aggregates for cement are either naturally or artificially produced. Natural aggregates are found in sea shores, river beds while the artificially produced aggregates are found in crushed plants. Sand and fine aggregates are naturally extracted from sand quarries.

In Nigeria, the high cost of procuring concrete materials for construction works have over the years constrained the user to compromise on quality. This has resulted in poor performance of infrastructure in service, a major factor that has contributed to the increase in maintenance cost and the series of collapsed structures with attendant loss of lives and properties (Ulaeto and Ugwoeri, 2023). Stakeholders in the Nigerian construction industry have been clamouring for the use of alternative

materials to limit cost of construction and enhance sustainability. Therefore, a need for the sourcing and development of alternative, non-conventional local construction materials. Nigeria in pursuit of her vision 2020 development goals has reawakened a serious need to use recycled materials as alternatives for the construction of functional but low-cost infrastructures in both urban and rural areas (Marut, Alaezi & Obeka, 2020). This draws questions on how this national and global objective could be realized in the area of construction of sustainable and green highway pavements.

This study looks towards sustainability in the construction of rigid (concrete) highway pavements through substitution of conventional coarse aggregates such as gravel and granite with recycled crushed asphalt pavement (RAP) obtained as waste from demolished flexible pavements, still maintaining the required high compressive strength. Indiscriminate disposal of used asphalt pavement has constituted a waste as well as source of pollution to the physical environment. To address the above issue, the practice of industrial ecology is needed. This involves, the treatment of waste of a particular industry as a raw material for another industry. Concrete as a composite construction material is composed primarily of aggregates, cement and water. In general, aggregates make up 70 to 80% of total concrete volume, so their selection is important. Aggregates also they control concrete properties, aggregates provide bulk, strength and wear resistance in these applications. These make the selection and proportioning of aggregates a case requiring careful attention. Conventional coarse aggregates generally consist of coarse gravel or crush rocks such as limestone or stone dust. Bulk of pavement structures is formed by aggregates (Vikas, *et al*, 2016). Recycled asphalt pavement (RAP) is the removed and reprocessed pavement material containing asphalt and aggregates. The use of recycled asphalt pavement has become a common practice in the construction, reconstruction of new and old hot mix pavements (Pradhan, Das & Patra, 2023) but little research has been done to examine the potentials of incorporating recycled asphalt pavement (RAP) into cement concrete in Nigeria. Majority of roads in the country are constructed as flexible pavements which are regularly rehabilitated. The Federal Government of Nigeria in the year 2023 expressed its desire to make a drastic shift from the use of flexible pavements to rigid concrete pavements for construction of federal highways with an estimated budget of thirty-five billion Dollars ($35 Billion) (Aina, 2023). Implementation of such projects using recycled materials would contribute significantly to project cost savings and the promotion of green construction. In this study, the compressive strength properties of cement concrete comprising different coarse aggregates are investigated through laboratory experiments.

The study aims to evaluate the compressive strength of concrete made with crushed recycled asphalt pavement as aggregates with a view to promoting its application in the sustainable construction of a rigid pavements. Specific objectives of the study include:

i. to assess the workability of concrete made with crushed recycled asphalt pavement as aggregates, and
ii. to assess the compressive strength of concrete made with of gravel, granite and crushed recycled asphalt aggregate in different proportions.

The use of demolished asphalt pavement as replacement to coarse aggregate in rigid pavements has benefits in terms of cost and reduction of pollution from construction industry. The cost of concrete production will reduce considerably compared to conventional concrete produced by using freshly obtained coarse aggregate. Since it is readily available at very low cost, its application will reduce the construction pollution and enhance the effective use of construction waste which contributes to solid waste management. The study also contributes to economy in road construction, limiting environmental degradation in terms of reduced mining and less pollution. Use of recycled asphalt pavement will also conserve resources, landfill space and will generate profit for the recyclers.

Literature Review

Tests on concrete with crushed recycled asphalt pavement as aggregate

This brief review of existing literature emphasises on the objectives and findings of experimental programs conducted on concrete made with crushed recycled asphalt as aggregate. Delwal, Fahmy and Taha (1997), Hassan, Brooks and Erdman (2000), Huang, Shu and Burdette (2006) and Okafor (2010), assessed a number of different mixtures with varying percentage replacements of coarse and fine aggregate with RAP and concluded that concrete made with fresh aggregate is stronger than concrete with any percentage of RAP. The study also added that RAP enhances the ductility and

elastic behaviour of concrete. Cuttell *et. al.* (1997) introduced RAP in steel fibre reinforced roller compacted concrete, using a hydraulic binder consisting of limestone, fly ash, slag and clinker. Three RAP percentages (0, 40, and 80) were used and hydraulic-binder-treated RAP material was also used which contained 5% binder. Results showed that the binder- treated RAP had the lowest compressive, splitting tensile strengths and elastic modulus.

Ramzi, *et. al*. (2002) through laboratory tests on cement stabilized reclaimed asphalt pavement (RAP) aggregate and reclaimed asphalt pavement-fresh aggregate blends concluded that 100% reclaimed asphalt pavement aggregate could be successfully utilized as a conventional base material if stabilized with cement. Hossiney, Tia and Bergin (2010) compared concrete mixes with RAP and fresh natural stone as coarse aggregate. This study concluded that compressive strength, splitting tensile strength, and flexural strength decreased with the addition of RAP. It also added that modulus of elasticity decreased with addition of RAP and coefficient of thermal expansion does not appear to be affected by RAP content.

Generally, there is a clear consensus that the introduction of RAP to concrete as the sole coarse aggregate decrease the strength properties and modulus of elasticity of the hardened concrete. Ductility of the hardened concrete incorporating RAP has also reported to increase relative to those of concrete made with natural aggregates. Taking into consideration the Nigeria context, a limited number studies cover RAP sourced from Nigerian dump sites and use of RAP as partial replacements to locally sourced natural coarse aggregates. These provides gap that justifies the relevance of the current study.

Materials and Methods

Materials

Materials used in this study include Portland Limestone Cement, fine aggregate (sharp river sand), coarse aggregate (gravel, granite and crushed recycled asphalt pavement) and water. Portland Limestone Cement manufactured by Dangote cement company in Nigeria was obtained from local dealers in Ikot Akpaden, Mkpat Enin Local Government Area of Akwa Ibom State and used throughout the production of cube specimens. Cement grade was the 44.5R with compressive strength of 44.5 MPa. The fine aggregate (river sand) was obtained within Ikot Obio Ndoho community, Mkpat Enin Local Government Area, Akwa Ibom State, Nigeria. It was sieved and the grading conformed to the zone 3 requirement of BS 882 (1983).

Coarse aggregates that were used for the production of the control samples (normal concrete) were gravel, granite and recycled crushed asphalt pavement. Gravels are results of the natural disintegration of rocks which are at least 2 mm in diametre. Larger sizes maybe called pebbles, cobbles or boulders. It was sourced locally from a river in Iton community within Mkpat Enin Local Government Area of Akwa Ibom State, South-South, Nigeria. It was subjected to sieve analysis in accordance to the BS 812-103 (1985). Granite (crushed aggregate) is quarried or excavated stone that has been crushed and screened to the desired standard particle size and distribution. Crushed stone aggregates are particularly suitable for use in the courses of streets, roads and other areas exposed to traffic. Granite was obtained from local dealers within Ikot Akapaden, Mkpat Enin Local Government Area of Akwa Ibom State, Nigeria. Sieve analysis was carried out on the crushed aggregates that were used in the experiment in accordance to BS 812-2 (1995). Recycled crushed asphalt pavement that was used in the production of sample specimens was sourced from a dump site owned by Julius Berger Nigeria in Uyo, Akwa Ibom State, Nigeria. A reasonable quantity was taken, processed and crushed manually to form a well graded material. The waste recycled asphalt rubbles were then sieved and graded to sizes similar to those of natural aggregates in accordance to the BS 812-103 (1985). The aggregates were used in a saturated surface dried condition. Water that was used to produce concrete samples was clean, free from injurious oils, chemicals and vegetable matter or other impurities. It was obtained from the Akwa Ibom State University fresh water supply system, within the school premises. It was portable.

Equipment/Apparatus

The tools and apparatus for the experimental tests were weight scale, mixing board, scooper, tapping rod, pycnometre, trowels, tapes, head pan, measuring cylinder, standard sieves (20mm-pans), 100mm x 100mm x 100mm cube moulds and compressive strength testing machine.

Concrete production mixed design

Concrete mix of gravel, crushed granite and crushed recycled asphalt pavements (sample specimens) were produced manually with the aid of a hand-trowel for all mix proportions. Concrete mix ratio of 1:1.5:2 (cement: fine aggregate: coarse aggregate) which was prescribed for concrete of grade M35 was used, with water-cement ratio of 0.5. The batch quantities were measured in kilograms. The above method was applied to the batching and mixing of natural coarse aggregates (gravel, granite) and recycled crushed asphalt pavement (RAP) aggregate in the following mix combinations.

i. Cement + fine aggregate + granite
ii. Cement + fine aggregate + gravel
iii. Cement+ fine aggregate + recycled crushed asphalt pavement
iv. Cement + fine aggregate + (granite + gravel)
v. Cement + fine aggregate + (granite + recycled crushed asphalt pavement)
vi. Cement + fine aggregate + (gravel + recycled crushed asphalt pavement)
vii. Cement + fine aggregate + (granite + gravel + recycled crushed asphalt pavement)

Laboratory investigations

Various tests were undertaken in order to assess the properties of the individual constituents of concrete and concrete sample specimens. Tests included sieve analysis, moisture content and absorption capacity, bulk density, specific gravity, slump test, density and compressive strength test.

Sieve Analysis

This is the process of selecting and obtaining a particular particle (grain) size of aggregate materials in a set of sieves arranged sequentially. The particle size distributions for both the coarse and fine aggregates were determine using sieve analysis in accordance with BS 812-103:1 [1985]. The weight retained on each sieve was recorded. The weights passing and the percentage passing was determined. The weight retained is summed together and compared with the weight of the sample at the beginning of the analysis.

Moisture Content and Absorption Capacity

The moisture content and absorption capacity of the aggregates was determined in accordance with the provision of BS 812- 2 (1995).

Bulk Density

The test of bulk density of the samples was carried out in accordance with BS 812-2 [1995]. Bulk density of concrete is the mass of freshly mixed concrete required to fill the container of a unit volume. Bulk density of concrete reflects the ability of concrete to function for structural support, water and solute movement, and durability. This method helps to calculate the yield of concrete per cubic metre.

i. Density of Concrete (w_1) is the mass per cubic metre of concrete and was calculated by dividing the weight of fully compacted concrete in the cylindrical measure by the capacity. of measure in kg/m^3

$$W_1 = \frac{W}{0.01} \quad (1)$$

ii. Yield of Concrete (v_2) is the volume of concrete produced per cubic metre.

$$V_2 = \frac{W_c + W_f + W_{ca} + W_w}{W_1} \quad (2)$$

Where,

W_c = Weight of cement in kg
W_f = Weight of fine aggregate in kg
W_{ca} = Weight of coarse aggregate in kg
W_w = Weight of water in kg

Specific Gravity

The specific gravity (Gs) of both the coarse and fine aggregates was determined by using the pycnometer method in accordance with BS 812-2 (1995). Specific gravity test of aggregates is done to measure the quality of the material while water absorption test determined the water holding capacity of the coarse and fine aggregates. Specific Gravity is the ratio of the weight of a given volume of aggregate to the weight of an equal volume of water. It is the measure of quality of the specific material. Aggregates having low specific gravity are generally weaker than those with higher specific gravity values.

Slump Test

The slump test was done according to BS 1881 - 102 (1983) for all the mixes. Concrete slump test was carried out to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction. Equipment used in the slump test include the slump cone, non-porous base plate, measuring scale, temping rod. The mould for the test is in the form of the frustum of a cone having height 30 cm, bottom diameter 20 cm and top diameter 10 cm. The tamping rod is made of steel with 16 mm diameter, 60cm long and rounded at one end. Figure 1 shows the slump test being carried out on a concrete sample.

Curing

Curing is the process of making the concrete surfaces wet for a certain time period after placing the concrete so as to promote the hardening of cement. This process consists of controlling the temperature and the movement of moisture from and into the concrete. Curing was carried out by carefully placing cast concrete cubes into rubber water tanks for the required duration as illustrated in Figure 2.

Compressive Strength Test of Concrete Cubes

Compressive strength tests were carried out in accordance to BS 1881-116 (1983). Test cube specimens were of size 100mm x 100mm x 100mm. Fresh concrete in the moulds were tapered so as to expel air voids. After 24 hours, moulds were removed, and test specimens were placed into a water tank for curing. The top surface of these specimens was made even and smooth. This is done by placing cement paste and spreading smoothly on the whole area of the specimen.

These specimens were tested in uniaxial compression after 7 and 28 days of curing using an electronic compression testing machine as shown in Figure 3. Load was applied gradually at a rate of 140 kg/cm^2 per minute till the specimens failed. Load at the failure divided by area of specimen gave the compressive strength of the concrete cube as define in Equation 3.

$$Compressive\ Strength = \frac{Crushing\ load\ as\ determined\ from\ compressive\ strength\ test\ machine}{Cross-Sectional\ area\ of\ loaded\ area\ of\ specimen} \quad (3)$$

Concrete mix constituents and proportion

Mixes adopted for this study are as presented in Table 1, for each sample. Varying coarse aggregate constituents were adopted. Generally, a mix of 1 : 1.5 : 2, which represented the ratio of cement to fine aggregate and to coarse aggregates was used for all samples. A water/cement ratio of 0.5, with a cement content of 3.33kg for each mix proportion was adopted. The different sets of concrete cubes of 100 x 100 x 100 mm were casted by manually mixing the coarse aggregate in different percentages of 100%, 50% and 33.3%, for each type of coarse aggregate considered.

Figure 1. Slump Test

Figure 2. Curing of Concrete Cubes

Figure 3. Crushing of Concrete Cubes

Table 1. Concrete mix constituents and proportion

SAMPLE NAME	**GRANITE**	**RAP**	**GRAVEL**	**GRAVEL + GRANITE**	**GRAVEL + RAP**	**GRANITE + RAP**	**GRAVEL + GRANITE + RAP**
LABEL	Y1	Y2	Y3	Y4	Y5	Y6	Y7
W/C RATIO	0.5	0.5	0.5	0.5	0.5	0.5	0.5
WATER (kg)	1.66	1.66	1.66	1.66	1.66	1.66	1.66
CEMENT (kg)	3.33	3.33	3.33	3.33	3.33	3.33	3.33
FINE (0mm – 3.35mm) (kg)	4.99	4.99	4.99	4.99	4.99	4.99	4.99
COARSE GRAVEL (5mm – 15mm) (kg)	-	-	6.66	3.33	3.33	-	2.22
GRANITE (5mm – 15mm) (kg)	6.66	-	-	3.33	-	3.33	2.22
RAP (6mm – 20mm) (kg)	-	6.66	-	-	3.33	3.33	2.22

Presentation of Results

Sieve analysis test

Results of sieve analyses in the form of particle size distribution curves are as presented in Figures 4 to 7. These are for fine aggregate (river sand) and coarse aggregates (gravel, granite and recycled crushed asphalt pavement). Results showed that the particle sizes of the sample of fine aggregate used for this study ranged from 0-3.35mm. The mass of fine aggregate retained on each sieve were recorded during the experiment from which the percentages passing were calculated. For the river sand, Figure 4 shows that more than 90% of the particles passed through the sieve size 3.35 mm. This allows for the classification of the aggregate as fine aggregate. Figure 4 also reveals that the river sand used is characterized by an s-curve, indicating that the aggregate has a gradation of particle size that span evenly in size from finest to coarsest.

The result of particle size distribution carried out on samples of gravel (river stones) aggregate is as shown in Figure 5. This aggregate is usually round with smooth edges. Sample obtained had particles ranging from 5 – 15 mm in size. From Figure 5, it is observed that 96.10 % of the gravel aggregate passed through sieve size 13.2mm and 77.89% passed through sieve size 10 mm. The graph showed that the sizes of the aggregate decreased with a steep curve towards zero percent. Granite is a quarried stone aggregate; they are usually angular or irregular in shape. Figure 6 shows the particle size distribution curve for the sample of granite carried out in accordance with BS 812-103 (1985). The granite sample ranged from 5 mm – 15 mm in size. It on sieve size 13.20 mm, 18.94% of the granite mass was retained and about 46.11% was retained on sieve with size 10mm. The Figure 6 also shows that 81% passed through sieve size 13.2mm and 27.79% passed through sieve size 10mm. The particle size distribution curve shown in Figure 6, is characterized by a steep curve, this showed that the coarse aggregate had little variations in sizes. Sieve Analysis for recycled crushed asphalt pavement (RAP) aggregate showed that the sizes of particles ranged from 6mm – 20mm. Result of sieve analysis is as shown in the particle size distribution curve presented in Figure 7. Figure 7 shows that the coarse aggregate is poorly graded with small variations in size.

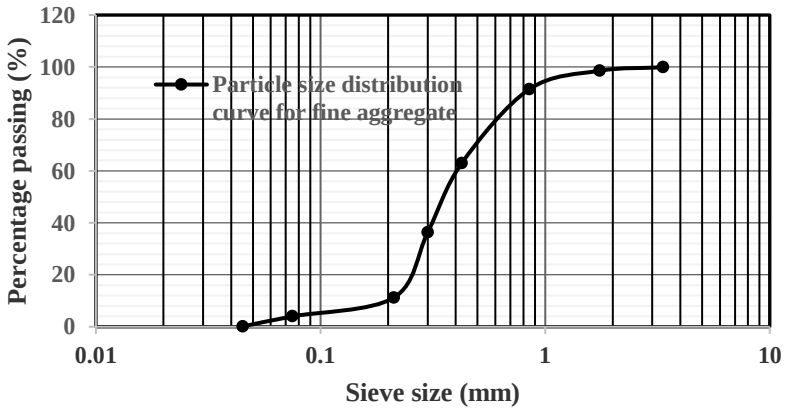


Figure 4. Particle size distribution curve of fine aggregate.

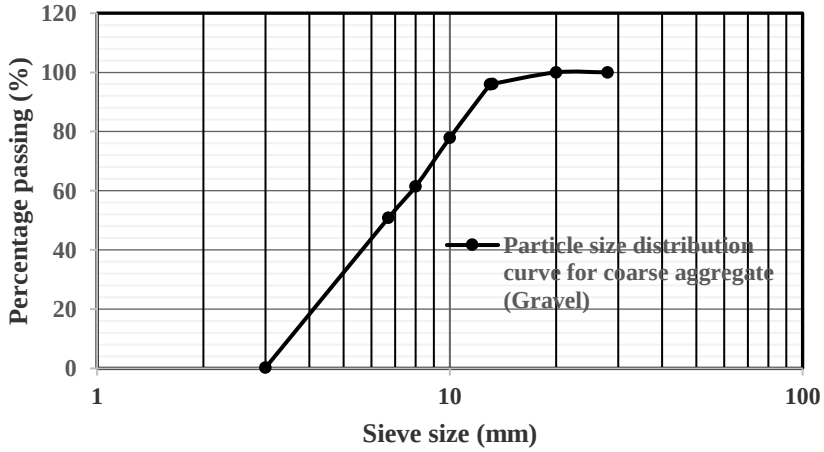


Figure 5. Particle size distribution curve of coarse aggregate (gravel).

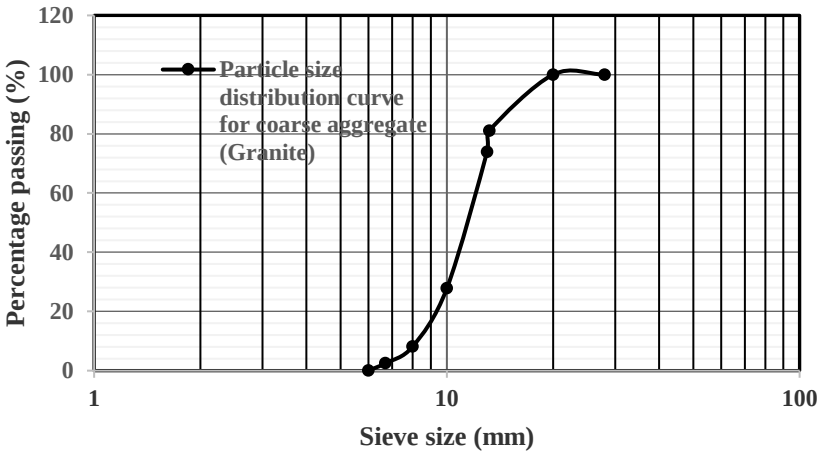


Figure 6. Particle size distribution curve of coarse aggregate (granite).

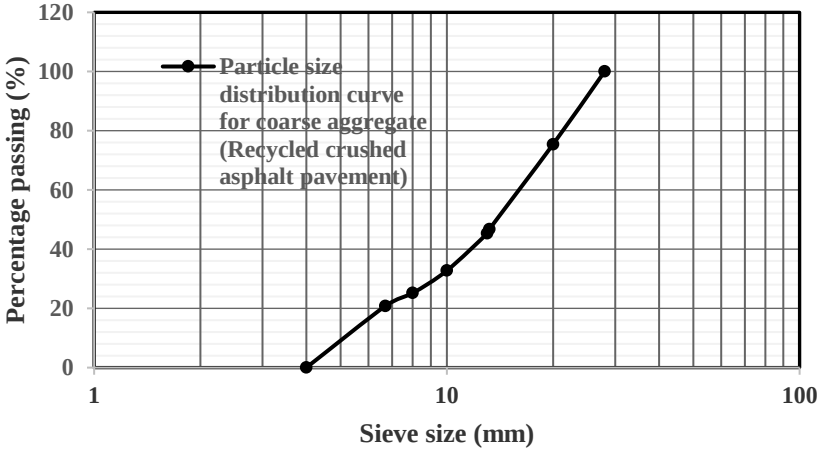


Figure 7. Particle size distribution curve of coarse aggregate (recycled crushed asphalt pavement)

Specific Gravity Test

Specific gravity test was carried out to determine the quality of the specific material. Aggregate having lower specific gravity are generally weaker than those with higher specific gravity. Table 2 shows the results of specific gravity test conducted on samples of fine and coarse aggregate. Similarly, the specific gravity conducted on samples of gravel, granite and RAP were 2.5, 2.9 and 2.0, respectively. The specific gravity test results show that RAP with a specific gravity of 2.0 was the least dense coarse aggregate used.

Table 2. Specific gravity of aggregates

Aggregate	Specific gravity
River sand	2.6
Gravel	2.5
Granite	2.9
Recycled crushed asphalt pavement (RAP)	2.0

Bulk Density of Concrete

The bulk density was determined for each mix proportion in accordance with BS 812: 2 (1995). Bulk density of concrete reflects the strength of concrete, water or solute movement and durability. It is the mass of freshly mixed concrete required to fill the container of a unit weight volume. Values of bulk density determined are as shown in Table 3. Overall, values of bulk density ranged from 2640 kgm^{-3}, for concrete made with granite to 2426 kgm^{-3} for concrete made with RAP.

Table 3. Bulk density of fresh concrete mix samples used in the study

SAMPLE NAME	SAMPLE STATE	WEIGHT OF CONTAINER (kg)	VOLUME OF CONTAINER (mm^3)	WEIGHT OF CONTAINER + AGGREGATE (kg)	BULK DENSITY (kgm^{-3})
GRANITE	Compacted	4.678	100 x 100 x 100	7.381	2640
RAP	Compacted	4.678	100 x 100 x 100	7.104	2426
GRAVEL	Compacted	4.678	100 x 100 x 100	7.250	2572
GRAVEL + GRANITE	Compacted	4.678	100 x 100 x 100	7.244	2566
GRAVEL + RAP	Compacted	4.678	100 x 100 x 100	7.136	2458
GRANITE + RAP	Compacted	4.678	100 x 100 x 100	7.238	2560
GRAVEL + GRANITE + RAP	Compacted	4.678	100 x 100 x 100	7.210	2532

Slump Test Results

The results of slump test carried out on samples of fresh concrete to determine their workability are as shown in Table 4. This was carried out in accordance with BS 1881-102 (1983).

Table 4. Results of Slump Test for all Mix Samples.

SAMPLE NAME	HEIGHT OF CONE (mm)	VERTICAL SETTLEMENT (mm)	SLUMP	% SLUMP
GRANITE	300	140.00	160.00	46
RAP	300	140.70	150.30	49
GRAVEL	300	100.00	200.00	33
GRAVEL + GRANITE	300	120.00	180.00	40
GRAVEL + RAP	300	150.20	140.80	50
GRANITE + RAP	300	230.30	60.70	77
GRAVEL + GRANITE + RAP	300	150.70	140.30	52

With water/cement ratio of 0.5 and cement content of 3.33 for each mix proportion, Table 4 shows that the slump ranged between 60.7mm and 200mm. Concrete made with granite and RAP had a slump value of 60.6 mm which describes the slump as true slump and its workability, medium. Concrete made with gravel + granite + RAP achieved a slump value of 140.3mm which described the slump as true with a high workability. Concrete made with gravel + RAP had a slump value of 140.8mm. The slumps took various shapes. Concrete made with gravel had a slump value of 200mm, concrete made with gravel + granite had a slump value of 180mm, concrete made with RAP had a slump value of 140.7mm, concrete made with granite had a slump value of 160mm and the slump were true with a high workability. Concrete with a slump greater than 100 mm is typically used where reinforcing has tight spacing and or concrete has to flow a great distance.

Water Absorption Test

The results of water absorption test carried out on samples of concrete cubes specimen for all mix proportions is as presented in Table 5. This test was carried out to determine the moisture content and absorption or water holding capacity of concrete in accordance with the provisions of BS 812:2 (1995). The results cover tests carried out on 7 days and 28 days old cubes. Concrete cubes with gravel, granite and RAP had the highest average percentage of water absorption at 7 days, while concrete cubes with a combination of gravel and RAP had the least average percentage of water absorption. At 28 days, concrete cubes with RAP and those with a combination of gravel and RAP were observed to have the highest average percentage of water absorption. Concrete cubes with granite as the coarse aggregate at 28 days showed the least value of average percentage of water absorption.

Table 5. Results for Average Percentage of Water Absorption for 7 Days and 28 Days

SAMPLE NAME	SAMPLE LABEL	7 DAYS (%)	28 DAYS (%)
GRANITE	Y1	1.1	1.2
RAP	Y2	1.2	1.6
GRAVEL	Y3	1.3	1.4
GRAVEL + GRANITE	Y4	1.2	1.4
GRAVEL + RAP	Y5	1.0	1.6
GRANITE + RAP	Y6	1.2	1.4
CRAVEL+ GRANITE + RAP	Y7	1.4	1.5

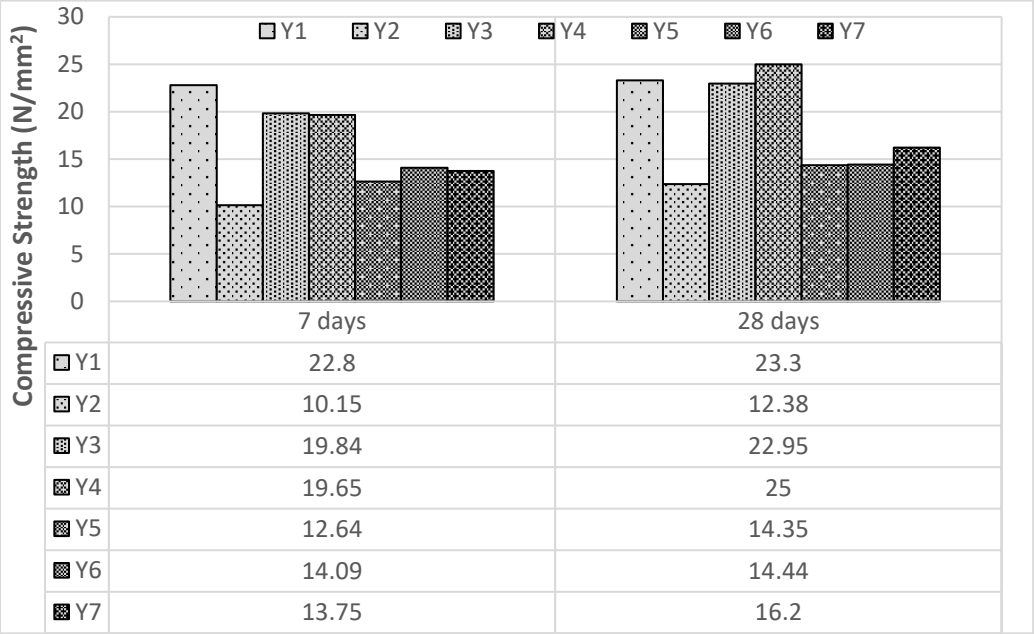
Compressive Strength Test

The compressive strength tests carried out on concrete cube specimens for all mix batches on the 7th day and 28th day are as shown in Table 6. Figure 8 allows for comparison of strength among the various concrete specimens made with different coarse and combination of coarse aggregates. From Table 6, it was observed that the compressive strength increased with age at curing, the highest strength was obtained from concrete mix proportion of gravel + granite 25N/mm^2, granite 23.3N/mm^2 and gravel 22.95N/mm^2 while the least strength was recorded for concrete made with RAP 12.38N/mm^2, gravel + RAP 14.35N/mm^2, granite + RAP 14.44N/mm^2 and gravel + granite + RAP 16.20N/mm^2.

Table 6. Average Strength for Compressive Strength Test for 7 Days and 28 Days

SAMPLE COARSE AGGREGATE CONTENT	SAMPLE LABLE	7 DAYS STRENGTH (N/mm^2)				28 DAYS STRENGTH (N/mm^2)			
		A	B	C	AVEARGE	A	B	C	AVERAGE
GRANITE	Y1	23.03	23.60	21.75	22.80	24.84	23.86	27.21	23.30
RAP	Y2	10.94	9.33	10.17	10.15	12.07	11.99	13.10	12.38
GRAVEL	Y3	20.32	19.89	19.31	19.84	24.78	22.97	21.09	22.95
GRAVEL + GRANITE	Y4	21.33	18.57	19.05	19.65	23.24	25.44	26.33	25.00
GRAVEL + RAP	Y5	13.35	13.00	11.56	12.64	13.33	13.59	16.13	14.35
GRANITE + RAP	Y6	13.56	13.60	15.16	14.09	14.91	14.55	13.85	14.44
GRAVEL + GRANITE + RAP	Y7	14.63	12.92	13.72	13.75	16.67	14.80	17.12	16.20

Cement content: 3.33, Water-cement ratio: 0.5, Cube specimen size: 50 mm x 50 mm x 50 mm



	7 days	28 days
Y1	22.8	23.3
Y2	10.15	12.38
Y3	19.84	22.95
Y4	19.65	25
Y5	12.64	14.35
Y6	14.09	14.44
Y7	13.75	16.2

Figure 8: Comparison of average compressive strength test among concrete specimens made with different coarse aggregates and combination of coarse aggregates

Discussion of Results

The results showed that the fine aggregate (river sand) had a specific gravity of 2.6. This is within the range of values as specified by Bowles (1997) for fine aggregates. Based on the established relationship between specific gravity and uniaxial compressive strength (Amuda, Uche & Amuda, 2014), RAP is be expected to be the weakest of the three coarse aggregates as it has the least specific gravity. This will also be expected as the RAP is made of natural aggregates bonded by dried and hardened tar. These tar interface provides a region of weakness through which failure planes would develop. The low values of specific gravity for RAP, relative to the natural aggregates, translates to the bulk density of fresh concrete samples made. Results showed that fresh concrete specimens made with RAP only had the least value of bulk density while those with RAP and other aggregates generally had bulk density values lower than those of similar concrete specimens without RAP.

Results of slump tests showed that slump values of all fresh concrete specimens fell within acceptable limits for use in rigid highway pavement construction (Kox *et. al.*, 2019). Poor particle grading of RAP aggregate contributed to its low slump value, which was the lowest among the aggregates assessed. Its rough surface increases friction between the coarse aggregate particles and other constituents of the fresh concrete mix would also contribute to the relatively low slump values. Fresh concrete mix with a combination of granite and RAP as coarse aggregates, which are aggregates with rough surface areas, gave the least value of slump.

Water absorption values between 1.2 and 1.6% measured for concrete specimens were low, though did not meet code requirements. Golewski (2023) cites that for proper durability, water absorption values of concrete should be within 4% to 6% and water absorption below 10% was generally considered low. A water absorption value of 0.6% is generally recommended for pavement construction in international codes.

Concrete cubes with only RAP aggregates gave the least compressive strength. This was believed to be due to the RAP aggregates being the weakest of the three aggregates considered (Kox *et. al.*, 2019). This observation was made over both the 7 days and 28 days compressive strength as elaborated in Figure 8. Introduction of RAP in combination with natural aggregates showed a reduction in the compressive strength of concrete relative to the compressive strength of concrete specimens made with the natural aggregates only. Observed reduction in strength were about 40%, with a 50% replacement of the natural aggregates. This indicates that higher strengths could be

obtained with lower percentage replacements. Therefore, establishing the potential for use of RAP in the sustainable production of rigid concrete highway pavements.

Conclusion and Recommendation

The following conclusions were drawn based on the findings of the study.

i. Concrete containing RAP either as the sole coarse aggregate or as partial replacement of natural aggregates are lighter and less workable than those containing only the natural aggregates, though the workability characteristics of RAP concrete are within acceptable limits.
ii. Concrete specimens containing RAP have higher percentage of water absorption than those with only natural aggregates. Therefore, surface treatment with hydrophobic materials must be considered when adopted for pavement construction.
iii. A reduction in compressive strength of about 40% is experienced in concrete specimens with 50% RAP aggregate content when compared with those without RAP. Lower strength losses is expected with lower RAP content.
iv. Similar compressive strength performances are expected from normal strength concrete partially replaced with RAP whether the natural aggregate replaced is gravel or granite.
v. RAP shows good potential for use in the sustainable production of rigid concrete highway pavements.

The study therefore recommends that further studies be carried out aimed at establishing optimum concrete mix characteristics and RAP aggregate content required to drive the practical and sustainable application of RAP concrete in construction of rigid highway pavements in Nigeria.

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INFLUENTIAL INDICES FOR ARCHITECTURE STUDENTS' PREFERENCES OF STUDIO WALL HANGINGS FOR ENHANCED AESTHETICS IN NIGERIA.

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Abstract
Understanding architecture students' aesthetic preferences is crucial for creating engaging studio environments. However, a gap persists in comprehending nuanced factors influencing their choices for studio wall hangings. This study investigated the factors influencing architecture students' preferences for studio wall hangings, employing the laddering technique of the mean-end chain model. The study Analysed attributes such as framed material, shape, texture, color, thickness, size, positioning, and subject matter/theme, and the underlying values guiding aesthetic choices were revealed. Significant influencers include achievement, conformity, hedonism, security, self-direction, stimulation, tradition, and universalism. Practical implications emphasise the importance of incorporating diverse architectural concepts and materials in design education to foster creativity and critical thinking. Architects can leverage these insights to create studio environments that inspire intellectual engagement and aesthetic appreciation. The findings offer valuable insights for both educational and professional contexts, contributing to a deeper understanding of architectural aesthetics and enhancing the studio experience for students and practitioners.
Key words*: Architecture student, Studio wall hanging, Aesthetic, Laddering interview, Means-end Chain.*

Introduction

The adornment of architectural studio spaces with wall hangings has emerged as a critical facet of architectural education, recognized for its pivotal role in nurturing creativity and innovation (Hemati and Zahedi, 2020). Wall hangings extend beyond mere decoration, profoundly influencing the ambiance and creative processes within architectural studios.

Extensive research has delved into the myriad factors shaping individuals' aesthetic inclinations, spanning cultural backgrounds to personal experiences (Hangerhall *et al*., 2004). Jung and Lee's (2020) investigation of university students' aesthetic preferences underscored the profound impact of cultural and personal influences, unraveling the intricate nature of aesthetic choices.

Across disciplines, studies affirm that aesthetically pleasing environments serve as catalysts for creativity, mood enhancement, and cognitive function improvement (Loye and Van den Berge, 2011). Within architectural education, studio spaces serve as crucibles for fostering creative thinking and innovation among students (Scrivener, 2018). Wall hangings, as integral components of these spaces, contribute to crafting visually stimulating settings that inspire imagination and exploration.

Moreover, the refinement of studio spaces aligns with broader educational goals, encompassing critical thinking, spatial awareness, and design literacy (Hossein and Tavassoli, 2019). Nonetheless, reconciling aesthetic aspirations with functional necessities poses challenges in studio design (Dunin-Woyseth, 2015). The emergence of digital technologies offers new avenues for exploring aesthetic expression and spatial engagement within architectural education (Kolarevic and Malkawi, 2005).

Addressing challenges associated with the absence and inadequacy of wall hangings in architectural studios requires integrating environmental stimulation techniques into pedagogy and adopting a holistic approach to aesthetic intelligence (Hossein and Tavassoli, 2019; Scrivener, 2018). Synthesising insights from existing research, this study endeavors to explore factors shaping architecture students' preferences in selecting studio wall hangings, particularly within Nigeria. The goal is to offer insights for nurturing enriched learning environments conducive to creativity and innovation in architectural education.

In the dynamic realm of architectural education, where cultivating aesthetic sensitivities is as crucial as mastering technical skills, the choice of studio wall hangings plays a pivotal role (Scrivener, 2018). Studios serve as creative crucibles, bearing witness to the significance of wall hangings as influential indices reflecting students' preferences and aspirations (Jung and Lee, 2020).

Observations highlight a significant disparity in the presence and quality of wall hangings within Nigerian architectural studios. Despite their potential to enhance ambiance and inspire creativity, many studios lack adequate wall hangings. Concerns about appropriateness and student satisfaction further compound the issue, hindering studios' ability to create conducive environments for learning and creativity.

This study seeks to explore the multifaceted factors influencing architecture students' preferences for studio wall hangings in Nigeria. By shedding light on underlying principles and addressing challenges associated with wall hangings, it aims to provide insights for fostering enriched learning environments in architectural education within the Nigerian context.

Review of related literature

Conceptual frame work:

The conceptual framework for this study is built upon the Means-End Chain (MEC) model. Originally conceived by Jonathan Gutman in 1982 to analyse consumer behavior regarding product choices, the MEC model offers a robust foundation for understanding the decision-making processes related to architectural preferences (Gutman, 1982).

Although initially developed for consumer goods, the MEC model has been successfully adapted to the realm of architecture and urban design, as evidenced by its application in various studies (Tania *et al*., 2006). In the context of this research, the MEC model serves as a framework for comprehending how architecture students perceive and prioritise different attributes of studio wall hangings, ultimately influencing their aesthetic preferences.

The MEC model operates by delineating the connections between product attributes and consumer values through a series of associations. These associations encompass both tangible and intangible elements, including concrete and abstract attributes, functional and psychological consequences, as well as instrumental and terminal values (Zinas and Jusan, 2014). By analysing these interconnections, researchers can gain insights into the underlying motivations and preferences driving architecture students' choices regarding studio wall hangings.

Laddering Technique: The laddering technique, integral to the Means-End Chain (MEC) model, serves as a fundamental method for conducting qualitative interviews to explore participants' perceptions regarding Attribute-Consequence-Value (A-C-V) elements (Jusan, 2007). By employing directed probes, such as the "why is that important to you?" question, researchers navigate participants' cognitive structures guiding decision-making, thereby revealing underlying motivations (Costa *et al*., 2004). Integration of the laddering technique with complementary data collection methods, such as questionnaires, facilitates a comprehensive understanding of participants' preferences and motivations. However, despite its utility, the MEC method is susceptible to limitations and biases that necessitate careful consideration to ensure research validity and reliability.

In terms of limitations, participants may provide socially desirable responses, potentially skewing the data (Tania *et al*., 2006). To address this, probing techniques during interviews are employed to encourage genuine expressions, with researchers vigilant in addressing social desirability effects during data analysis. Additionally, memory recall inaccuracies among participants may undermine response reliability (Tania *et al*., 2006). Acknowledging this limitation, strategies such as prompts and visual aids are utilised to assist participants in articulating preferences more accurately.

Furthermore, findings from a specific cultural context may lack applicability elsewhere (Jusan, 2007). To mitigate this limitation, the study explicitly acknowledges contextual limitations and underscores the need for diverse cultural exploration in future research.

In terms of biases, preconceived notions among researchers may influence data collection and analysis (Tania *et al*., 2006). To counteract this bias, emphasis is placed on reflexivity and transparent documentation to mitigate researcher biases, ensuring credible interpretation of results. Additionally, researchers' cultural backgrounds may tint participant response interpretation (Tania *et al*., 2006). A collaborative approach involving researchers from diverse backgrounds enriches interpretation sensitivity to cultural nuances.

Moreover, the MEC method may overlook pertinent preference influencers (Jusan, 2007). Methodological transparency and data triangulation mitigate scope limitations, advocating for broader variable exploration in future studies.

Through meticulous acknowledgment and mitigation of these limitations and biases, researchers bolstered study rigor and credibility within the MEC model, offering insightful revelations into architectural preferences and consumer decision-making processes.

Material and Method

The method for eliciting studio space attributes and preferences among architecture students in Nigeria was carefully designed to encompass the nation's diverse geopolitical zones.

To comprehensively capture the spectrum of perspectives, laddering interviews were conducted with architecture students representing universities situated across Nigeria's six geopolitical zones. These zones include the North-West (Ahmadu Bello University, Zaria – Kaduna State), North-East (Modibbo Adama University, Yola – Adamawa State), North-Central (University of Jos – Plateau State), South-West (University of Lagos – Lagos State), South-East (Enugu State University of Science and Technology – Enugu State), and South-South (University of Port Harcourt – Rivers State).

Through a purposive sampling strategy, a total of sixty-eight (68) final-year architecture students were selected, ensuring representation from each geopolitical zone. The choice of the specific academic level is informed by the recognition that students in their later year of study have a more advanced exposure to design studios and may have encountered a broader range of experiences, making their perspectives particularly valuable. The sample size was determined based on the principle of data saturation, signifying the point at which no new information or themes emerge from the data (Guest *et al*., 2006).

The laddering interviews were structured around the central question of why students preferred specific attributes of wall hangings in their studio spaces, employing a continuous "why" questioning technique at each level of inquiry. These interviews were conducted in a relaxed and conducive atmosphere, both physically and through video calls, facilitating comprehensive data collection.

Recording equipment, notably an Infinix S phone with RAM 4.00 and ROM 64.00 gigabyte capacity, facilitated seamless data capture during the interviews. Each session lasted an average of 55 minutes, with a 5-minute break provided for refreshment, thereby ensuring participant comfort and engagement.

Data processing involved transcribing recorded interviews into textual data and conducting content analysis manually. Following the guidelines outlined by researchers such as Coolen and Hoekstra (2001) and Jusan (2007), the analysis focused on identifying attributes, consequences, and values expressed by participants. Particular emphasis was placed on correlating motivating values with Schwartz's motivational value domains, including Hedonism (pleasure, enjoying life), Power (social power, wealth), Tradition (modesty, devoutness), Security(family security, cleanness), Achievement (success, ambition), Benevolence (helping, true friendship), Universalism (social justice, unity with nature), Stimulation (daring, exciting life), Self-Direction (independence, curiosity), and Conformity (politeness, self-discipline). A Hierarchical Value table is then produced, which is a presentation of all the most frequently mentioned attributes, consequences, and values (Tania *et al*., 2006).

Overall, the method employed rigorous techniques to elicit and analyze architecture students' preferences for studio wall hangings across Nigeria's diverse geopolitical landscape, providing valuable insights into the underlying motivations and values driving their aesthetic choices.

Results and Discussions

Figure 1 below presents findings from laddering interviews. The findings from these interviews were first transcribed from voice recorded data into textual data. This was later categorized into attributes, consequences and value elements as profiled in the figure 1. The numbers in parenthesis represents the frequency of mention of the categorized elements.

***Material- Bamboo frame*:**

The analysis of architecture students' preferences regarding studio wall hangings, specifically focusing on "Bamboo framed material," elucidates key insights into design considerations. With 42 mentions out of 68 responses, bamboo emerges as a significant factor influencing choices. The prominence of "Natural Appeal" (mentioned 21 times) underscores the aesthetic allure of bamboo, resonating with Hedonistic and Traditional values (Chen, 2018). This appreciation reflects not only an intrinsic visual appeal but also a cultural reverence for bamboo as a traditional building material (Chen, 2018).

The mentions of "Eco-Friendly" (5 times) and "Sustainability" (5 times) highlight a growing environmental consciousness among students (Gao *et al*., 2019). Bamboo's reputation as an eco-

friendly and sustainable material aligns with Universalist values, indicating a broader concern for societal and environmental well-being (Gao *et al*., 2019).

Additionally, "Warmth and Sophistication" (mentioned 11 times) signify bamboo's ability to imbue spaces with a sense of comfort and elegance, aligning with Hedonistic values (Chen, 2018). This suggests that bamboo framed material offers not only visual appeal but also tactile and emotional qualities that enrich architectural experiences.

***Practical Implications*:** Incorporating bamboo-framed materials into studio wall hangings can enhance aesthetics by appealing to values such as natural appeal, eco-friendliness, sustainability, warmth, and sophistication. Educators can emphasise sustainable material choices in design curriculum, while architects can leverage bamboo's natural appeal to create aesthetically pleasing and environmentally friendly studio environments.

Shape- Rectangular shape:

Rectangular framed shape attribute garnered significant attention, mentioned 44 times out of 68 responses, suggesting its considerable influence on students' aesthetic choices. One consequential aspect associated with the rectangular framed shape is its perceived "Versatile and balance option," mentioned 21 times. This suggests that students view rectangular frames as versatile design elements capable of achieving aesthetic balance within a space. This aligns with the value of Achievement, indicating a desire for functional and visually pleasing solutions (Buijs, 2017). The association of this consequence with Achievement implies that students prioritise achieving a harmonious and adaptable aesthetic outcome in their studio spaces.

Furthermore, "Simplicity and clarity" emerged as another significant consequence, with 23 mentions. This highlights students' preference for minimalist and straightforward design aesthetics associated with rectangular framed shapes. The emphasis on simplicity and clarity reflects the value of self-direction, signifying a desire for autonomy and clarity in design choices (Van de Veer and Marshall, 2018). This suggests that students value the clean lines and understated elegance offered by rectangular frames, aligning with their individualistic and self-directed design preferences.

***Practical Implications*:** Utilising rectangular framed shapes in studio wall hangings can offer versatility, balance, simplicity, and clarity. Educators can teach students about the functional benefits of rectangular frames, while architects can leverage their balanced and unobtrusive aesthetic to create visually appealing studio spaces conducive to creativity and productivity.

Texture- Matte finish frame:

Matte finish framed texture attribute garnered significant attention, being mentioned 49 times out of 68 responses, indicating its substantial impact on students' aesthetic preferences. One consequential aspect associated with the matte finish framed texture is its ability to "enhance detail," mentioned 23 times. This suggests that students perceive matte textures as enhancing the intricacies and subtleties of the artwork or design displayed within the frame. This association with enhancing detail aligns with the value of self-direction, indicating a desire for autonomy and clarity in design choices (Van de Veer and Marshall, 2018). Students value the ability to control and direct their viewing experience, focusing on the finer details of the artwork or design.

Moreover, "minimising glare" emerged as another significant consequence, with 15 mentions. This highlights students' preference for matte finishes in reducing glare and reflections, which can be distracting and detract from the viewing experience. The emphasis on minimising glare aligns with the value of security, indicating a desire for a sense of safety and comfort in the viewing environment (Kaplan and Kaplan, 1989). Students prioritise an environment conducive to focused observation and analysis, without the interference of external factors such as glare.

Additionally, "optional viewing experience" was mentioned 11 times, indicating that students appreciate the flexibility and versatility offered by matte finish framed textures. This aligns with the value of self-direction, as students value the ability to choose and control their viewing experience based on personal preferences and needs (Van de Veer and Marshall, 2018). Matte textures provide an option for both immersive and casual viewing experiences, catering to individual preferences and enhancing overall engagement.

Practical Implications: Opting for matte finish framed textures can enhance detail, minimise glare, and offer optional viewing experiences. Educators can discuss the benefits of matte finishes in reducing reflections and enhancing visual clarity, while architects can use matte textures to create immersive and comfortable studio environments that promote focused engagement with artwork.

Color- Black frame:

Black framed color attribute received significant attention, being mentioned 43 times out of 68 responses, indicating its notable impact on students' aesthetic choices. One consequential aspect associated with the black framed color is its ability to "add contrast and sophistication," mentioned 24 times. This suggests that students perceive black frames as enhancing the contrast between the artwork or design and its surroundings, thereby adding a sense of sophistication to the overall presentation. This association with adding contrast and sophistication aligns with the value of hedonism, indicating a desire for sensory pleasure and aesthetic enjoyment (Chen, 2018). Students value the visual impact and elegance brought about by the contrast provided by black frames.

Moreover, "cohesive and unified presentation" emerged as another significant consequence, with 19 mentions. This highlights students' preference for black frames in creating a cohesive and unified visual presentation. The use of black frames contributes to a sense of conformity and consistency in the display of studio wall hangings, aligning with the value of conformity (Kim and Markus, 1999). Students prioritise a harmonious and coordinated aesthetic in their studio spaces, which is facilitated by the use of black frames to create a unified visual composition.

***Practical Implications*:** Choosing black framed colors can add contrast, sophistication, and cohesive presentation. Educators can explore the psychological effects of color contrast and sophistication in design, while architects can use black frames to create visually striking and harmonious studio wall hangings that elevate the overall aesthetic appeal of the space.

Thickness- Thin profile frame:

Thin profile framed thickness attribute garnered significant attention, being mentioned 41 times out of 68 responses, indicating its substantial influence on students' aesthetic choices. One consequential aspect associated with thin profile framed thickness is its ability to "save space," mentioned 18 times. This suggests that students perceive thin frames as contributing to efficient space utilisation, allowing for more artwork or design elements to be displayed within a given area. This association with space-saving aligns with the value of achievement, indicating a desire for practical and functional solutions (Buijs, 2017). Students value the ability to maximise the use of available space in their studio environments, achieving a sense of accomplishment in optimising spatial resources.

Moreover, "not overwhelming space" emerged as another significant consequence, with 23 mentions. This highlights students' preference for thin profile framed thickness in creating a visually balanced and unobtrusive presentation. The use of thin frames helps to avoid overwhelming the space with bulky or imposing elements, contributing to a sense of security and comfort in the studio environment (Kaplan and Kaplan, 1989). Students prioritise a harmonious and uncluttered aesthetic, which is facilitated by the use of thin frames to maintain visual coherence and spaciousness.

***Practical Implications*:** Opting for thin profile framed thickness can save space, avoid overwhelming the environment, and offer a sense of security. Educators can highlight the space-saving benefits of thin frames, while architects can use thin profiles to create elegant and unobtrusive studio wall hangings that maximise spatial efficiency without sacrificing visual impact.

Size- Medium (450mm by 600mm) frame:

Medium (450mm by 600mm) framed size attribute received significant attention, being mentioned 46 times out of 68 responses, indicating its notable influence on students' aesthetic preferences. One consequential aspect associated with the medium framed size is its ability to provide a "fitting comfortable" display, mentioned 21 times. This suggests that students perceive medium-sized frames as comfortably fitting within the designated space, contributing to a sense of security in the studio environment. This association with fitting comfort aligns with the value of security, indicating a desire for a sense of safety and comfort in the design choices (Kaplan and Kaplan, 1989). Students value the ability of medium-sized frames to create a visually pleasing and harmonious display without overwhelming the space.

Moreover, "functional clarity" emerged as another significant consequence, with 25 mentions. This highlights students' preference for medium-sized frames in achieving functional clarity and coherence in the presentation of studio wall hangings. The use of medium-sized frames facilitates a clear and organised display, allowing for easy interpretation and appreciation of the artwork or design elements. This aligns with the value of self-direction, as students prioritise autonomy and clarity in their design choices (Van de Veer and Marshall, 2018). Medium-sized frames provide students with the flexibility to curate and arrange their studio space according to their individual preferences and needs.

***Practical Implications*:** Using medium-sized frames can provide fitting comfort, functional clarity, and a balanced presentation. Educators can discuss the importance of proportional framing in design composition, while architects can employ medium-sized frames to create visually balanced and comfortable studio environments that facilitate clear and organised displays of artwork.

Positioning- 1800mm from floor to center of art:

1800mm from floor to center of art positioning attribute garnered substantial attention, being mentioned 49 times out of 68 responses, indicating its considerable impact on students' aesthetic choices. One consequential aspect associated with positioning the art at 1800mm from the floor is its ability to "enhance spatial balance," mentioned 12 times. This suggests that students perceive this positioning as contributing to a harmonious spatial arrangement within the studio environment. The association with enhancing spatial balance aligns with the value of universalism, indicating a broader concern for the overall visual coherence and equilibrium in the space (Gao *et al*., 2019). Students value the ability of this positioning to create a balanced and visually pleasing composition that appeals to a wide range of viewers.

Moreover, "engagement facilitation" emerged as another significant consequence, with 18 mentions. This highlights students' perception that positioning the art at 1800mm from the floor facilitates engagement and interaction with the artwork. This alignment with engagement facilitation corresponds to the value of stimulation, indicating a desire to create dynamic and immersive experiences that captivate viewers' attention (Ryan and Deci, 2000). Students value the ability of this positioning to encourage active participation and exploration, fostering a deeper connection with the artwork.

Additionally, "narrative reinforcement" was mentioned 19 times, indicating that students recognize the role of this positioning in reinforcing the narrative or storytelling aspect of the artwork. This aligns with the value of universalism, as students appreciate the ability of this positioning to convey universal themes and messages that resonate with diverse audiences (Gao *et al*., 2019). Students value the opportunity to enhance the narrative impact of the artwork through strategic positioning, creating a more compelling and immersive experience for viewers.

Practical Implications: Positioning artwork at 1800mm from the floor to the center of art can enhance spatial balance, facilitate engagement, and reinforce narrative themes. Educators can emphasise the importance of strategic art placement in creating cohesive and immersive studio environments, while architects can use this positioning to create dynamic and impactful displays that resonate with viewers on both intellectual and emotional levels.

Subject matter and theme- Intellectual engagement:

Intellectual engagement subject matter and theme attribute received significant attention, being mentioned 62 times out of 68 responses, indicating its substantial impact on students' aesthetic choices and intellectual engagement. The first consequential aspect associated with this attribute is the subject matter of the "Fallingwater House (13) - showcasing clean lines," mentioned 5 times. This suggests that students are drawn to studio wall hangings featuring iconic architectural designs such as Fallingwater House, known for its clean lines and innovative design (Hess, 2003). The association with self-direction indicates that students value the autonomy to explore intellectually stimulating subjects that align with their personal interests and passions.

Moreover, "innovative materials" emerged as another significant consequence, with 8 mentions. This highlights students' preference for studio wall hangings that showcase the use of innovative materials in their construction or representation. The mention of achievement suggests that students value the opportunity to engage with designs that push the boundaries of traditional materials and techniques, reflecting a desire for innovative and forward-thinking approaches to architecture (Buijs, 2017).

Moreover, architects and designers can leverage intellectually engaging subject matter and innovative materials to create studio wall hangings that stimulate curiosity and imagination. By featuring iconic architectural designs and showcasing the use of cutting-edge materials, professionals can create immersive environments that spark intellectual dialogue and inspire new ideas (Hess, 2003). Additionally, the use of intellectually engaging subject matter and innovative materials can contribute to a more dynamic and enriching studio experience, encouraging students to push the boundaries of their creativity and explore new possibilities in architectural design.

The second consequential aspect associated with intellectual engagement is the subject matter of "Notre Dame in Paris," mentioned 14 times. This suggests that students are drawn to studio wall

hangings featuring iconic architectural landmarks such as Notre Dame Cathedral, known for its historical significance and architectural beauty (Macaulay, 2013). The mention of "stone tracery (5)" and "pointed arches (6)" within the cathedral highlights specific architectural elements that students find intellectually engaging and aesthetically appealing. The association with tradition suggests that students value the exploration of architectural heritage and the preservation of historical craftsmanship (Watkin, 2009).

Moreover, "soaring spires" emerged as another significant consequence, with 3 mentions. This suggests that students are interested in studio wall hangings that feature architectural elements such as spires, known for their grandeur and vertical emphasis. The mention of soaring spires aligns with the value of achievement, indicating a desire to engage with designs that evoke a sense of awe and admiration (Ching, 2014). Students value the opportunity to explore architectural themes that inspire ambition and celebrate human ingenuity.

The third consequential aspect is the subject matter of the "Chrysler Building in New York City," mentioned 14 times. This suggests that students are drawn to studio wall hangings featuring iconic architectural landmarks such as the Chrysler Building, known for its Art Deco design and distinctive silhouette (Cruickshank, 1988). The mention of "bold geometric patterns (4)," within the building highlights specific architectural elements and design features that students find intellectually stimulating and aesthetically appealing. The association with stimulation suggests that students value the opportunity to engage with designs that evoke a sense of curiosity and excitement (Ryan & Deci, 2000).

Moreover, "streamlined forms" emerged as another significant consequence, with 3 mentions. This suggests that students are interested in studio wall hangings that feature architectural elements characterised by sleek and modern aesthetics. The mention of streamlined forms aligns with the value of achievement, indicating a desire to engage with designs that represent progress and innovation in architectural design (Ching, 2014). Students value the opportunity to explore architectural themes that celebrate advancements in technology and design innovation.

Additionally, "decorative motifs" was mentioned 7 times, indicating that students appreciate studio wall hangings that feature ornamental details and decorative elements. The mention of decorative motifs aligns with the value of tradition, suggesting that students value the exploration of historical design traditions and cultural heritage (Watkin, 2009). Students value the opportunity to engage with designs that pay homage to the rich history and craftsmanship of architectural ornamentation.

The fourth consequential aspect is the subject matter of the "Guggenheim Museum Bilbao," mentioned 12 times. This suggests that students are drawn to studio wall hangings featuring iconic architectural landmarks such as the Guggenheim Museum Bilbao, renowned for its innovative design and cultural significance (Vincent and Phaidon Editors, 2007). The mention of "sustainable design principles" within the museum highlights specific architectural themes that students find intellectually stimulating and aesthetically appealing. The association with universalism suggests that students value the exploration of architectural designs that transcend cultural boundaries and promote global understanding.

Moreover, "dynamic spatial experience" emerged as another significant consequence, with 4 mentions. This suggests that students are interested in studio wall hangings that evoke dynamic and immersive spatial experiences. The mention of dynamic spatial experience aligns with the value of stimulation, indicating a desire to engage with designs that provoke curiosity and excitement (Ryan and Deci, 2000). Students value the opportunity to explore architectural themes that challenge conventional notions of space and encourage interactive engagement.

The fifth consequential aspect is the subject matter of the "Boston City Hall London," mentioned 9 times. This suggests that students are drawn to studio wall hangings featuring iconic architectural landmarks such as Boston City Hall, known for its bold and innovative design (Campbell, 2014). The mention of "bold massing" within the building highlights specific architectural elements that students find intellectually stimulating and aesthetically appealing. The association with achievement suggests that students value the exploration of designs that push the boundaries of architectural conventions and demonstrate creative excellence.

Moreover, "showcasing raw concrete facades" emerged as another significant consequence, with 4 mentions. This suggests that students are interested in studio wall hangings that feature architectural elements characterised by raw and unadorned materials such as concrete. The mention of raw concrete

facades aligns with the value of stimulation, indicating a desire to engage with designs that provoke curiosity and evoke sensory experiences (Ryan and Deci, 2000). Students value the opportunity to explore architectural themes that challenge traditional notions of beauty and embrace the raw authenticity of materials.

Practical implications: Integrating intellectually engaging subject matter and themes, such as iconic architectural landmarks, sustainable design principles, bold massing, and raw concrete facades, into studio wall hangings significantly enhances aesthetics. These elements imbue studio spaces with visual intrigue, historical depth, and modern sophistication. By encouraging exploration of diverse architectural concepts and materials, educators inspire creativity and critical thinking among students, leading to innovative and thought-provoking designs. This approach enriches the studio experience for both students and professionals, fostering intellectual curiosity, appreciation for the built environment, and a deeper connection to design.

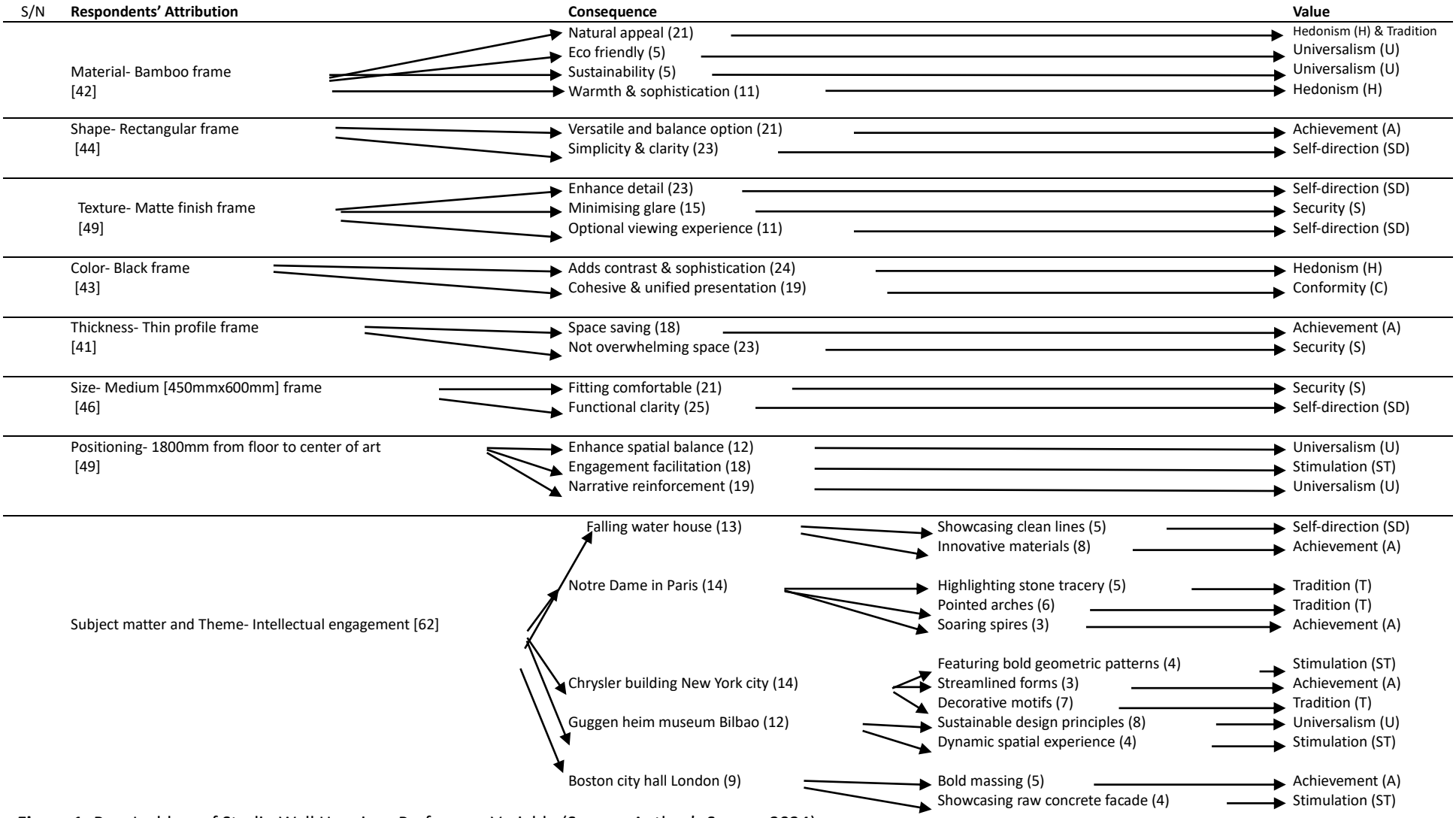

Figure 1: Raw Ladders of Studio Wall Hangings Preference Variable (Source: Author's Survey, 2024)

Furthermore, the comparative linked means-end chain hierarchical values (table 1) generated from the findings in figure 1 provides insight into the underlying values that architecture students associate with their preferences for studio wall hangings. Here's an interpretation and discussion of the results:
Achievement (Frequency of Linkage: 6): The high frequency of achievement-oriented values suggests that students are heavily motivated by success and recognition in their aesthetic choices (Maslow, 1943; Leder, *et al*., 2013). This implies a strong desire to stand out or excel in their design decisions, seeking validation through unique or innovative approaches (Maslow, 1943; Leder, *et al*., 2013). It may lead to a competitive environment where students strive to outperform each other creatively, potentially fostering a culture of excellence and pushing boundaries in design.
Conformity (Frequency of Linkage: 1): The low frequency of conformity indicates that students are less inclined to adhere strictly to traditional or conventional norms in their aesthetic preferences (Cialdini and Goldstein, 2004). Suggests a positive shift towards fostering individual expression, promoting innovation, embracing diversity, nurturing critical thinking, and empowering creative autonomy within educational and artistic contexts.
Hedonism (Frequency of Linkage: 3): The moderate frequency of hedonistic values suggests that students derive pleasure and enjoyment from their aesthetic choices (Frijda, 1986; Kaufman, 2019). This implies a preference for designs that evoke positive emotions or sensory experiences, prioritising aesthetic pleasure over other considerations.
Security (Frequency of Linkage: 3): The moderate frequency of security-oriented values indicates that students value stability, safety, and predictability in their aesthetic preferences (Maslow, 1943; Leder, *et al*., 2013). This preference can influence various aspects of artistic expression, from the choice of materials and design principles to the emotional responses elicited by artworks and environments.
Self-direction (Frequency of Linkage: 5): The high frequency of self-directed values suggests that students prioritise autonomy, independence, and personal expression in their aesthetic choices (Deci and Ryan, 1985; Deci, 2002). This may foster an environment where students feel empowered to pursue their artistic visions without constraints, leading to a diverse range of innovative and personalised designs.

Stimulation (Frequency of Linkage: 4): The moderate frequency of stimulation-oriented values suggests that students are motivated by novelty, excitement, and sensory engagement in their aesthetic preferences (Ryan and Deci, 2000). This may lead to a focus on creating dynamic and visually captivating designs that capture attention and spark imagination.
Tradition (Frequency of Linkage: 4): The moderate frequency of traditional values suggests that students value heritage, continuity, and cultural norms in their aesthetic preferences (Watkin, 2009). This may lead to a respectful approach to design that draws inspiration from established conventions while also exploring innovative ways to reinterpret tradition for contemporary contexts.
Universalism (Frequency of Linkage: 5): The high frequency of universalistic values suggests that students prioritise inclusivity, social justice, and global perspectives in their aesthetic preferences (Schwartz, 1992; Jones, 2020). This may lead to a commitment to socially conscious and culturally sensitive design practices that address pressing issues and promote positive social change on a global scale.
Overall, the comparative linked means-end chain hierarchical value analysis reveals a diverse range of values underlying architecture students' preferences for studio wall hangings. These values reflect individual motivations, preferences, and aspirations, shaping the aesthetic landscape of studio environments and influencing design decisions in architectural practice. Understanding these underlying values is crucial for educators and practitioners to create inclusive, engaging, and meaningful studio experiences that resonate with students' diverse needs and aspirations.

Table 1: Summary of Comparative Linked Means-end Chain Hierarchical Values

S/No.	Content Element Value	Frequency of Linkage
1	Achievement (A)	06
2	Conformity (C)	01
3	Hedonism (H)	03
4	Security (S)	03
5	Self-direction (SD)	05
6	Stimulation (ST)	04
7	Tradition (T)	04
8	Universalism (U)	05
	Total	**31**

Source: Author's Survey, 2024

Contextualising Architectural Preferences: A Global Perspective

Within the global architectural landscape, preferences are intricately woven by multifaceted factors, reflecting broader trends and cultural dynamics influencing architectural paradigms worldwide (Campbell, 2014). For instance, the pursuit of achievement and self-direction in architectural design resonates with universal aspirations for innovation and creative expression (Maslow, 1943; Leder, *et al*., 2013; Campbell, 2014). Architects across the globe increasingly embrace unconventional approaches to design, driven by a fervent desire for recognition and success (Maslow, 1943; Leder, *et al*., 2013; Campbell, 2014).

Similarly, hedonistic values in architecture, characterized by a quest for pleasure and sensory experiences in design, echo fundamental human desires for beauty and emotional resonance in built environments (Frijda, 1986; Campbell, 2014; Kaufman, 2019). This emphasis on stimulation suggests a global appetite for architectural designs that not only engage the senses but also provoke contemplation and evoke emotional responses, reflecting diverse cultural and social influences shaping architectural aesthetics worldwide (Frijda, 1986; Campbell, 2014; Kaufman, 2019).

In an era of heightened global connectivity, security-oriented values in architecture, such as stability and safety, hold universal appeal as individuals seek environments that provide a sense of security and belonging (Maslow, 1943; Leder, *et al*., 2013; Campbell, 2014). Moreover, the appreciation for tradition in architectural design underscores a global acknowledgment of the significance of heritage, cultural identity, and historical context in shaping-built environments (Watkin, 2009; Campbell, 2014). Architects worldwide draw inspiration from architectural traditions and historical contexts, integrating traditional elements into contemporary designs to create spaces imbued with cultural significance (Watkin, 2009; Campbell, 2014).

While there's a notable emphasis on individual expression and creativity in architecture, there's also a recognition of the importance of inclusivity and universality in design (Schwartz, 1992; Campbell, 2014; Jones, 2020). The occasional presence of conformity suggests a delicate balance between individual expression and adherence to shared norms and standards, ensuring architectural designs resonate with diverse audiences globally (Schwartz, 1992; Campbell, 2014; Jones, 2020). Universalistic values underscore the significance of creating architecture that transcends cultural boundaries, fosters social equity, and addresses pressing global challenges like climate change and urbanization (Schwartz, 1992; Campbell, 2014; Jones, 2020).

In essence, architectural preferences embody a convergence of global influences, local contexts, and individual aspirations in the quest to craft meaningful, impactful, and culturally resonant built environments. Understanding and contextualising these preferences within a global framework is indispensable for architects to create architecture that is responsive to local needs while reflecting broader global trends and values.

Conclusion

In conclusion, the study on influential indices for architecture students' preference of studio wall hangings for enhanced aesthetics, utilising the laddering technique of the mean-end chain model, has provided valuable insights into the underlying factors guiding students' aesthetic choices. Through the analysis of attributes such as framed material, shape, texture, color, thickness, size, positioning, and subject matter/theme, it became evident that various values such as achievement, conformity,

hedonism, security, self-direction, stimulation, tradition, and universalism play significant roles in shaping architectural preferences.

The findings underscore the multifaceted nature of architectural aesthetics, reflecting a complex interplay of individual motivations, cultural influences, and design principles. Moreover, the identification of values such as self-direction, stimulation, and universalism highlights the importance of creativity, innovation, and inclusivity in architectural education and practice.

Practical implications derived from the study suggest opportunities for educators to incorporate diverse architectural concepts and materials into design curriculum, fostering creativity and critical thinking among students. Additionally, architects can leverage these insights to create studio environments that inspire intellectual engagement, foster aesthetic appreciation, and promote cultural understanding. Furthermore, future research could explore the longitudinal effects of exposure to diverse architectural aesthetics on students' design sensibilities.

Overall, the study contributes to a deeper understanding of the underlying values guiding architecture students' preferences for studio wall hangings, offering valuable insights for both educational and professional contexts. By recognising and embracing the diverse array of values shaping architectural aesthetics, educators and practitioners can create enriching studio experiences and contribute to the advancement of the architectural profession.

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AN EVALUATION OF THE CRITICAL SUCCESS FACTORS FOR THE ADOPTION OF GREEN BUILDING INITIATIVES FOR MORTGAGE FINANCE

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ABSTRACT
The issue of green building is a contemporary phenomenon worldwide, particularly for its energy saving prowess, among other things. The aims to evaluates the critical success factors for adoption of green building initiatives. The study data were sourced from professionals in the built environment. The study administered 400 questionnaire based on the confidence level of the research in the population and the questionnaire were administered to professionals in the built environment using simple random sampling techniques. The study retrieved 339 questionnaires from the professionals that comprised of estate surveyors, Architects, Builders, quantity surveyors and land surveyors across the Kaduna metropolis. The study employed descriptive method such mean score analysis and relative importance index (RII). The result revealed that the perceived level of adoption green building initiatives is found above 0.65 relative important index and level of awareness of associated benefits was found below 0.65. The result of mean score analysis revealed that all the factors maintained high relative importance index over and above 0.65, indicating that all the factors were highly acceptable as critical success factors for the adoption of green building. The study recommends that awareness on both health and physical benefits green building practices should be created among the built professionals and furthermore the awareness of success factors for the adoption green building practice for mortgage finance should be publicized.
Keywords: Critical Success Factor, Green Building Initiative, Mortgage Finance.

1.0 **Introduction**

Green building is a phenomenon that is noted particularly for its energy saving prowess worldwide. David Gardiner & Associates (2010), sees "green building" as one that incorporates environmental and health concerns and resource efficiency throughout its life cycle, from citing and design to operation and maintenance, all the way through to deconstruction. Indeed, in the past few decades it has been noted as an emerging trend in commercial real estate development design and construction of sustainable or "green" buildings, for the huge impact of the design, construction and operation of commercial real estate (Pierce, 2013). It is however noteworthy that, despite the varied housing policies guiding the Nigerian housing provision, its delivery is yet to level up with the global acceptable sustainability requirements (Oluleye, Ogunleye and Oyetunji, 2020). According to Yusof, Hamdan, Mara and Alam (2013), in any housing delivery, sustainability attainment determines its success.

Many people see a "green building" as one that has received some sort of third-party certification that validates its green features (David Gardiner & Ass. 2010). Again, according to the U.S. Environmental Protection Agency, green building is "the practice of creating structures and using processes that are environmentally responsible and resource–efficient throughout a building's life–cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. On the other hand, U.S. Office of the Federal Environmental Executive defines green building as "the practice of (1) increasing the efficiency with which buildings and their sites use energy, water, and materials, and (2) reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal – the complete building life cycle." (David Gardiner & Associates LLC. 2010).

Further, there has been growing number of approaches, criteria, and standards for certifying green buildings in recent years, with the dominant certification system in the U.S. being the Leadership in Energy and Environmental Design (LEED), Green Building Rating System from the U.S. Green Building Council (USGBC) which was adopted by the Canadian Green Building Council (CaGBC), (Energy Star, the dominant labelling programme for actual energy performance in existing buildings and for developing energy targets in new construction and it is thus an important part of an overall operations and management strategy for any commercial building, but it is not in itself considered a green building certification.) (David Gardiner & Associates LLC. 2010). LEED and Energy Star were jointly sponsored by the Department of Energy and the Environmental Protection Agency in the US.

Others still in Canada is the Building Environmental Standards from the Building Owners and Managers Association (BOMA BESt). The counterpart standards for United Kingdom's is the Building Research Establishment Environmental Assessment Method (BREEAM). This is a widely used sustainability assessment method which guides and informs developers and architects to masterplan projects, infrastructure and buildings within the built environment. According to Agyekum, Goodier and Oppon (2021), the Building and Construction Authority, BCA (2014), defines a green building as an energy and water-efficient building that possesses a healthy indoor environment formed from eco-friendly materials.

Very unlike the developed world, Onub (2019) noted that there are numerous challenges facing developing countries including a rapid population growth, which comes with increased demands for shelter, water and other natural resources needed for human survival. Again, despite the fact that buildings and other infrastructural projects are necessary to meet the demands of the rising population, developing countries needs a widely used sustainability assessment method which guides and informs developers and architects to masterplan projects, infrastructure and buildings within the built environment (Wu, Mao, Wang, Song, and Wang, 2016)

As noted by Agyekum, Opoku, and Opoku (2020a, b), green building project financing serves as a financial investment to develop and produce green or sustainable buildings. Similarly, Shan et al. (2017) defines sustainable or green construction project financing to include raising financial capital for sustainable construction projects or sustainable development.
A major driving force for green building development which has obviously affected its finance is the elevated concerns about the environment and climate change. This has obviously led to the recent surge in green buildings, generating billions of dollars in gross domestic product and millions of jobs over the past few years, with the market for green buildings in the U.S. and Canada expected to continue to grow despite the current economic recession (David Gardiner & Ass. 2010). Further according to David Gardiner & Ass. (2010), governments have also been an important driver of the burgeoning green building market in the developed economies, setting green policy requirements for their own buildings and providing incentives and requirements for the private sector. Equally critical and particularly of greatest importance to the financial sector, has been the increasing awareness that green buildings have significant economic benefits in addition to their environmental benefits. These elements that affects the financial sector include: owner or user, investor or private developer, lender, and insurer. The owner/user role concerns many institutions seeking third-party certification for the office buildings and branches that they own or lease. Investor participation in green buildings began slowly but has been accelerating rapidly, with increasing project development, investment in green real estate funds, and attention to Responsible Property

However, Despite the many benefits of green buildings worldwide, private and public developers find it challenging to fund such projects (Hupp, 2010). As noted by Seth, Shrivastava and Shrivastava (2016), success factors could be described as a few/limited/narrow aspects that attention needs to be paid to so as to guarantee success for an organization in achieving its target. Indeed, if continuous attention is paid to the success factors, high performance outcomes will be guaranteed in the particular activity in which the organization partakes (Habidin and Yusof, 2013). This project therefore looks into the CSFs that aid or promote green building or green initiative finance and development.

2.0 LITERATURE REVIEW

2.1 Fundamentals of Green Building Initiatives

Green imitative or green building has to do with energy saving prowess, among other things. It incorporates environmental and health concerns and resource efficiency throughout its life cycle, from citing and design to operation and maintenance of a building all the way through to deconstruction using processes that are environmentally responsible and resource–efficient throughout a building's life–cycle (UNEP, 2010; David Gardiner & Associates LLC. 2010). As an important form of GB, green housing (GH) is a new housing model designed and built based on the principle of sustainable symbiosis between man and nature and the principle of efficient utilisation of resources, which can

make the internal and external material energy systems of the house virtuous cycle and achieve a certain degree of self-sufficiency in energy without waste and pollution (Sang and Yao, 2019).
In developed countries like America, Financial institutions play an important role in supporting the development of real property. Whether by providing financing to developers, mortgages to homeowners, or providing insurance solutions, banks, investors and insurers can play a leadership role in assisting in the transition to a greener building stock (UNEP,2010). This is obvious because green building finance is a key factor in addressing climate change given that buildings consume approximately 40% of the world's materials and energy (UNEP, 2010). Greenhouse gases are a major challenge to the environment owing to human activity in which case, construction constitute a major problem in terms of costs if negative impacts have to be minimised (Lee, Lee, Kim, and Kim, 2013). Lee et. al. (2013) also notes that this costs which has negative effects on financing needs government intervention for smooth financing to vitalize green building projects. Such intervention includes hedging the risks through Public-Private Partnership (PPP) arrangements and governmental guarantees.

However, for a building to qualify as a "green building" fundamentally it must possess some third-party certification that validates its green features. Example of these abounds in US Leadership in Energy and Design (LEED) system adopted by the Canadian Green Building Council), Canadian Building Environmentalll Standards, the Building Owners and Managers Association (BOMA BESt). Green Building Rating System from the U.S. Green Building Council (USGBC), Canadian Green Building Council (CaGBC)), Canada is the Building Environmental Standards from the Building Owners and Managers Association (BOMA BESt) and Singapore BCA (David Gardiner & Associates LLC. 2010 and Agyekum, Goodier and Oppon, 2021). Again, according to Lee et. al. (2013), certification comes through guarantees- Certified Emission Reduction (CER), which is an emerging trend in environment finance Indeed, Green building is a compilation of advanced building principles and methods that exceed all existing building codes in creating a better interior environment and at the same time reducing the negative impact on the planet (Wells 2008) which require a sustainability.

2.2 Mortgage Finance and Green Building in Nigeria

Green finance can be regarded as strategic approach for the finance sector to encourage a world with lower carbon emission and a healthy climate. Green finance has been variously defined by authors; according to Nobanee (2021) Green finance focuses mainly to enhance and sustain the natural environment along with managing current and future environmental risks. Green finance is therefore defined as finance initiative, process, product, or service which can be either designed to provide protection of the natural environment or to manage the environment which will affect not only finance and but also local and global investment. As noted by Agyekum et al. (2020a, b), green building project financing is any financial investment to develop and produce green or sustainable buildings. Again, Sustainable or green project financing has been defined by Shan et al. (2017) as sustainable financing which include raising financial capital for sustainable construction projects or sustainable development. Soundarrajan and Vivek (2016) noted that sustainable project financing is a strategic method where several financial institutions like banks, insurance firms, property companies, mutual funds, institutional investors and others direct their financial resources to sustainable development projects. Again, to Hohne et al. (2012), sustainable construction project financing is a financial investment geared towards sustainable construction projects.
According to Agyekum et al, (2021) the International Finance Corporation, IFC (2019) reports that venturing into green or sustainable buildings is one of the next decade's most significant investment opportunities. This view was further supported by Shan et al. (2017) who notes that sustainable or green construction project financing include raising financial capital for sustainable construction projects or sustainable development. Nobanee, (2021) identified the common finance options under green building to include loans, bonds, and promissory notes. The study further stated that more products are available at large volume financing but the predominant finance instruments are debt and equity as well as risk management products, guarantee equity financing. Finance instruments have several features based on the level of seniority. Agyakum et al, (2021), also concurred with Fuerst and McAllister (2011) that with green buildings, higher sale premiums of up to 31% and faster sale times could be achieved. With such revelations, the WGBC (2013) iterated that such buildings have up to

23% higher occupancy rates, with a whopping rental income of up to 8%. And with these benefits associated with green buildings investors and financiers are provided with platforms to lead in shaping and accelerating the multi-trillion-dollar business opportunity of GB.
UNEP (2010) also observed, that for green building not to get involved as the world turns it attention to issues of environmental portends greater risk and the financial sector has a great role to play in this sector. Indeed, financial institutions have a greater role to play in encouraging changes necessary to reduce the impact of greenhouse gas emissions, water consumption, and other environmental impact (UNEP, 2010). To achieve the internationally agreed targets of the Paris climate accord and sustainable development goals, there is the need to mobilise financial resources privately and publicly (United Nations Environment Programme, UNEP, 2016). The World Investment Report (2014) estimates the global financial market for implementing the sustainable development goals (SDGs) through 2030 to be around $ US 5 trillion. Green initiative has not really taken a frontal stage in Africa unlike most parts of the developed world. Again, a critical area that is neglected, is the financing of green building projects as IFC (2018) reported that sub-Saharan Africa's cities are home to more than 470 million people, with the number expected to double over the next 25 years. This means meeting this housing need presents a significant opportunity for greening this future construction worth about $768 billion until 2030 (IFC, 2019). Indeed, when pushing for the adoption of more sustainable building projects, it is critical to discuss financing, especially the potential financial drivers or enablers and obstacles.

Although in Africa not much is known regarding green building project financing, there are some evidence in portions of East Africa, South Africa and West Africa. In East Africa, evidence on green initiative is limited which is attributed to the characteristics of the East African property finance Market (e.g. high-interest rates/cost of debt and low liquidity from shallow capital markets), making it difficult for such investments to be made (UN Habitat, 2018). Agyakum et al (2021) in South Africa observed in a report that green fund that was established in 2011 (Bhandari (2014). Although the fund provides grant and loan finance to public and private actors supporting South Africa's various green initiatives and national plans, albeit limited, for complex diligence and application requirements, inadequate understanding of the dynamics of various projects and broad focal areas of the fund (Bhandari, 2014). Again, in Ghana, there are recent evidence of green movement ithough still young as recent studies have shown: examining of drivers of Green initiatives (Agyekum et al., 2020a, b,), barriers (Agyekum et al., 2019), strategies to promote green buildings (Darko et al., 2018)

2.3 Critical Success Factors for Green Building Mortgage Finance

As earlier mentioned, success factors could be described as a few, limited and narrow aspects that attention needs to be paid to so as to guarantee success for an organization in achieving its target (Seth, et. al. 2016). Continuous attention to the success factors, connotes high performance for activities in which an organization partakes (Habidin and Yusof, 2013). CSFs help to achieve desired goals and are essential to the success of a project (Darko and Chan, 2016). Essentially, specific list of CSFs is very important for successful execution of a project throughout its life cycle. CSFs were once considered "an area of activity where key results are absolutely necessary for the manager to achieve his or her goals (Wang, Yao, Wu and Chen, 2017).

Various CSFs have been observed in literature. Critical Success Factor (CSF) of green house (GH) development were studied in China particularly since the successful development of green housing (GH) became a major strategic choice (Sang and Yao, 2019). The aim was to assess the impact of CSFs on GH development by identifying 20 controllable CSFs through a review of literature. Data collected was categorised and used for principal component analysis (PCA). The factor analysis showed that the CSFs can be summarised into five important principal components, namely, (1) project management factors, (2) personnel ability factors, (3) teamwork-oriented factors, (4) human resource factors, and (5) financial and constraint factors. Again, multiple regression analysis was used to assess the importance of CSFs.

Oyebanji et al (2017) studied Sustainable Social Housing (SSH) with a view to determine the CSFs from economic, environmental and Social perspectives in meeting housing needs. The data gathered

through relevant documents and respondents were analysed respectively NVivo and Statistical Package for Social Science (SPSS). Which revealed some CSFs for achieving SSH for meeting housing needs namely; adequate funding and provision, affordability, efficient economic planning, appropriate construction technology, environmental protection, use of environmentally friendly materials, effective land use planning, appropriate design, security of lives and property, provision of social services and ensuring social cohesion. The major CSFs however, relevant and crucial for mortgage financing are economic and environmental factors.

Over the years in China, a major focus of research in China is for GH development is to know the CSFs. For instance, Zhen (2012) analysed the reasons for the slow development and the obstacles of constructing low-carbon buildings in Chinese cities. The study concluded that the CSFs included construction cost, policy content, and public perception. Again Li, Chen, Chew, Teo, and Ding (2011) went into the key success factors affecting the performance of the Singapore Green Label Certification project and found out that "coordination between designers and controllers" and "technical and innovation-oriented factors" are the most influential factors. Zuo, Read, Pullen and Shi (2012), put key success factors of achieving carbon neutral architecture in Australian commercial architecture from the perspective of stakeholders; such factors include market, technology, and policy (government support, regulation, and demonstration project). Shen, Tang, Siripanan, et al., (2017), on the other hand examined the key success factors of GBs from the perspective of project participants in Thailand with the results indicating that "capability of individual participants" and "integration of project team" could significantly affect the delivery of GB projects.

Zuo et al. (2012) summarised the key success factors of achieving carbon neutral architecture in Australian commercial architecture from the perspective of stakeholders; the factors include market, technology and policy (government support, regulation, and demonstration project). With the increasing number of GB projects, the exploration of CSFs for GH projects will continue to gain academic interest in the future. the present study conducted a comprehensive literature review of CSFs for GH projects by following the methods proposed by Hwang et al. (2016, 2018). Advances in Civil Engineering External Incentives and Constraints. Sufficient financial resources can bear the high development cost of GH, which can effectively mobilise the enthusiasm of enterprises to develop GH (Zhang et al, 2016: Oyebaniji et al, 2017). For example, the banks' loan concessions can alleviate the financial pressure of enterprises to develop GB to a certain extent and improve their willingness to develop GB (Shen et al, 2017: Hwang et al,2017). At the same time, the government's economic incentives and regulatory measures are important considerations for companies to make GH development decisions (Murtagh et al, 2016). The government provides incentives for the development of GH projects, supervises the construction management of contractors, and reduces the tax credits for homebuyers (Sakr et al, 2011; Doskocil and Lacko, 2018). These strategies have effectively motivated the construction of GH and improved the willingness of consumers to purchase. The realisation is apparent that the technical specifications of GH are crucial. the performance standard of GH is higher than that of traditional housing (Ihuha et al, 2014; Xu et al, 2015). The perfect technical specifications have effective restraint and guidance for the construction of GH. GH is a new type of building that requires new technologies, environmentally friendly materials, reliable simulation analysis and complex architectural design; this concept integrates a large number of advanced and complex technologies, which not only has higher requirements on the construction capacity of enterprises but also generates higher incremental costs in terms of human resources, materials, and machinery. In essence, technical innovation and effective cost management are crucial in the construction and delivery of GH projects (Lam et al, 2010; Pheng et al, 2014 and Yetes, 2014). Successful cases of GH projects have encountered more uncertainties and complexities in the project process and risks are unrecognised or even unpredictable compared with traditional housing, hence, perfect risk management system not only helps the project to achieve the expected goal in terms of time, cost, and schedule but also deals with numerous unexpected risks thereby ensuring success of the project (Hwang et al, 2016; Banihashemi *et al*, 2017 and Wang et al, 2014). Participants Ability and Quality is very germane as at the strategic level of GB projects, the support and capabilities of senior management play a positive role in achieving the GH project management objectives; their correct decision-making and guidance contribute to the realisation of high-performance and high-level GB projects (Pheng et al, 2014; Aktas & Ozorhon, 2015).

It has been observed variously that there is no significant progress in third world countries in green building development and if this needs to take places as Agyekum et al (2021) has observed in Ghana, drivers or critical success factors or enablers behind green building project financing must be identified as these can promote green building project financing. These Critical Success factors (CSF) will be determined from literature which shall be ranked via questionnaire with contractors, estate developers, mortgage bankers and Estate Surveyors and Valuer s in the construction industry. The CSF will then be validated, survey identified, drivers will then be validated by experts or Green Building professionals in Nigeria. It is hoped that the outcome of this research will benefit various stakeholders (e.g. financial institutions, investors, developers, and policymakers) promoting knowledge and skills to aid sustainable development in Nigeria via green building projects finance.

3.0 **Methodology**

The study employed descriptive survey design which allows description of the phenomenon in the real term. The study utilized primary source of data collected through closed ended questionnaires. The study administered 400 questionnaires based on the confidence level of the research in the population and the questionnaires were administered to professionals in the built environment using simple random sampling techniques. The study retrieved 339 questionnaires from the professionals that comprised of estate surveyors, Architects, Builders, quantity surveyors and land surveyors across the Kaduna metropolis. The data was analysed using both descriptive techniques (mean score, relative important index-RII) and inferential techniques using factor analysis (principal component analysis).

4.0 **Results and Discussion**

4.1 **Demographic Information of Respondents**

The response on demographic information is presented in Table 1. 51% of the sampled majority respondents were male, 95.9% fall within the age bracket of 41-50urs. 94.4% had first degree or higher national diploma. 35.4% majority of the respondent were registered estate surveyor. 25.7% were registered architects while 16.5% and 14.7% were registered builders and quantity surveyor respectively. 94.4% majority of sampled respondents had between 16-20years working experience.

Table 1 Demographic Information of Respondents

Demographic Information		**Frequency**	**Percent**
	Male	166	49.0
Gender	Female	173	51.0
	Total	339	100.0
	18-30yrs	-	-
Age	31-40yrs	14	4.1
	41-50yrs	325	95.9
	51-60yrs	339	100.0
	61yrs and above		
	Total		
Academic Qualification	ND		
	HND/B.tech/Bsc	320	94.4
	Masters	5	1.5
	PhD	14	4.1
	Total	339	100.0
Professional Status	Registered Estate surveyor	120	35.4

	Registered Architects	87	25.7
	Registered Builders	56	16.5
	Registered Quantity surveyors	50	14.7
	Registered Land surveyor	26	7.7
	Total	339	100.0
Years of Experience in Built Industry	10years and below	-	-
	11-15yrs	5	1.5
	16-20yrs	320	94.4
	21yrs and above	14	4.1
	Total	339	100.0

4.2 Level of Awareness of Features of Green Building Initiative Practices

The level of awareness of feature of green building practices is presented in table 2. Low energy lighting design and better orientation is most aware feature of green building with highest relative awareness index of 0.928. Cost-effective and environmentally friendly technologies was the second most aware feature of green building practice with awareness index of 0.89. The use of renewable energy and natural resources along with effective use of existing landscape were the third and fourth the most aware features of green building at relative awareness index of 0.888 and 0.84 respectively. Quality air for human safety both indoor and outdoor air and proper control and efficient building management system had high awareness index at 0.802 and 0.714 respectively. There is low awareness of use of recycle building material for friendly environment and efficient use of water resource with as low awareness index was recorded at 0.67 and 0.689 respectively as compare to the awareness of other features. Finally, the result revealed that the relative awareness index for all the features of green building were above 0.65. This indicates that there is high level of awareness of feature of green building across the sampled professionals.

Table 2 Level of Awareness of Features of Green Building Initiative Practices

	Responses (%)					Total (%)	MS	RII	RK
Features	Very high	High	Moderate	Low	Very low				
The use of energy-saving efficient and eco-friendly equipment	30	35.5	20,5	15.0	0.0	339(100)	3.67	0.738	5
Low-energy lighting design and better orientation	41.7	32.5	15.3	5.5	5.0	339(100)	4.64	0.928	1
Use of recycle building materials for friendly environmentally.	25.8	33.4	17.1	20.2	3.5	339(100)	3.35	67.0	7
Quality air for human safety both indoor air and outdoor air	37.6	25.8	10.0	21.4	5.2	339(100)	4.01	0.802	5
Use of renewable energy and natural resources	46	25.7	16.5	11.8	0.0	339(100)	4.44	0.888	3
Proper controls and efficient building management system.	31	45.5	0.0	19	4.5	339(100)	3.57	0.714	6
Efficient use of water resources	40.5	20.4	13.5	25.6	0.0	339(100)	3.43	0.686	8
Effective use of existing landscapes features	39.8	31.2	16.7	12.3	0.0	339(100)	4.20	0.840	4
Cost-effective and environmentally-friendly technologies	29.7	45	25.3	0.0	0.0	339(100)	4.45	0.89	2

Source: Author, field computation, 2024

4.3 Perceived level of Adoption of Green Building Practice Initiatives

The perceived level of adoption of green building practices is presented in table 3. There is high level of adoption of green building practices in the study area. Adoption of the use of natural landscape as green building practice was found very high among the professionals at relative importance index of 0.934 and is ranked the most adopted building practice. This is followed by high level of adoption of the use of energy-efficient and eco-friendly equipment as second the most adopted green building practice.at high relative importance index at 0.86. Adoption of the Use of renewable energy and adoption of existing landscapes features were ranked 3th and 4th the most adopted green building practices respectively at relative important index of 0.825 and 0.82. Adoption natural Quality air for human safety and comfort is ranked 5th at 0.796, Adoption of the Use of recycle & environmentally friendly building materials is ranked 6th at 0.735, Adoption of low-energy lighting design and Low-energy lighting design were ranked 7th at 0.73 each, while adoption use of gray water recycling and Adoption of environmentally-friendly technologies were ranked the least adopted green building practice in the study area at 0.712 and 0.68 respectively. Finally, the result revealed that the relative important index for all the green building practices were above 0.65. This indicates that there is high level adoption of green building by the sampled professionals.

Table 3 Perceived level of Adoption of Green Building Practice Initiatives

	Responses (%)								
Green Building Practices	Very high	High	Moderate	Low	Very low	Total (%)	MS	RII	RK
Adoption of the use of natural landscapes	30	35.5	20,5	15.0	0.0	339(100)	4.67	0.934	1
Adoption of cost-effective and environmentally friendly technologies	41.7	32.5	15.3	5.5	5.0	339(100)	3.67	0.734	6
adoption use of gray water recycling.	25.8	33.4	17.1	20.2	3.5	339(100)	3.56	0.712	8
Adoption of the Use of renewable energy	37.6	25.8	10.0	21.4	5.2	339(100)	4.12	0.825	3
Adoption natural Quality air for human safety and comfort	46	25.7	16.5	11.8	0.0	339(100)	3.98	0.796	5
Adoption of the Use of recycle & environmentally friendly building materials	31	45.5	0.0	19	4.5	339(100)	3.67	0.735	6
Adoption of the Use of energy-efficient and eco-friendly equipment	40.5	20.4	13.5	25.6	0.0	339(100)	4.33	0.866	2
Adoption of existing landscapes features	39.8	31.2	16.7	12.3	0.0	339(100)	4.10	0.82	4
Adoption of low-energy lighting design	40	20.5	18.5	21.0	0.0	339(100)	3.65	0.73	7
Low-energy lighting design	42.5	23.5	0.00	30.5	3.50	339(100)	3.65	0.73	7
Adoption of environmentally-friendly technologies	29.7	45	25.3	0.0	0.0	339(100)	3.40	0.68	9

4.4 Perceived Level of Awareness of Benefits of Green Building practice Initiative

The result of perceived level of awareness of benefits associated with the adoption of green building practice initiatives is presented in Table 4. The Quality indoor air for human safety and comfort, maximum use of natural day-lighting and Low-cost building management system were ranked first the most aware benefits of green building practice by the professionals at 0.642 index. Awareness of benefit of low energy consumption through use of natural ventilation rather than air-conditioning was ranked second as the most aware benefit of green building practice at 0.640. lower environmental impact building materials and low cost of energy lighting design were ranked third and fourth the most aware benefit of green building practice at 0.638 relative index. Increase management

productivity and effectiveness is ranked fifth at 0.63 relative index. Use of gray-water recycling for landscape and WCs and minimizing site impact through sensitivity to site ecology were ranked the same 6th at 0.612 each. There is relatively low level of awareness of benefits of green building practice as relative importance index is found below 0.65. By implication, there is low level of awareness of benefits of green building practice.

Table 4 Perceived Level of Awareness of Benefits of Green Building practice Initiative

Benefits	Very High	High	moderate	Low	Very low	Total	MS	RII	RK
low energy consumption through use of natural ventilation rather than air-conditioning	33.9	41.4	22.7	2.00	0.00	100(339)	3.21	0.642	2
low cost of energy lighting design	23.6	41.4	0.0	30.0	5.00	100(339)	3.19	0.638	4
lower environmental impact building materials.	34.5	23.5	22	20.0	0.0	100(339)	3.20	0.64	3
Quality indoor air for human safety and comfort	34.5	40.2	0.0	15.0	10.3	100(339)	3.23	0.646	1
maximum use of natural day-lighting	45.5	30.5	0.00	24.0	0.00	100(339)	3.23	0.646	1
Low-cost building management system.	21.5	33.6	41.7	20.1	0.0	100(339)	3.23	0.646	1
Use of gray-water recycling for landscape and WCs	19.5	23.5	31.50	15.5	10.0	100(339)	3.06	0.612	6
minimizing site impact through sensitivity to site ecology	20.5	15.5	31.5	20.0	12.5	100(339)	3.06	0.612	6
increase management productivity and effectiveness	21.3	30.7	30.03	17.97	0.00	100(339)	3.15	0.63	5

Source: Author's computation, 2024

4.5 Success Factors for the Adoption of Green Initiatives for Mortgage Finance

Table 5 revealed the success factors for the adoption of green building practice initiative for mortgage finance. The factors were measured on five Likert scale and result revealed that there is high level relative important index across the success factors such that technology specification had highest relative importance index and was ranked first at 0.79 relative important index. Designer ability is ranked second as the most important factor at 0.766 relative important index. green team education training and team motivation were ranked third and fourth at 0.75 and 0.752 respectively as most important factors for the adoption of green building. Project manager ability and Stakeholders' active participation were ranked fifth and sixth 0.740 and 0.734 respectively. Effective collaboration and communication; Good trust relationship among stakeholders; and Project management support were rated 7th, 8th and 9th with relative important index of 0.726, 0.72, and 0.716 respectively as important factors. Effective government policies and regulatory has relative important index of 0.718 and was ranked 10th. Owner active participation and commitment; Worker's experience and objectives; and effective Feedback had the same relative importance index of 0.71 and were ranked 11th the most successful factors for the adoption of green building practice initiative for mortgage finance. End user Participation and Advanced machinery and innovative technology had 0.708 relative important index and was ranked 12th position as the least important success factor. By implication, all the success factors had relative important index over and above 0.65 acceptability bench mark. Therefore, adherence to the factors provide basis for adoption of green building initiatives.

Table 5 Success Factors for the Adoption of Green Initiatives for Mortgage Finance

Success Factors	SA	A	ID	D	SD	Total	MS	RII	RK
Effective government policies and regulatory	21.5	31.3	0.00	33.2	14.0	100(339)	3.56	0.712	10
Owner active participation and commitment	33.3	36.5	12.5	17.7	0.00	100(339)	3.55	0.710	11
Technology specification	45	25.7	17.5	11.8	0.0	100(339)	3.97	0.794	1
Project management support	32	44.5	0.0	19	4.5	100(339)	3.58	0.716	9
Project manager ability	40.5	20.4	13.5	25.6	0.0	100(339)	3.70	0.74	5
Designer Ability	39.8	31.2	16.7	12.3	0.0	100(339)	3.83	0.766	2
Worker's experience and objectives	29.7	45	25.3	0.0	0.0	100(339)	3.55	0.710	11
Clear project goal and objectives	41.7	32.5	15.3	5.5	5.0	100(339)	3.60	0.72	8
End user Participation	25.8	33.4	17.1	20.2	3.5	100(339)	3.54	0.708	12
Stakeholders' active participation	37.6	25.8	10.0	21.4	5.2	100(339)	3.67	0.734	6
Effective collaboration and communication	46	25.7	16.5	11.8	0.0	100(339)	3.63	0.726	7
Good trust relationship among stakeholders	31	45.5	0.0	19	4.5	100(339)	3.60	0.720	8
Team motivation	40.5	20.4	13.5	25.6	0.0	100(339)	3.76	0.752	4
Green team education and training	39.8	31.2	16.7	12.3	0.0	100(339)	3.77	0.754	3
Effective Feedback	46	25.7	16.5	11.8	0.0	100(339)	3.57	0.710	11
Effective cost management	31	45.5	0.0	19	4.5	100(339)	3.67	0.734	6
Advanced machinery and innovative technology	40.5	20.4	13.5	25.6	0.0	100(339)	3.54	0.708	12
Project risk management	39.8	31.2	16.7	12.3	0.0	100(339)	3.55	0.710	11
Effective project planning and control	29.7	45	25.3	0.0	0.0	100(339)	3.80	0.726	7

Source: Author Computation, 2024. (Strongly agree SA, Agree=A, Indifferent=ID, Disagree =D and Strongly Disagree =SD)

5.0 **CONCLUSION AND RECOMMENDATION**

The study evaluated of critical success factors for the adoption of green building practice alongside with awareness and associated benefits were examined simultaneously. The study understood that there is high level of awareness of green building practices among the sampled professionals, by implication, the practices of green building is new to build professionals in the study area. Furthermore, the study also understood that the level of adoption of green building practices is very high in the study area however, the study discovered that there is low level of awareness of full benefits associated with the adoption of the green building initiative practices among the sampled professionals. Adoption of the use of natural landscape as green building practice was highly appraised among the professionals followed by the adoption of the use of energy-efficient and eco-friendly equipment. the success factors for the adoption of green building practice initiative for mortgage finance were highly appraised among the professional and it is understood that all the success factors had a very high acceptability index. Therefore, adherence to the factors provide basis for adoption of green building initiatives appraised. It is recommended that awareness on the on both health and physical benefits green building practices should created among the built professionals and

furthermore the awareness of success factors for the adoption green building practice for mortgage finance should be publicized across government agencies especially at ministry of environment.

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COMPARATIVE ANALYSIS OF FACTORS INFLUENC ING OCCUPANCY RATIO AND RENTAL VALUE OF HIGH AND LOW RISE BUILDINGS IN KADUNA

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Abstract
The study examines the factors influencing occupancy ratio and rental value of high-rise and low-rise buildings in the Kaduna metropolis of Nigeria. A quantitative approach was adopted with questionnaires administered on thirty five registered estate surveyor firms in the study area with purposive sampling techniques used to identify firms managing both low and high rise buildings. Thirty of the administered questionnaires were returned valid for analysis showing 85.7% success rate. With the aid of five point likert scale analysed with average mean and relative importance index (RII), findings revealed that the non-provision of elevator was ranked highest among the factors influencing rental values of high rise building with 0.77 RII value while that of low rise building was found to be population/demand with 0.71 RII. Also revealed by the study is an upward trajectory of rental values for both high and low-rise building; although, low rise buildings commanded a higher rental value when compared to high rise buildings. With a similar RII value of 0.80, location influences occupancy ratio of high rise buildings while individual preferences does for low rise buildings. The study concludes that inadequate facilities such as elevator, emergency exits and fire extinguishing in high rise building affected rental values over time thereby making low rise building at better investment option. The study therefore recommends that real estate investors should intensify regulatory supervision of high-rise building constructions to ensure adherence to sound structural design and execution alongside provision of basic facilities like emergency exits, fire extinguishing systems and elevators to further enhance the rental values and eventual return on investment.
Keywords: *Occupancy level, Rental value, High-Rise Building; Factors*

Introduction

After food and clothes, shelter is one of man's three fundamental requirements. Shelter is a topic that continually resurfacing in public debate among those involved in the design and construction of structures. When man was largely traditional, the question of shelter was not as pressing as it is today (Desai & Dharmapala, 2009). The original community was completely unplanned and centered on horizontal building development rather than predefined arrangements or preferences for height (Berger, 2006; Shirowzhan, 2020). Individuals, corporations, and governments have developed different inventions as a result of urbanization to address the problem of human shelter, particularly in the housing sector, resulting in vertical building development (Wang & Wang, 2010; Nwankwo & Okonkwo, 2012).

A construction with walls, floors, a roof, and typically windows is referred to as a building (Sadineni, 2011). As a result, tall buildings are multi-story structures where the majority of residents rely on elevators (lifts) or staircases to get to their destinations. Most countries refer to such buildings as "high-rise buildings," although Britain and several European countries refer to them as "tower blocks" (Urban, 2013; Urban, 2018). The emergence of large cities is aided by the rapid rise of the economies of the major countries. The population density is expanding as a result of extensive internal and external migration to major cities. As a result, the number of contemporary multi-story and high-rise structures is growing, and engineering and transportation infrastructure is evolving at a breakneck speed (Penner et al., 2013; McDuie-Ra & Chettri, 2020). Overall, housing, as a component of man's environment, has a significant impact on the community's health, social behaviour, satisfaction, and overall well-being. It is the best physical and historical proof of civilisation in a country, and it represents a society's sociocultural and economic ideals (Aluko, 2009).

A building is designated a high-rise when a "occupied floor" is more than 75 feet above the lowest level of fire department truck access, according to the criteria for a high-rise building in Section 202 of the 2015 International Building Code (IBC). A mid-rise apartment building has five to twelve floors, which is shorter than a high-rise. This indicates that they are likely to feature an elevator and amenities like swimming pools and community spaces (Yuen et al., 2006). In the United States, a high-rise is defined as a structure that is more than 75 feet (23 meters), or about seven storeys tall, according to the National Fire Protection Association (NFPA) (Li et al., 2018). A high-rise is defined

by most building engineers, inspectors, architects, and other professionals as a structure that is at least 75 feet tall (Kavilkar & Patil, 2014). High-rise buildings are frequently associated with high resource consumption, requiring considerable quantities of building materials during construction, significant amounts of energy for building operations, and generating big amounts of garbage when they are demolished at the end of their life cycle (Ahmad et al., 2017). With the growing urbanization of many emerging countries, more people are flocking to cities, resulting in a considerably higher demand for construction space than before (Suzuki et al., 2013). As a result, high-rise structures are being constructed in these developing economies to accommodate the great demand (Ma *et al.*, 2012).

High-rise structures differ from mid-rise and low-rise ones in various ways (Korolchenko & Kholshchevnikov, 2017). The manner in which high-rise impacts people, profit, and the environment, as well as how society, economy, and the environment interact with high-rise, are the primary factors that lead to this differentiation (Ahmad et al., 2017; Høibø et al., 2015; da Rocha & Kemmer, 2013). When it comes to sustainability and growth, high-rise building challenges play both a beneficial and negative role (Ahmad et al., 2017; Avini et al., 2019). While some of the difficulties are genuine and readily apparent, others are potential that are now limited to experimental use or that must be incorporated into standard building construction and management practices (Pekuri et al., 2011).

The development of high-rise structures is an emerging trend in 21st-century cities around the world, mostly to address the issues of urban overcrowding, ensuring judicious use of limited land resources, as a status symbol, as tourist attractions, and to create magnificent skylines (Janssen-Jansen & Hutton, 2011; Swapan et al., 2017; Konaev, 2019). Despite these benefits, the construction of high-rise buildings in Nigeria has been plagued by problems (Nimlyat et al., 2017). The retarded growth translates to a scarcity of high-rise buildings in Nigerian cities, as well as the fact that most of those that do exist are underutilized due to a number of chronic issues that result in lower occupancy rates than planned (Bernt, 2009). As a result, several high-rise residential buildings have been converted to commercial and office complexes, or mixed-use developments including residential on the first few levels (Nimlyat et al., 2017; Han et al., 2021).

The ratio of occupied rooms to available rooms is known as the building occupancy rate. The percentage of occupied rooms in a property at any particular time is known as the occupancy rate (deRoss, 1999; Gurran & Phibbs, 2017). It influences the return on investment and is one of the most high-level markers of real estate performance. The ratio of rented or used space to total available space is known as the occupancy ratio. Analysts utilize occupancy rates to analyze a variety of topics, including residential, hospitals, business, hotels, and rental units (Thrall, 2001). The study of building occupancy ratio efficiency is a scientific study that benefits not only the residents of buildings (high or low rise), but also the property owners and managers (Craig, 2015). One of the most essential inputs for building simulations, design specifications design, optimization, and environmentally friendly policy decisions is the occupancy of residential structures (Hu et al., 2019).

Results from empirical studies revealed the following different outcomes; Olajide (2018) explores the position of building or neighbourhood characteristics of investment properties among the key determinants of residential property value on residential neighbourhood and suggests that accessibility is the most significant determinant of property value, follow by neighbourhood security and lastly building or neighbourhood characteristics. There is however no statistically significant relationship between building or neighbourhood characteristics and investment property values. Oladapo et al. (2019) study reveals that dwelling attributes of number of rooms, bath and toilets and accessibility attributes of nearness to primary and secondary school are the main attributes that determine the preferred location of tenants' residence and influencing the rental value of residential property. Abidoye and Chan (2016) from the framework of 20 attributes of residential investment property in Lagos, Nigeria observed in order of importance the most highly significant variables that influence the property value as: property location; neighbourhood characteristics; property state of repairs; size of property; availability of neighbourhood security and age of the property. Popoola, Jinadu, Liman, and Abd'Rasack (2015) examined environmental quality effect on rent of residential properties at the exterior zones of Minna, Nigeria and observed that rents variation in the selected sub-urban areas can be credited to ecological quality factors. Danlami et al (2019) in their study reveals various property attributes such as number of rooms and conveniences as well as accessibility features such as nearness to schools as main features influencing location choice of tenants' residence and the rental value the property can command. of residential property. McElveen et al. (2020) specified the neighbourhood

features such as renters' percentage, household income, economic boundaries, and school districts as the factors that influence the value of residential real estate. However, none of these recent studies have been able examine the factors influencing the rental values of high-rise and low-rise properties, this is the gap which this study intends to address.

The aim is to identify and analyse the various factors that influence the occupancy ration and rental value of high-rise and low-rise building to gauge the performance of investment in such properties in Kaduna, Nigeria. To achieve this central aim, the following variables are considered: general and specific factor influencing rental values of apartments; specific factor influencing rental values of High rise and low-rise; factors influencing occupancy ratios; trends in rental values of the apartments; the pros and cons of both high-rise and low-rise buildings are related to the study area.

Methodology

This study was conducted in Kaduna, a state in the North Eastern part of Nigeria within latitude 10° 36' 33.5484" N and longitude 7° 25' 46.2144" E (see figure 1). Quantitative research approach was adopted for this study, with a structured close ended questionnaire administered on respondents. Data for this study were gathered from purposive sampling techniques which enable selection of estate surveyors and valuers firm with the considered properties in the Kawo and Television areas of the location. A total of thirty five (35) registered estate Valuers were sampled while thirty (30) questionnaire were returned valid and analysed for this study. The contents of questionnaires comprise the demographic information of respondents, expected attributes of high- and low-rise building, factors influencing occupancy ratio of high rise building. This shows 85.7% return considered relevant and enough. The study adopted descriptive method of data analysis which comprises percentages and mean score (A five point likert scale was adopted to analyse the factors in the questionnaire ranging from the least 1 to 5 being the highest scale). Combinations of average mean alongside the relative importance index (RII) were further applied to enable ranking of the factors in line with their level of importance.

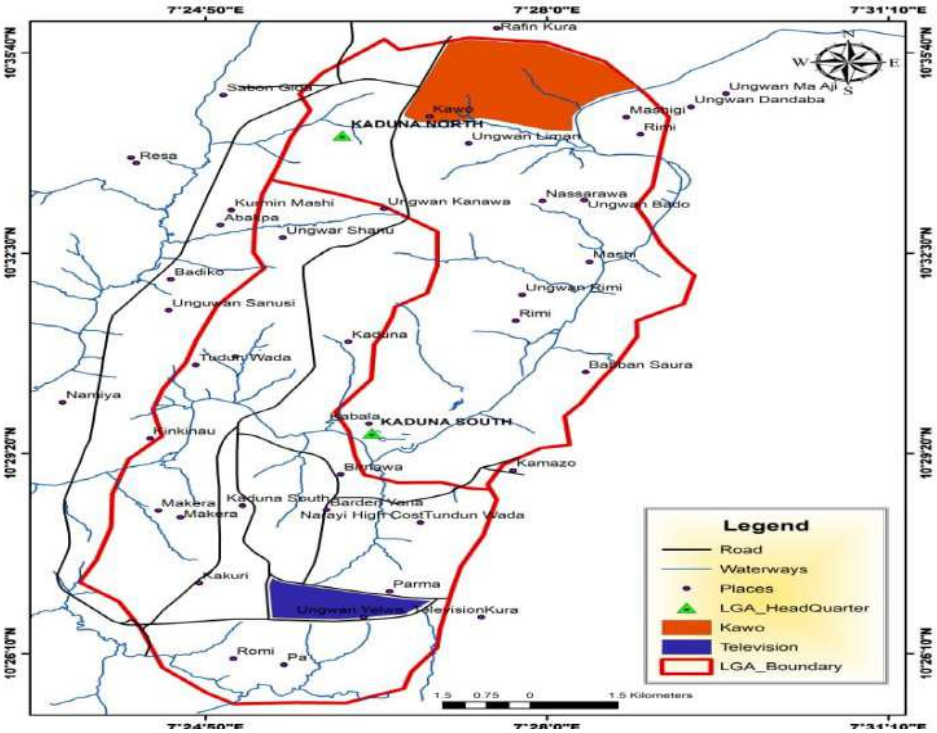

Figure 1: Kaduna showing the Study Area
Source: Authors Design, 2022

5.0 Result and Interpretation

Table 1 revealed the general factors influencing the rental value of properties in the study area. As observed from table 1, Inadequate structural quality was ranked highest with 0.78 relative importance index (RII) followed by Amenities and facilities which is ranked second with 0.76 RII while Size and

Layout was ranked third having 0.75 RII. Void in property is ranked fourth with 0.74 RII. Household income could be seen on the fifth spot with 0.73 RII values. The neighborhood attributes sixth ranked factor with 0.71 RII. location was ranked seventh among the least ranked factors at 0.70 relative importance index (RII). Meanwhile, provision of emergency 0.69, economic condition / Cost of construction and fire incidence 0.68, and market condition were ranked at 0.69, 0.68 and 0.60 respectively. All the factors had relative important index of 0.60 and above this indicates that these factors have high influence on rental values.

Table 1 General Factors Influencing Rental Value Properties

Factors Influencing Rental Value	N	SUM	Mean	RII	Rank
Structural Qualities	30	117	3.89	0.78	1
neighborhood attributes	30	107	3.56	0.71	6
Provision of emergency exits	30	104	3.45	0.69	8
Cost of construction and fire incidence	30	102	3.40	0.68	9
Household income	30	110	3.67	0.73	5
Location factors	30	105	3.50	0.70	7
Void in property	30	111	3.70	0.74	4
Economic condition	30	102	3.40	0.68	9
Market condition	30	90	3.00	0.60	10
Amenities and facilities	30	114	3.80	0.76	2
Size and Layout	30	113	3.75	0.75	3

Source: Author's Field Computation

The specific factors influencing the rental value of high rise building in the study area was revealed to be numerous. As observed from Tables 2, non-provision of elevator was ranked highest with 0.77 relative importance index (RII) followed by cost of construction and fire incidence having 0.76 RII at second spot while poor structural designs and incessant cases of building collapse occupies the third spot with 0.75 RII as number of floors could be seen on the fifth spot with 0.71 RII values. The sixth ranked factor with 0.69 RII was inadequate provision of emergency exits while the least ranked factor recorded 0.59 relative importance index (RII). Meanwhile, population and demand was ranked highest for low rise buildings with 0.71 RII followed by building collapse with 0.65 RII while stringent regulations was ranked third with 0.49 RII. Equally, 0.55 RII was observed for fire outbreaks ranked fourth while high cost of maintenance ranks fifth with 0.53 RII alongside 0.46 RII recorded for the duo of poor structural designs and cost of construction respectively. A RII value of 0.44 was observed for inadequacies in the provision of elevator ranked seventh and finally ranked lowest with 0.34 RII was absence of elevator.

Table 2 Specific Factors Influencing Rental Values High-rise and Low-rise Properties

	Variables	SD	D	N	A	SA	F	fx	Mean	RII	Rank
High rise	Inadequate emergency exits		7	8	9	6	30	104	2.13	0.69	6th
	Poor structural design		3	10	9	8	30	112	3.73	0.75	3rd
	Incessant accident of building collapse		5	8	6	11	30	113	3.77	0.75	3rd
	Non-Provision of elevator	2	5	1	10	12	30	115	3.83	0.77	1st
	Fire outbreaks/incidence		4	8	8	10	30	114	3.8	0.76	2nd
	Stringent regulatory measures		6	9	5	10	30	109	3.63	0.73	4th
	Maintenance cost		7	8	9	6	30	104	3.47	0.69	6th
	Number of floors		6	10	6	8	30	106	3.53	0.71	5th
	Construction cost		4	8	8	10	30	114	3.80	0.76	2nd
Low rise	Inadequate emergency exits	10	7	10	3		30	66	2.20	0.44	7th
	Poor structural design	11	5	8	6		30	69	2.30	0.46	6th
	Incessant accident of building collapse		9	9	7	5	30	98	3.27	0.65	2nd
	Non-Provision of elevator	19	4	4	3		30	51	1.70	0.34	8th
	Fire outbreaks/incidence	11		8	7	4	30	83	2.77	0.55	3rd
	Stringent regulatory measures	7	8	12		3	74	74	2.47	0.49	5th
	Maintenance cost	13		6	7	4	30	79	2.63	0.53	4th
	Population/Demand	3	7	7	4	9	30	99	3.53	0.71	1st
	Cost of construction	10	6	9	5		30	69	2.30	0.46	6th

It can be concluded that the rental value of high rise buildings were influenced by series of factors which all relates to provision of basic and essential facilities like elevators, construction cost, emergency exit in times of accidents and fire outbreak alongside regulatory (Sunder, 2004; Ali, 2008) framework for structural design (Ali & Al-Kodmany, 2012), fear of building collapse (Okeke et al., 2020; Dwijendra et al., 2021), maintenance cost, similar to (Hu et al., 2019; Mohammed, 2021) all approaching 1.00 RII and contributes immensely to the price tag by investors in order to recoup their return on investment (RoI). Consequently, the same factors considered above are peculiar to low-rise buildings, though lower than the RII recorded for high rise buildings.

Studies have shown that many factors contribute to building occupancy ratio. As observed in Table 3 shows the various factors and their levels of importance in relation to occupancy ratio of low and high rise buildings in the study area. Findings revealed that the factor in high rise buildings with the highest relative importance index (RII) and ranked highest was family size and nature of design with 0.79 followed by number of room and locational attributes with 0.78 RII value and the availability

facilities had 0.75 RII making it ranked third. With 0.75 RII, level of demand was ranked fourth at 0.72 RII followed by availability of property space and individual preferences at 0.70 RII and 0.69 RII were ranked 5th and 6th respectively. Finally, the least ranked factor with the lowest RII was found to be population at 0.58 RII. Contrastingly, the highest ranked factor influencing occupancy ratio in low rose building with 0.79 RII value was family size followed by number of room and availability facilities. From the foregoing, it could be inferred that all variables analysed greatly influences occupancy ratio of buildings.

Table 3: Factors Influencing Building Occupancy Ratio

Factors influencing occupancy ratio	N	SUM	Mean	RII	Rank
Family size	30	119	3.97	0.79	1
Individual preference	30	104	3.45	0.69	6
Population	30	87	2.90	0.58	7
Available facilities	30	113	3.76	0.75	3
Number of rooms	30	116	3.87	0.78	2
Level of demand	30	108	3.60	0.72	4
Nature design	30	119	3.97	0.79	1
Locational attributes	30	116	3.87	0.78	2
Available property space	30	105	3.50	0.70	5

Source: Field survey computation

Results from the analysed data on rental trend over the past five years presented in Figure 2 indicated that the rental value for single room apartment in the study area was ₦40000 in 2017 and 2018 while it increased to ₦50000 in 2019 and dropped to ₦35000 in 2020 only to rise again in 2021 to ₦55000. Monetary value placed on two bedrooms apartment in 2017 and 2018 was ₦75000 with an increase to ₦90000 observed in 2019 which later dropped to ₦70000 in 2020 and eventually rose to ₦100000 in 2021. Occupants of three bedrooms apartment in the high rise building available in the study area paid ₦100000 in 2017 and 2018 while ₦120000 was paid in 2019 as the price dropped to ₦85000 in 2020 and later rose to 120000 in 2021. Similarly, single room apartment in the low rise apartments has a rental value of ₦55000 in 2017 and 2018 which later rose to ₦70000 in 2019 and dropped to ₦60000 in 2020 before rising to ₦85000 in 2021.

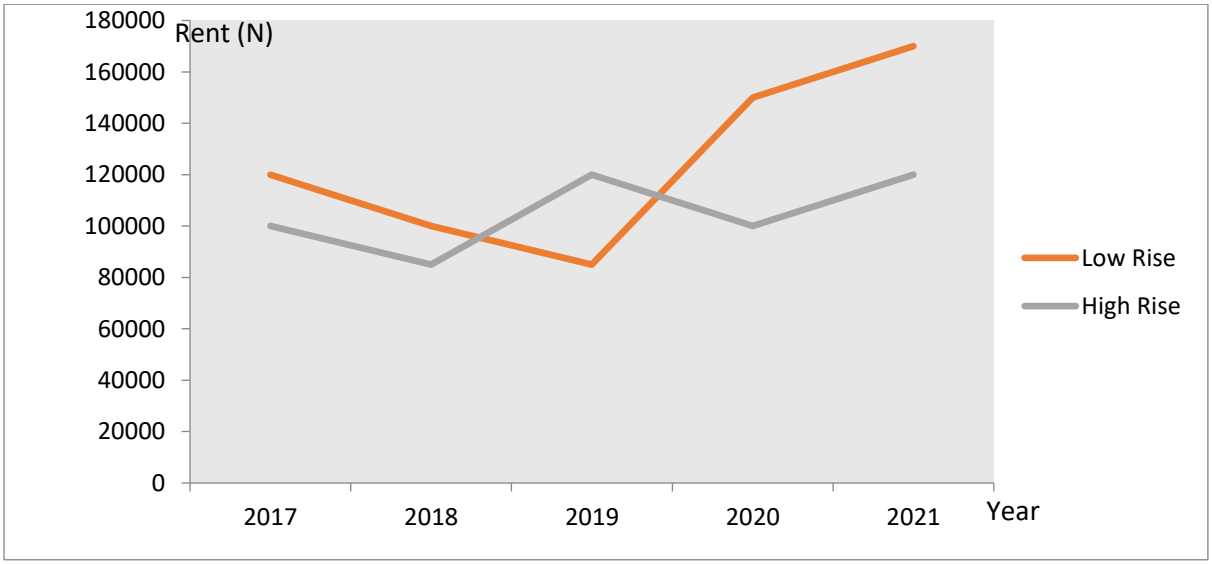

Figure 2: Rental Trend for Single Rooms in the Study Area

Figure 3 revealed **the** monetary value placed on two bedrooms apartment in 2017 and 2018 was ₦150000 with an increase to ₦170000 observed in 2019 which later dropped to ₦150000 in 2020 and

eventually rose to ₦200000 in 2021. Two bedrooms apartment for the low rose buildings in 2018 and 2018 possess ₦150000 values while the rental value for 2019 was ₦200000 which also rise to ₦250000 in 2020 and increased to ₦2700000 in 2021.

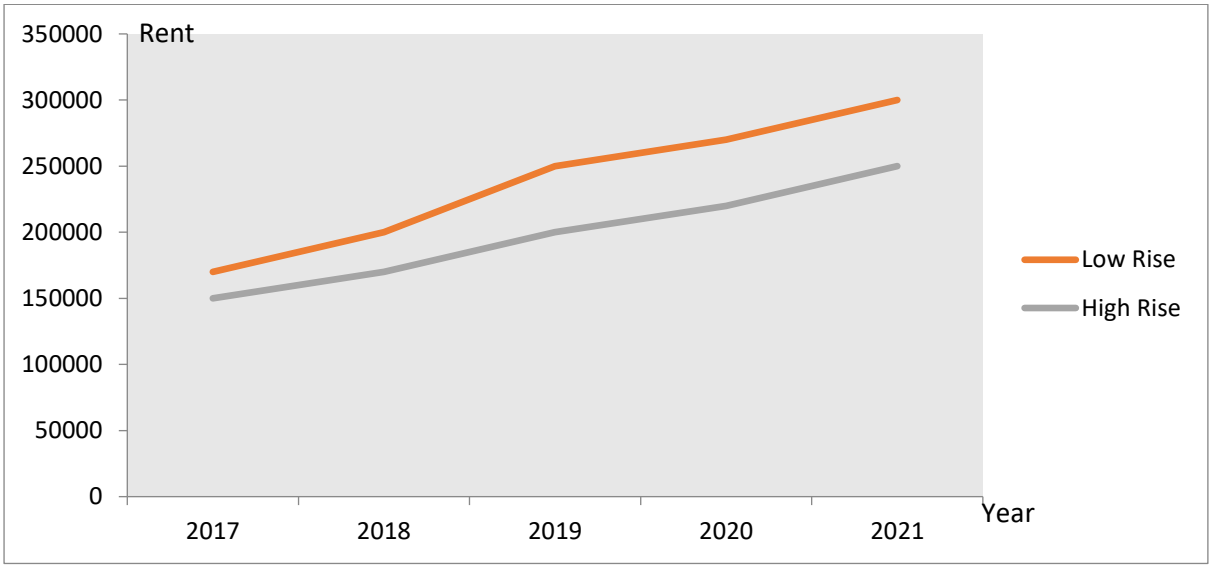

Figure 3: Rental Trend for Two-Bedroom Rooms in the Study Area

Figure 4 shows the three bedrooms apartment in the high rise building available in the study area and the rent goes for ₦100000 between 2017 and 2018 and moved upwardly in 2019 to ₦150000 and dropped to ₦200000 in 2020 and later rose to 270000 in 2021. Similar pattern was observed in the rental trend for three-bedroom apartment of low rise building with ₦120000 paid as rent by occupants in 2017 and 2018 while ₦145000 was paid in 2019 while a drop to ₦90000 was observed in the rent for 2020 and an increase to ₦160000 was attainable in 2021.

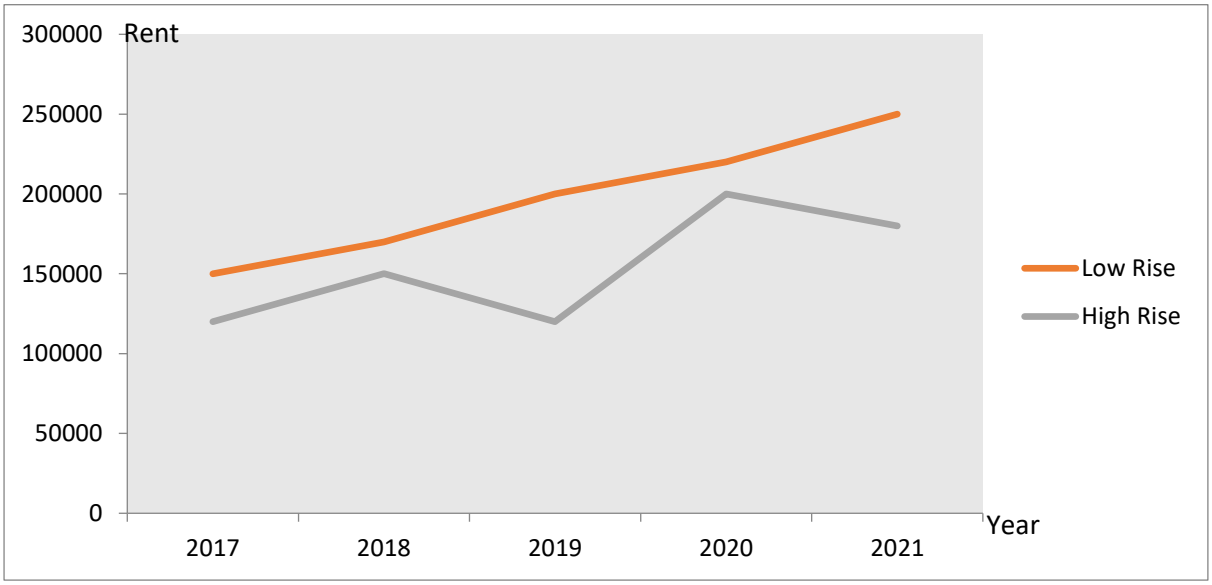

Figure 3: Rental Trend for Two-Bedroom Rooms in the Study Area

From the foregoing, it can be inferred that the rental trend in the study area is on an upward trajectory irrespective of the height. However, a slight variation is observed as the rental value of low rise building was higher than the high rise buildings. More so, a drop and reduction in the rental value was observed for 2020, which is traceable to the global lockdown as a result of the COVID-19 pandemic that brought the world to a standstill and agrees with the findings of (Oyedeji, 2020). In addition, the high rental value in high rise building is as a result of the convenience attached and reduced occurrence of various incidence alongside the high demand for such type of properties.

As obtained in Table 4, the pros and cons of occupying high and low rise building as peculiar to the study area revealed that residing in a high rise building ensures absolute control over noise with 4.27 mean value recorded for less noise ranking it highest, followed by provision of vantage view of the city with 4.20 mean and the least ranked merits of residing in a high rise building was found to be availability of cleaner air as a result of distance from the ground floor where noise and all other forms of pollution thrives. Consequently, the highest ranked shortcoming of occupying a high rise building as observed from the analysed field data was the problem of vertical transportation and movement with 4.10 mean value followed by resident's anxiety for height having 4.06 mean values and 4.00 mean values was recorded for possibility of accidents and emergency situations while the lowest ranked demerit was wind induced motion with 3.73 mean value.

Meanwhile, slight variation in both pros and cons was observed for the analysed data on low rose buildings. As contained in the same table, control of noise level in low rose building has a mean value of 3.73 and this was followed by 3.47 mean values observed for both cleaner air and vantage view of the city as analysed from the collected data. In contrast, the shortcomings of residing in low rise building revealed height anxiety being ranked highest with 3.10 mean followed by propensity for accident and emergency situation to occur ranked second with 2.47 mean value while 2.30 mean was recorded for vertical transportation within the building ranks third and the least ranked shortcoming having 2.23 mean was motion/vibration induced by wind.

Table 4: Pros and cons of High and Low Rise Buildings

Building Heights		Variables	SD	D	N	A	SA			
			1	**2**	**3**	**4**	**5**	**fx**	**Mean**	**Rank**
High rise	Pros	Vantage View			3	9	13	125	4.20	2nd
		Cleaner air			11	7	13	121	4.03	3rd
		Less noise			7	14	9	128	4.27	1st
	Cons	Height Anxiety			8	12	10	122	4.06	2nd
		Wind Induced Motion		4	8	10	8	112	3.73	4th
		Vertical Transportation			7	13	10	123	4.10	1st
		Accidents and emergency			9	12	9	120	4.00	3rd
Low rise	Pros	Vantage View		7	8	9	6	104	3.47	2nd
		Cleaner air		6	11	6	7	104	3.47	2nd
		Less noise		5	8	7	10	112	3.73	1st
	Cons	Height Anxiety	12	3	7	5	3	94	3.10	1st
		Wind Induced Motion	9	8	10	3	-	67	2.23	4th
		Vertical Transportation	10	9	7	-	4	69	2.30	3rd
		Accidents and emergency	6	8	12	4	-	74	2.47	2nd

Source: Field survey (2022)

It can be implied from the above that residing in a high rise building provides a vantage view of the entire neighbourhood coupled with cleaner ventilation and air alongside less pollution from noise. However, occupants often time feel anxious from height which is not advisable for children while vertical movement and transportation in the buildings is equally a challenge to the elderly, especially in buildings with no elevator without leaving behind accidents and emergency situations similar to the findings of (Ibem et al., 2015; Ahmad et al., 2017). However, though similar to the low-rise buildings, the observed advantages and demerit are less pronounced therein. Hence, the residents' preference to reside in low rise buildings to high rise buildings.

Conclusion

The study comparatively analysed the both general and specific factors influencing occupancy ratio and the rental value of high and low rise building in Kaduna with focus on rental value alongside pros and cons of building heights as peculiar to the study area. Findings from the relative importance index analysis revealed that low rise buildings had higher rental values than high rise buildings while a drop in rental value was experienced in 2020 resulting from the global lockdown from COVID-19 and rental value of two bedroom was found relatively stable over the period. Non Provision of elevator was ranked the highest factor influencing rental value and occupancy ratio of high rise buildings with 0.77 RII while inadequate emergency exits and maintenance cost were ranked lowest with 0.69 RII. However for low rise buildings, provision of elevator was the least ranked factor with 0.34 RII while the highest factor influencing property values was demand/population with 0.71 RII values. The highest factor influencing occupancy ratio for high rise buildings was location with 0.80 RII while individual preference was the highest with same RII for low rise buildings in the study area. The study therefore recommends that, investors and stakeholder in the housing sector should intensify regulation and supervision of high rise building constructions to ensure adherence to sound structural design and execution on site alongside provision of basic facilities like emergency exits, fire extinguishing systems and elevators to further enhance the rental values and eventual return on investment.

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ANALYSIS OF THE FACTORS INFLUENCING VARIATION IN VALUE OF MINERAL LAND COMPENSATION IN KEBBI STATE, NIGERIA

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Abstract
Consequent upon numerous crises often experience in the mining communities which has largely been blamed upon divergent values ascribed to mineral land, the factors influencing this issue are necessary for consideration for a fair policy formulation among the stakeholders. Therefore, this study examine the factors causing the variation in mineral land compensation values. Data were sourced through administration of questionnaire on 89 numbers of the firms of estate surveying and valuation in the north western part of Nigeria (Kebbi. Sokoto, Zamfara, Kaduna, Kano, Jigawa and Katsina States) as provided in the NIESV (2022) register. Seventy–two (72) (representing 80.9%) firms filled and returned the questionnaire out of which only thirty-eight (38) firms has ever carried out such assignment-valuation of mineral land for compensation. Thus, thirty-eight (38) response of valuers in these firms which represent 52.78% of the filled and returned questionnaires were adopted for analysis. Factor analysis was employed for data analysis. Results showed that the factors causing variations are: inadequate legal frameworks and external influences, valuers' knowledge and different approaches by valuers. It was recommended that ESVARBON be empowered to develop a workable framework that will guide Estate Surveyors and Valuers in the assessment of compensation value for all mineral properties in Nigeria. This will go a long way in minimizing the aftermath agitations on compensation assessment in the state.
Keywords: *Claimants; Compensation; Mineral land; Variation; Valuation.*

Introduction

Three categories of compensation estimates are usually created in practice when determining the monetary compensation. These are estimates of damages arrived at by experts, claims submitted for compensation by the claimant, and ultimately, the amount paid as compensation to the claimant (Thébaud *et al*. (2005) as cited in Olukolajo (2019)). Estate Surveyors and Valuers (ESVs) plays a major role as professionals in determining the compensation payable to claimants in Nigeria. However, mining companies also embarks on negotiation with the land owners who are oblivious of what the value of their land is. This always results in discrepancy in figures emanating for the same land.

The causes of valuation discrepancy has been a subject of discussion in the academia, among professionals and the judiciary, particularly in UK and Australia (Atilola, Ismail, Achu and Bujang 2019). Thus, issues of discrepancies in valuation were raised by Congress which culminated to congressional bill in the US; in the same manner, two major commissions of enquiry were set up in the UK and one commission in Australia (Babawale, 2008). Today a lots of studies has been carried out on value variation in property valuation. Nasir (2006), Ayedun, Oloyede and Durodola (2012), Akinjare, Iroham and Oloke (2013), Effiong (2015), Munshifwa, Jain, Kaunda, Masiba, Lungu, Chunda-Mwango, Mushinge and Ngoma (2016) and Adegoke (2016) has worked on the factors responsible for variance in various purposes of valuation.

In Nigeria, the determination of compensable values for interest in land and landed properties is statutory. However, the few available studies on compensation are on environmental contamination particularly oil spills and infrastructural developments. Not much work has been conducted on compensation of mineral land in Nigeria thus, leading to dearth of studies on factors causing variation in the compensation value of mineral land. Also, apart from the studies of Munshifwa *et al.* (2016) and Atilola, *et al*. (2019) that identified and evaluated the factors causing variance in rateable values in Zambia and Nigeria respectively, no other studies on factors influencing variance in (statutory) mineral land compensation value to the best of the researchers' knowledge. Thus, this study, tends to fills this gap by exploring factors responsible for variance in mineral land compensation values in Nigeria.

Literature Review

Many studies have been carried out on mineral land, there is dearth of studies on factors causing variation in the compensation value of mineral land. However, there are lots on factors responsible for variation in related studies on market values (Kimutai 1995; Akinjare, *et al*. 2013; Effiong, 2015; Munshifwa *et al*., 2016), compensation for compulsory land acquisition and compensation for environmental damages.

Kimutai (1995) examined "an analysis of the causes of variations in valuation for land compensation". Both percentages and content analysis method were adopted for data analysis, the study revealed two categories of causes of variances in land compensation values as specific and general. The specific causes are: different dates of assessment, additional incidental costs included in some valuation reports returned by private valuers, differing views on sub-divisions as a viable project, differences in measurements of land to be acquired and use of different comparables. While the general causes are: lack of prompt compensation, lack of an exhaustive definition of "market value' as explained by Land Acquisition Act, lack of sales comparables in some rural areas affected by public purpose projects, assessment of severance and injurious affection, reluctance on the part of acquiring authority to initially apply private treaty negotiations before resorting to compulsory land acquisition and differences in times of assessment.

Ayedun, *et al*. (2012), examined the reasons for the variance and inaccuracy in valuation in Nigeria. Weighted mean and simple percentage was adopted for analysis. The study established the following factors as contributing to the variation in values: dearth of relevant market evidence/data, the use of valuation and techniques that are out-of-date, outdated valuation data, the absence of valuation controls and regulatory frameworks, a lack of valuation standards/manuals, inadequate training, failure to punish errant valuers for negligence, imperfection of the property market, the use of financial material and other forms of inducements by clients to influence the valuer, and inexperienced valuers.

Akinjare, *et al*. (2013) carried out a study on valuation discrepancies (variance) in the value opinion of professional valuers' in Lagos. The study employed weighted arithmetic mean for analysis and categorized factors responsible for discrepancies (variance) as endogenous and exogenous factors. The endogenous factors comprise adjusting values to suit recent valuations of similar properties, use of different methods of valuation, working with different parameters such as yield, and the professional experience of valuer. The exogenous factors are professional experience of valuer, clients influence on valuation, lack of adequate market information, and lack of support from other valuers conversant with the market. The study revealed that presently the variance amongst Nigerian valuation is principally attributable to the use of different yield by valuers, lack of adequate market information and clients influence on valuation.

Effiong (2015) carried a comparative study of valuation variance and accuracy between Nigeria and UK. Simple descriptive statistical tools of weighted mean, simple percentage and bar chart were used for analysis. The findings from the study show that the possible causes of valuation variance include lack of standards, lack of market data/comparables, lack of regulatory framework, methods/bases of valuation adopted, client's influence, inadequate training of valuers, imperfect knowledge of the property market, wrong assumptions on cost per square metre, lack of professional experience as well as failure to discipline valuers on cases of negligence with lack of standards ranked first with the highest frequency and mean score.

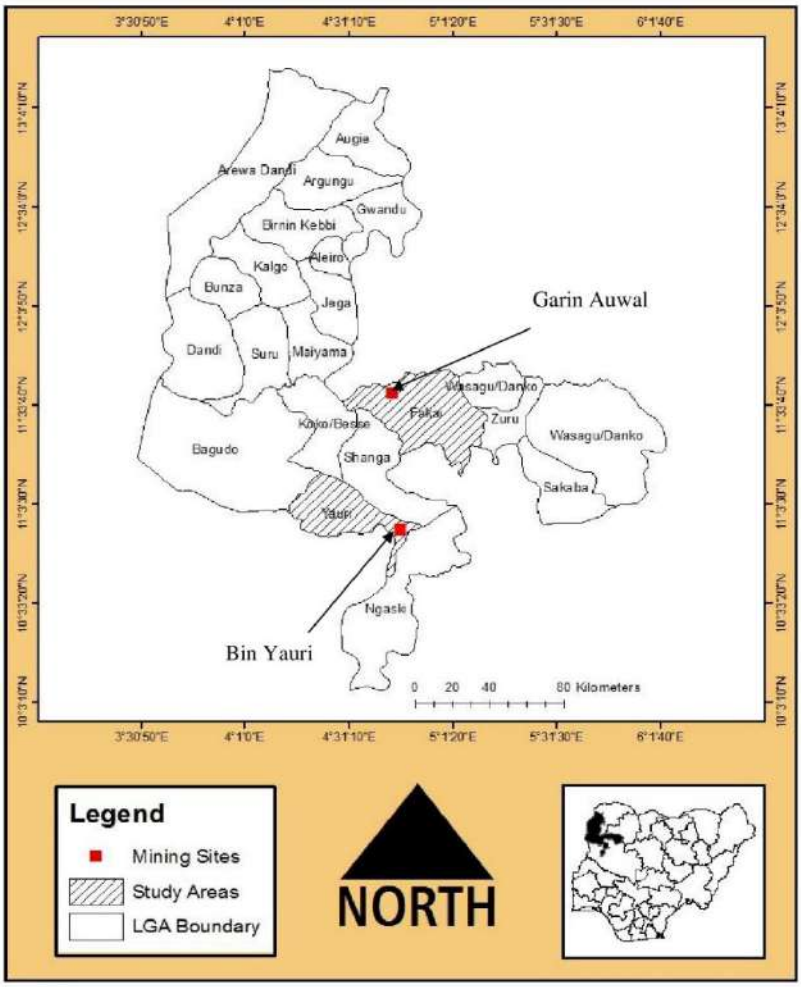
Munshifwa, *et al*. (2016) examined variances in rateable values in rating practice in Zambia: The role of mental models in value assessment. A two tailed Fishers' Tests was used. The paper finds that, besides information factors a major cause of the variance is valuation surveyor-specific factors which, among others, include adoption of different methods and viewpoints.

Also, Atilola, *et al*. (2019) studied An Evaluation of factors causing Variance in Property Assessment. Relative Importance Index (RII) was adopted for analysis. Finding showed that factors that fell within the range index of significant factors (0.841 to 0.979) are: experience in rating valuation, comprehensiveness of the law, unrealistic valuation assumption and availability of market indices for the input variables. Other significant factors are explicitness of the law, integrity of the valuer, valuer's negligence, absence of quality control and training in valuation.

While, Olukolajo, (2019) studied causes of discrepancies in value estimates on compensation for oil spill damages in the Niger Delta region of Nigeria using weighted mean score and factor analysis as analytical tools. The study revealed four categories of factors causing discrepancies in valuers' opinion of compensation value for damages resulting from oil spills in the Niger Delta area of Nigeria as: weak standards/codes of practice, inadequate legal frameworks and external influences, gaps in valuers' knowledge, and professional misconduct.

Study Area

Yauri and Fakai Local Governments Areas of Kebbi State are located between latitudes 10°10′N and 11°40′N of the equator and longitude 3°30′E and 5°10′E of the Greenwich meridian. The local governments shares local boundaries with Ngaski Local Government to the West, Zuru and Danko local Governments to the east, Kebbe Local Government Area of Sokoto State to the North, and Rijau Local Government of Niger State to the South. Yauri and Fakai have a total land area of about 3,380km2 and 2,247km2 respectively (KBSG, 2008). Garin-Awwal is in Fakailocal government area while Bin-Yauri is in Yauri local government area.



Source: GIS & Cartography Unit, Geography Department BUK (2020)

Fig. 1

Methodology

The study is survey research which involves questionnaire administration to the target populations so as to extract necessary information for the study. Target population for this study were the 89 numbers of registered firms of Estate Surveying and Valuation in North-Western geo-political zone of Nigeria comprises of Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa and Kaduna states as contained in the directory of the Nigerian Institution of Estate Surveyors and Valuers (NIESV) (2022). Out of 89 questionnaire administered 72 were retrieved, representing 80.9% out of which only 38 has ever had experience in compensation valuation of mineral land. Thus, the 38 response from the experienced valuers on mineral land compensation representing 52.78% of the retrieved questionnaire were adopted for further analysis. Factor analysis was employed in analyzing the data collected.

Suitability Test of Dataset for Factor Analysis

Responses on the factors causing the variations in compensation values of mineral land received from heads of estate surveying and valuation firms were subjected to suitability test. Kaiser Meyer Olkin's (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity were employed to test the factorability of the data gathered. This is detailed in Table 1

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.850
Bartlett's Test of Sphericity	Approx. Chi-Square	1706.195
	Df	90
	Sig.	.000

Source: Field Survey, 2023

As shown in Table 1, the KMO obtained was 0.850 at a significant level of 0.000. The Bartlett's Test of Sphericity and sampling adequacy yielded a significant of p=0.000, with a chi square value of 1706.195 which is significant at p<0.000 indicating that the sample is adequate. The KMO is 0.850 also indicates that the sample used is adequate.

Furthermore, total variance explained among the factors is presented in Table 2

Table 2: Total variance explained of the factors causing variation in compensation values of mineral land

Components	Initial Eigen-values		
	Total	% of Variance	Cumulative %
Different dates of assessment.	15.194	75.970	75.970
Additional incidental costs included by valuers.	1.389	6.945	82.915
Differences in measurements of land to be acquired.	1.244	6.222	89.137
Use of different comparables.	.593	2.967	92.104
Lack of sales comparables in rural areas.	.369	1.845	93.949
Lack of an exhaustive definition of “market value” by the extant law.	.294	1.469	95.419
Assessment of severance and injurious affection.	.261	1.303	96.721
Weak standards/codes of practice.	.168	.838	97.559
Inadequate legal frameworks.	.111	.557	98.116
Gaps in valuers’ knowledge.	.083	.414	98.531
Application of multiple standards.	.077	.383	98.914
Application of multiple procedures.	.070	.349	99.263
Application of multiple methods of valuations.	.050	.252	99.515
Use of different methods of valuation.	.034	.169	99.685
Professional experience of valuer.	.023	.117	99.802
Use of different yield by valuers.	.017	.084	99.885
Lack of adequate market information.	.010	.052	99.937
Incomprehensiveness of heads of claims.	.007	.033	99.970

Undue influence of compensation claimant.	.004	.020	99.990
Imposition of valuation method to be applied.	.002	.010	100.000

Source: Data Analysis, 2023

Table 2 lists the eigen-values associated with each linear component (factor) before and after extraction as well as after rotation. Before extraction, 20 linear components were identified within the data set. The eigen values associated with each factor represents the variance explained by the linear component represented as the percentage of variance explained. The Table further shows that three (3) components were extracted under 6.222 eigen-value minimum. The clustering of factors constituting factors causing variations in compensation values of mineral land within the three (3) components generated normalized cumulative sums of squared loading of 89.137%.

This shows that the three (3) components depict 89.13% of the characteristics of the twenty (20) isolated factors. In other words, 89.13% of the total variation in the factors causing variation in compensation values of mineral land in Kebbi State is explained by cumulative effect of the three (3) components extracted. Thus, efforts to identify the determinants of variation in compensation values of mineral land in Kebbi State should be targeted at the three (3) major factors identified, which are, different dates of assessment, additional incidental costs included by valuers and differences in measurements of land to be acquired.
Three (3) factors were extracted for rotation using varimax method. To aid the interpretation of the three (3) factors that were retained, varimax rotation was performed and this gave rise to the component matrix in Table 3.

Table 3: Rotated component matrix for factors causing variation in compensation values of mineral land

Factors	1	2	3
Factor 1: Inadequate Legal Frameworks and External Influences			
Undue influence of compensation claimant.	.751		
Additional incidental costs included by valuers.	.792		
Incomprehensiveness of heads of claims.	.733		
Differences in measurements of land to be acquired.	.624		
Use of different comparables.	.818		
Lack of sales comparables in rural areas.	.792		
Lack of an exhaustive definition of “market value” by the extant law.	.618		
Assessment of severance and injurious affection.	.622		
Weak standards/codes of practice.	.660		
Inadequate legal frameworks.	.692		
Professional experience of valuer.	.857		
Application of multiple methods of valuations.	.875		
Lack of adequate market information.	.835		
Variance (%)	**6.945**		
Factor 2: Valuers’ Knowledge			
Gaps in valuers’ knowledge.		.805	
Application of multiple standards.		.819	
Application of multiple procedures.		.877	
Use of different yield by valuers.		.670	
Variance (%)		**6.222**	
Factor 3: Different Approaches			
Different dates of assessment.			.847
Use of different methods of valuation.			.686
Imposition of valuation method to be applied.			.807
Variance (%)			**75.97**
Total % Variance			**89.137**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Source: Data analysis, 2023

Table 3 showed the loading of the factors into three (3) principal components after suppressing factors with loadings less than 0.6. Factor 1 *inadequate legal frameworks and external influences* has thirteen (13) components and explained 6.94% of the total variance. They include additional incidental costs included by valuers, use of different comparables, lack of sales comparable in rural areas, lack of an exhaustive definition of market value by the extant law, assessment of severance and injurious affection, weak standards/codes of practice, inadequate legal frameworks, application of multiple methods of valuations, professional experience of valuer, lack of adequate market information, incomprehensiveness of heads of claims, undue influence of compensation claimant and differences in the measurement of land to be acquired. Four (4) items are included for Factor 2 - *valuers' knowledge* which explained 6.22% of the total variance, these are, gaps in valuers' knowledge, application of multiple standards, application of multiple procedures, use of different yield by valuers. Factor 3- *different approaches, explained* 75.97% of the total variance and contained three (3) factors, which are different dates of assessment, use of different methods of valuation and imposition of valuation method to be applied.

Discussion of Results

Table 2 revealed that three (3) components were extracted under the 6.222 eigenvalue minimum which components generated normalized cumulative sums of squared loading of 89.13%. This shows that 89.13% of the total variation in the factors responsible for variation in compensation values of mineral land in Kebbi State is explained by the cumulative effect of the three (3) components extracted. Three (3) factors were extracted from rotation using the varimax method (Table 3). The three components have thus been named *inadequate legal frameworks and external influences factors, valuers' knowledge factors and different approaches by valuers factors.* This finding is in disagreement the study of Ayedun *et al.* (2012) which listed experience, educational background and available market information at disposal of individual valuers as first, second and third respectively as the factors responsible for variance or inconsistency in valuation amongst the valuers. So also the study is in disagreement with the study of Olukolajo (2019) which categorized the factors causing discrepancies in value estimates on compensation for oil spill damage in the Niger Delta as weak standards/codes of practice, inadequate legal frameworks and external influences, gaps in valuers' knowledge, and professional misconduct.

Conclusion

The study has identified factors causing variation in valuers' opinion of compensation value for mineral land n Kebbi state, Nigeria. These factors were classified into four categories through factor analysis, these are: *inadequate legal frameworks and external influences factors, valuers' knowledge factors and different approaches by valuers factors.* It is recommended that ESVARBON be empowered to develop a workable framework that will guide Estate Surveyors and Valuers in the assessment of compensation value for all mineral properties in Nigeria. This will minimize the agitations in the state. Valuers must undertake training and retraining programmes as new methods and approaches are evolving towards best practices globally.

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MAPPING BIM INTEGRATION IN NIGERIAN ARCHITECTURE EDUCATION

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Abstract
This research examined the current state of integration of Building Information Modelling (BIM) training in architecture education within Nigerian universities accredited by the National Universities Commission (NUC) by assessing the level of BIM integration in architecture education. A mixed-method approach was employed, combining literature review, curriculum content analysis, and a field survey of faculty members in NUC-accredited Architecture Departments. Using a stratified random sampling technique was used to select the accredited departments across the three strata, Federal, State and Private Universities. The population sample of 400 faculty members across 35 NUC accredited departments of architecture were administered questionnaire. Data were retrieved from 378 respondents and employed statistical techniques, including descriptive and inferential statistics, such as, mean score and Analysis of Variance (ANOVA) respectively, to analyse the data. Findings from Content Analysis and ANOVA results revealed that there is significant difference in BIM integration across NUC- accredited Architecture Departments. This study contributes to the existing body of knowledge by providing insights into the current state of BIM integration in Nigeria architecture education. It highlights the variability in BIM integration levels across universities ranging from basic use (Level 0-1) to advanced practices (Level 3) and ranked three (3) key factors influencing BIM adoption as, BIM integrated into the curriculum, BIM-related projects included in the curriculum and BIM-related encouraged and supported within the architecture programme. The research also offers recommendations for enhancing BIM integration and addresses gaps in the literature. Based on the findings, recommendations proposed to enhance BIM integration in architecture education are; allocate funds for advanced BIM software and hardware, support BIM research through grants and scholarships, reform curricula to include BIM modules, forge academia-industry partnerships for practical BIM exposure and create policies to equalize BIM adoption regionally.

INTRODUCTION

Today's world is dominantly driven by technology such that practically every facet, including the architecture, engineering and construction (AEC) industry, has undergone transformations. Among these technological innovations, Building Information Modelling (BIM) stands out as a powerful tool revolutionising the way architects design, collaborate, and manage construction projects (Asim *et al.*, 2021). BIM potential to enhance efficiency, reduce errors, and improve project outcomes has led to its widespread adoption in the AEC sector globally (Ayman *et al.*, 2019).

As the architecture profession evolves in response to technological advancements, it is imperative for architecture education to adapt and equip future professionals with the necessary skills and knowledge to thrive in this digital era. The integration of BIM training in architecture education remains a topic of interest and inquiry, particularly in the Nigerian context. In Nigeria, the National Universities Commission (NUC) accredits all programmes in universities across the country, with departments of architecture overseeing the quality and relevance of architecture education. Understanding the current level of integration of BIM training in NUC-accredited departments of architecture is essential for assessing the preparedness of graduates to meet industry demands and technological advancements.

This research examined the current aspects of BIM integration in architecture education in NUC-accredited departments of architecture in Nigeria. By conducting a curriculum content analysis, surveying faculty members, and employing statistical techniques, this study provides insight into the status quo of BIM integration and its implications for architecture education and practice in Nigeria.

LITERATURE REVIEW

The integration of BIM in architecture education has emerged as a critical area of research and practice, reflecting the evolving demands of the architecture profession and the broader construction industry. This literature review synthesizes existing studies to provide a comprehensive understanding of the theoretical underpinnings, practical implications, and current trends shaping BIM integration in architecture education. Anchored on the objectives of the study, the review examined key themes,

including the rationale for BIM adoption in education, pedagogical approaches to BIM integration, challenges and barriers, and the global context of BIM in architecture education.

The rationale for integrating BIM in architecture education stems from the industry's increasing reliance on digital technologies to streamline design processes, enhance collaboration, and improve project outcomes. BIM, characterised by its ability to create and manage digital representations of physical and functional characteristics of built assets, offers students a platform to develop proficiency in digital design tools essential for contemporary architecture practice (Károlyfi *et al.*, 2021). Proponents argue that exposure to BIM during education encourages innovation, prepares graduates for industry demands, and enhances their competitiveness in the job market (Govender *et al.*, 2019).

Pedagogically, BIM integration in architecture education encompasses a spectrum of approaches, ranging from introductory courses on BIM fundamentals to immersive, project-based learning experiences with data-driven design projects (Benner & McArthur, 2019). Scholars advocate for a balanced curriculum that combines theoretical knowledge with hands-on application, emphasising critical thinking, problem-solving skills, and interdisciplinary collaboration (Tang *et al.*, 2020; Ye & Xu, 2023). Project-based learning, wherein students engage in real-world design challenges using BIM tools, has gained traction as an effective pedagogical strategy for nurturing creativity, teamwork, and practical skills (Benner & McArthur, 2019).

Despite the potential benefits, the integration of BIM in architecture education is not without challenges. Limited access to software and hardware, inadequate digital skills training, and resistance to change within academic institutions are among the primary barriers cited in the literature (Babatunde & Ekundayo, 2019). Additionally, the rapid evolution of BIM technology poses challenges in curriculum development and maintenance, requiring educators to adapt continuously to emerging tools and methodologies (Wong *et al.*, 2011).

The adoption and implementation of BIM in architecture education differ across geographic regions, reflecting variances in institutional priorities, industry practices, and regulatory frameworks. While some countries, such as the United States and several European nations, have made significant strides in BIM integration, others, particularly in the Global South, face challenges related to resource limitations and infrastructure development (Calitz & Wium, 2022). Nonetheless, initiatives such as international collaborations, knowledge-sharing networks, and capacity-building programmes contribute to the global dissemination of best practices and promote a more inclusive approach to BIM education (Li-Hua, 2007). Jolanta and Pupeikis (2018) avows the attitudinal variance in implementing BIM across different higher education institutions in Lithuania, with the strength of BIM development in interdisciplinary joint semester projects in Faculty of Civil Engineering and Architecture. A later perspective in a comparative study on BIM integration in architecture education revealed possibilities of integration in different study cycles, with Nordic countries providing instances of varying integration models. (Mlinkauskienė *et al.*, 2020).

Synthesizing the literature reveals a growing body of research focused on BIM integration in architecture education, underscoring its significance as a transformative force in shaping the future of the AEC professions. However, notable research gaps persist, particularly regarding the development of standardised frameworks for BIM education, assessment of student learning outcomes, and longitudinal studies tracking the impact of BIM integration on graduates' career paths. Addressing these gaps requires interdisciplinary collaboration, empirical research, and a commitment to continuous innovation in curriculum design and delivery.

METHODOLOGY

The study employed a mixed-method approach to investigate the integration of BIM in architecture education within Nigerian universities. The methodology involved a stratified random sampling and data collection. The research population comprised faculty members from identified universities, summing up to 665 individuals. This population was determined through an extensive search and consultation with lecturers from the NUC accredited universities, which revealed an average of 19 lecturers per department across the 35 universities. To ensure representation, a stratified random sampling technique was employed based on university classifications such as federal, state, and private. In determining the sample size, a two-stage sampling technique was adopted. The first stage involved the purposive selection of the 35 NUC accredited schools offering architecture, out of the

264 number of universities in Nigeria representing 13.26% of all universities in Nigeria. The sample size of 400 was scientifically calculated using Yamane's formula, considering a 95% confidence level and a coefficient of variation (CV) of 0.05. This sample size represents approximately 60% of the total population of lecturers in NUC accredited departments of architecture. Proportionate sampling was then used to determine the number of respondents from each university, ensuring a fair representation across universities. The survey instrument used was a structured questionnaire, developed to collect quantitative data addressing the research question and hypothesis. Likert-scale items were incorporated to assess various aspects, including BIM incorporation into the curriculum. The questionnaire underwent pre-testing for reliability and validity to ensure the accuracy and consistency of the collected data.

Data collection involved both primary and secondary sources. Primary data were collected through the distribution of survey questionnaires to faculty members in NUC accredited departments of architecture. Secondary data sources included academic documents, such as curriculum documents and institutional reports, and published literature on BIM implementation in architecture education, providing additional context and supporting the study's findings. In total, 378 responses were obtained, forming the basis for analysis and interpretation in this research.

Data analysis includes both descriptive and inferential statistics. Descriptive statistics was used to analyse demographic patterns and opinions among respondents, while inferential statistics such as Analysis of Variance (ANOVA) was employed to explore variations in BIM integration levels among universities. Hypotheses formulated based on research objectives were tested using statistical techniques to determine significant differences in BIM integration across departments.

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS`

Data Presentation

This section is based on the number of questions retrieved from the field survey conducted. 400 participants were sent the questionnaire created to obtain required data on BIM integration in architecture education from the accredited universities in Nigeria. However, only 378 responded, and this was employed for the purpose of the study. This indicates a 94.4% response rate, which is relatively high.

Table 1: Questionnaire Distribution and Administration

Information on Questionnaire	Frequency	Percentage
Distributed questionnaire	400	100%
Retrieved and Valid Responses	378	94.5%

Source: Authors' Field data (2023)

Descriptive Statistics

This section employed descriptive tools of frequency and percentages to show patterns in the demographic characteristics of the respondents. Alabi and Bukola (2023) affirmed descriptive statistics as offering a snapshot of the main characteristics of the variables under investigation.

Table 2: Demographic Characteristics of the Respondents

Individual Characteristics	Frequency	Percentage
Gender		
Female	69	18.3
Male	309	81.7
Total	378	100.0
Age		
25 - 34 years	54	14.3
35 - 44 years	81	21.4
45 - 54 years	170	45.0
55 - 64 years	47	12.4
> 65 years	26	6.9

Individual Characteristics	Frequency	Percentage
Total	378	100.0
Years of Teaching Experience		
0-5 years	62	16.4
6-10 years	101	26.7
11-15 years	28	7.4
16-20 years	128	33.9
21 years and above	59	15.6
Total	378	100.0
Designation/Rank of Respondents		
Technologist	14	3.7
Assistant Lecturer	13	3.4
Lecturer II	69	18.3
Lecturer I	87	23.0
Senior Lecturer	61	16.1
Professor	134	35.4
Total	378	100.0
Do you teach any CAD/BIM-related course?		
Yes	250	66.1
No	128	33.9
Total	378	100.0
What level is CAD/BIM-related courses taught in your department?		
Undergraduate	244	64.6
Postgraduate	14	3.7
Both	58	15.3
None	62	16.4
Total	378	100.0

Source: Authors' Field data (2023)

The results presented in Table 2 relates to the distribution of specific individual characteristics of lecturers across NUC accredited departments of architecture in Nigeria universities. With regards to gender, 69 (18.3%) respondents are female, while 309 (81.7%) are male, indicating that men are the dominant lecturers among the participants. In terms of age, 54 (14.3%) respondents are within 25 and 34 years, followed by 81 (21.4%) respondents within 35 and 44 years, 170 (45.0%) respondents are within 45 and 54 years, 47 (12.4%) respondents are within 55 and 64 years, and 26 (6.9%) respondents are above 65 years. This showed that most of the lecturers are averagely around 50 years old. With regards to their teaching experiences, 62 (16.4%) respondents have between 0-year and 5-years teaching experience, 101 (26.7%) respondents have between 6- and 10-years teaching experience, 28 (7.4%) respondents have between 11- and 15-years teaching experience, 128 (33.9%) respondents have between 16- and 20-years teaching experience, and 59 (15.6%) respondents have over 20 years teaching experience. The findings suggest that most of the lecturers have been teaching for more than 15 years. With regards to the rank of the respondents, 14 (3.7%) respondents are technologists, 12 (3.4%) respondents are assistant lecturers, 69 (18.3%) respondents are lecturer II, 87 (23%) respondents are lecturer I, 61 (16.1%) respondents are senior lecturers, and 134 (35.4%) respondents are professors. This indicated that many professors participated in the field exercise.

When asked if the respondents teach any CAD/BIM-related courses, 250 (66.1%) respondents answered 'Yes', while 128 (33.9%) respondents answered 'No', indicating that most of the lecturers that participated are familiar with CAD/BIM-related courses. Regarding the level where CAD/BIM related courses are taught in the architecture departments, 62 (16.4%) respondents said No Level, 244 (64.6%) respondents said Undergraduate Level, 14 (3.7%) respondents indicated Postgraduate Level, and 58 (15.3%) respondents indicated at Both Levels.

Analysis of Data

Data analysis of this study comes in two folds for the objective. Firstly, curriculum content from 10 randomly selected NUC accredited undergraduate architecture programmes covering the six geopolitical zones in Nigeria was analysed to understand the patterns, themes, and meanings present in the gathered curriculum set of data. The second part presents and analyses the opinion of respondents with regards to integration of BIM in architecture education.

Curriculum Content Analysis

Table 3 presents a structured overview of undergraduate architecture courses related to BIM in selected Nigerian universities covering the six geopolitical zones. Table 3 is organised into rows and columns, with each row corresponding to a specific university and each column representing a combination of undergraduate levels (100, 200, 300, and 400) and semesters (1st and 2nd). Curriculum of ten universities were examined and they include; Ahmadu Bello University (ABU), Zaria; Abubakar Tafawa Balewa University (ATBU); Baze University; Obafemi Awolowo University (OAU); Federal University of Technology, Akure (FUTA); Covenant University; University of Nigeria, Nsukka (UNN); Chukwuemeka Odumegwu Ojukwu University (COOU); Godfrey Okoye University (GOUNI); and University of Uyo (UNIUYO).

Table 3: Undergraduate Architecture BIM related Courses in Selected Nigeria Universities across Levels per First (1st) and Second (2nd) Semesters

University	100		200		300		400	
	First	Second	First	Second	First	Second	First	Second
ABU Zaria	ARC 121 - Introduction to Basic Computer Skills (2 LH; 2 Units)	ARC 122 - Introduction to Basic Computer Skills (2 LH; 2 Units)	ARC 221 - Computer Aided Architectural Design (2 LH; 2 Units)	ARC 222 - Computer Aided Architectural Design (2 LH; 2 Units)	Nil	Nil	Nil	Nil
ATBU	Nil	Nil	Nil	Nil	Nil	ARC 324 - Computer Aided Design and Drafting I (1 LH; 1 Unit)	ARC 414 - Computer Aided Design and Drafting II (1 LH; 1 Unit)	Nil
BAZE	Nil	Nil	ARC 217- Computer Applications in Architecture I (1 LH; 2 Units)	ARC 227 - Computer Applications in Architecture II (1 LH; 2 Units)	ARC 317 - Computer Applications in Architecture III (1 LH; 2 Units)	ARC 327 - Computer Applications in Architecture IV (1 LH; 2 Units)	Nil	Nil
OAU	Nil	Nil	CSC 201 - Introduction to Computing (1 LH; 2 Units)	CSC 208 – Computing Technology (1 LH; 2 Units)	Nil	Nil	Nil	Nil

University	100		200		300		400	
	First	Second	First	Second	First	Second	First	Second
FUTA	Nil	Nil	Nil	Nil	Nil	Nil	ARC 415 – Computer Aided Design (2 LH; 1 Unit)	Nil
COVENANT	Nil	Nil	Nil	Nil	ARC 319 - Introduction to AUTOCAD (2 LH; 1 Unit)	ARC 329 - AUTOCAD – 3D (2 LH; 1 Unit)	ARC 419 - Building Information Modelling I (2 LH; 2 Units)	ARC 429 - Building Information Modelling II (2 LH; 2 Units)
UNN	Nil	ARC 172- Computer Application to Architecture I (2 LH; 2 Units)	ARC 271- Computer Application to Architecture II (2 LH; 2 Units)	ARC 272- Computer Application to Architecture III (2 LH; 2 Units)	ARC 371- Computer Application to Architecture IV (2 LH; 2 Units)	Nil	ARC 471- Computer Application to Architecture V (2 LH; 2 Units)	Nil
COOU	Nil	ARC 114- Computer Application to Architecture I (2 LH; 2 Units)	ARC 213 - Computer Application to Architecture II (2 LH; 2 Units)	ARC 214 - Computer Application to Architecture III (2 LH; 2 Units)	Nil	Nil	Nil	Nil
GOUNI	Nil	Nil	Nil	Nil	ARC 323 - Computer Aided Design (2 LH; 2 Units)	Nil	Nil	Nil
UNIUYO	Nil	Nil	Nil	Nil	ARC 333 - Introduction to Computer Aided Design (2 LH; 2 Units)	Nil	Nil	Nil

Source: Authors' Field data (2023)

Based on various range of courses and their distribution across different levels and semesters, it is obvious that various Nigerian universities apply varying strategies to impart digital design skills to future architects. One prominent observation is the variability in the types of BIM-related courses offered across the selected universities. The presence of specific courses like "Computer Applications in Architecture," "Computer-Aided Design and Drafting," and "Introduction to Computing" suggests the diverse approaches to integrating digital tools into architecture education. The timing of BIM integration varies significantly among universities. Some, like ABU Zaria and Baze University, introduce BIM-related courses as early as the 100 level, exposing students to fundamental digital

skills from the onset. Contrastingly, other universities, such as ATBU and FUTA, delay BIM courses until the 400 level. This discrepancy raises questions about the rationale behind the timing of BIM education and its implications for students' preparedness for contemporary architecture practice.

Inclusion of courses like "Building Information Modelling I" and "Building Information Modelling II" in the curricula of institutions like Covenant University indicates a more profound exploration of BIM concepts. These courses focus on the practical application of BIM tools, aligning with industry demands for architects proficient in 3D modelling, visualisation, collaborative design processes and federation of disciplines' models. This depth of integration is crucial for producing graduates equipped to navigate the complexities of modern architecture practice.

The presence of "Nil" entries in some universities, particularly in specific levels or semesters, suggests potential gaps in the integration of BIM-related courses. It raises questions about the reasons behind the absence of such courses in certain programmes and whether there is a conscious decision to omit them or if it reflects a broader trend in the curriculum design.

The discussion on BIM integration in Nigerian universities underscores the evolving nature of architecture education. The presence of BIM-related courses reflects an acknowledgment of the industry shift towards digital technologies. However, the variability in offerings and timing necessitates a more deliberate and standardised approach to ensure graduates are well-prepared for contemporary architecture practice.

Integration of BIM in Architecture Education

Table 4 presents opinion of the respondents with regards to integration of BIM in architecture education using minimum, maximum, standard deviation, mean. There are ten (10) items measuring integration of BIM in architecture education. Among the constructs, the item with the highest mean score is item 1, which was stated as "BIM technology is integrated into the curriculum" (M=4.00, SD=0.855). This was followed by item 6 and item 10 stated as "BIM-related projects or assignments are included in the curriculum" (M=3.15, 1.213) and "BIM-related research is encouraged and supported within the architecture programme" (M=3.15, SD=1.267) respectively. The item with the lowest ranking is item 3, which was stated as "The architecture programme emphasises the use of BIM in design studios." (M=2.36, SD=1.027). This was followed by item 8, which was stated as "BIM is discussed in theoretical courses" (M=2.53, SD=1.043). The mean scores of some of the items are above 3 being the midpoint, which suggests that there was high level of acceptance with the statements, while average score of some of the items are below 3, indicating that there was high level of disagreement with those statements. The analysis of BIM integration in Nigerian universities revealed a moderate overall integration. While the average scores (MEAN) for most aspects range between 2 and 4 on a 5-point Likert scale, this suggests a generally positive attitude towards BIM rather than a guarantee of its widespread implementation.

There is a positive sign with "BIM technology integrated into the curriculum" ranking highest. This indicates that a basic integration of BIM exists across the programmes. However, areas requiring more advanced integration, like faculty expertise in BIM (ranked 4th) and emphasising BIM within design studios (ranked 10th), show lower scores. This suggests potential shortcomings in these crucial areas.

In essence, there is an acknowledgment of BIM's importance and some level of curriculum integration. However, the variability across universities and the lower scores for aspects like faculty training and design studio application highlight the need for further development to achieve a truly "high" level of BIM integration in Nigerian architecture education.

Table 4: Respondents' Opinion on BIM Integration in Architecture Education

BIM Integration	MIN	MAX	SD	MEAN	RANK
BIM technology is integrated into the curriculum. (e.g. 2D CAD, 3D CAD, Parametric modelling using AutoCAD, ArchiCAD/Revit)	2	5	0.855	4.00	1st
BIM-related projects or assignments are included in the curriculum	1	5	1.213	3.15	2nd
BIM-related research is encouraged and supported within the architecture programme	1	5	1.267	3.15	3rd

BIM Integration	MIN	MAX	SD	MEAN	RANK
The faculty members are knowledgeable about BIM and its applications (Use of digital modelling tools)	1	5	0.957	3.04	4th
There are opportunities for hands-on practice with BIM tools.	1	5	1.179	2.93	5th
Sufficient resources (computers, software, etc.) are available for learning BIM.	1	5	1.428	2.93	6th
The architecture programme collaborate with industry professionals for BIM-related activities	1	5	1.295	2.65	7th
The architecture programme provides access to BIM industry experts for guidance	1	5	1.206	2.64	8th
BIM is discussed in theoretical courses (for example building services, construction management, history and theory, climatology, building components etc.)	1	4	1.043	2.53	9th
The architecture programme emphasizes the use of BIM in design studios.	1	4	1.027	2.36	10th

Source: Authors' Field data (2023)

Hypothesis Testing

This section employs different statistical techniques to test the hypothesis of the study. Null hypothesis one (Ho1), stated thus; There is no significant difference in the current integration of BIM training in NUC accredited departments of architecture in Nigeria universities. To test Ho1, ANOVA was employed, considering its suitability for checking the difference across groups. A one-way ANOVA was performed. This statistical test determined whether there are statistically significant differences among the means of the various aspects of BIM integration in Architecture departments as reported by respondents. On the other hand, integration of BIM into architecture education stands as the representative of training. Responses on integration was aggregated and weighted such that it becomes overall responses on BIM integration. Table 5 shows the result.

Table 5: Aggregated and Weighted Responses on BIM Integration using ANOVA

BIM Integration	Sum of Squares	df	Mean Square	F	P-value	F crit.
Between Groups	32.56	9	3.62	3.49	0.002	2.12
Within Groups	67.64	190	0.356			
Total	100.2	199				

Source: Authors' computation (2023)

Table 5 presents the ANOVA result showing the difference across various aspects of BIM integration in terms of training. The F-statistics of 3.49 with an associated p-value of 0.002 indicates that there is statistically significant difference in BIM integration in NUC accredited departments of architecture in Nigeria universities. Hence, the study rejects the null hypothesis that there is no significant difference in the current integration of BIM training in NUC accredited departments of architecture in Nigeria universities. Based on this decision, the alternative hypothesis is accepted, which indicates that there is significant difference in the current level of integration of BIM training in NUC accredited departments of architecture in Nigeria.

Based on the ANOVA results indicating significant differences in the current integration of BIM training in NUC accredited departments of architecture in Nigeria universities, a post hoc test was necessary to identify which specific groups differ. Tukey's Honest Significant Difference (HSD) test was found as a suitable post hoc test for this purpose given that it compares all possible pairs of means to determine which specific means are significantly different from each other. The data in Table 6 is an extract from table 4.

Table 6: BIM Integration Aspects with Mean Values

BIM Integration	Mean
BIM technology is integrated into the curriculum. (e.g. 2D CAD, 3D CAD, Parametric modelling using AutoCAD, ArchiCAD/Revit)	4.00
BIM-related projects or assignments are included in the curriculum	3.15
BIM-related research is encouraged and supported within the architecture programme	3.15
The faculty members are knowledgeable about BIM and its applications (Use of digital modelling tools)	3.04
There are opportunities for hands-on practice with BIM tools.	2.93
Sufficient resources (computers, software, etc.) are available for learning BIM	2.93
The architecture programme collaborates with industry professionals for BIM-related activities	2.65
The architecture programme provides access to BIM industry experts for guidance	2.64
BIM is discussed in theoretical courses (for example, building services, construction management, history and theory, climatology, building components etc.)	2.53
The architecture programme emphasizes the use of BIM in design studios	2.36

Source: Authors' Field data (2023)

Tukey's HSD Test

In performing the Tukey Honest Significant Difference (HSD) Test, the following were considered. (i) Determine the HSD value using; (ii) Compare each pair of means.

$$\text{HSD} = q\sqrt{\frac{MSW}{\text{n}}} \qquad \text{Equation 1}$$

Where: q is the studentized range statistic, which depends on the number of groups and the degrees of freedom within groups. For 10 groups and 190 df, q is 3.926 (from the Tukey HSD table). Mean Square Within (MSW) is 0.356, n is the number of observations per group (assumed to be 20 for simplification). Hence substituting the values in Equation 1, thus;

$$\text{HSD} = 3.926\sqrt{\frac{0.356}{20}}$$

HSD = 3.926 x 0.1337 = 0.525

HSD is 0.525

Using the calculated HSD value (0.525), comparison of the means of each pair of BIM integration aspects was conducted to determine if the difference is greater than 0.525. A pairwise comparison revealed that out of a total pair of 48, significant deference existed in xx number of pairs. Table 7 highlights the significant difference among pairs.

Table 7: POST-HOC Test Showing Tukey HSD Pairwise Comparison

Comparison	**Mean Difference**	**Significant (Yes/No)**
BIM technology vs BIM-related projects	4.00 - 3.15 = 0.85	Yes
BIM technology vs BIM-related research	4.00 - 3.15 = 0.85	Yes
BIM technology vs Faculty knowledge	4.00 - 3.04 = 0.96	Yes
BIM technology vs Hands-on practice	4.00 - 2.93 = 1.07	Yes
BIM technology vs Sufficient resources	4.00 - 2.93 = 1.07	Yes
BIM technology vs Industry collaboration	4.00 - 2.65 = 1.35	Yes
BIM technology vs Access to BIM experts	4.00 - 2.64 = 1.36	Yes
BIM technology vs Theoretical courses	4.00 - 2.53 = 1.47	Yes
BIM technology vs Design studio emphasis	4.00 - 2.36 = 1.64	Yes

Comparison	Mean Difference	Significant (Yes/No)
BIM-related projects vs BIM-related research	3.15 - 3.15 = 0	No
BIM-related projects vs Faculty knowledge	3.15 - 3.04 = 0.11	No
BIM-related projects vs Hands-on practice	3.15 - 2.93 = 0.22	No
BIM-related projects vs Sufficient resources	3.15 - 2.93 = 0.22	No
BIM-related projects vs Industry collaboration	3.15 - 2.65 = 0.50	No
BIM-related projects vs Access to BIM experts	3.15 - 2.64 = 0.51	Yes
BIM-related projects vs Theoretical courses	3.15 - 2.53 = 0.62	Yes
BIM-related projects vs Design studio emphasis	3.15 - 2.36 = 0.79	Yes
BIM-related research vs Faculty knowledge	3.15 - 3.04 = 0.11	No
BIM-related research vs Hands-on practice	3.15 - 2.93 = 0.22	No
BIM-related research vs Sufficient resources	3.15 - 2.93 = 0.22	No
BIM-related research vs Industry collaboration	3.15 - 2.65 = 0.50	No
BIM-related research vs Access to BIM experts	3.15 - 2.64 = 0.51	Yes
BIM-related research vs Theoretical courses	3.15 - 2.53 = 0.62	Yes
BIM-related research vs Design studio emphasis	3.15 - 2.36 = 0.79	Yes
Faculty knowledge vs Hands-on practice	3.04 - 2.93 = 0.11	No
Faculty knowledge vs Sufficient resources	3.04 - 2.93 = 0.11	No
Faculty knowledge vs Industry collaboration	3.04 - 2.65 = 0.39	No
Faculty knowledge vs Access to BIM experts	3.04 - 2.64 = 0.40	No
Faculty knowledge vs Theoretical courses	3.04 - 2.53 = 0.51	Yes
Faculty knowledge vs Design studio emphasis	3.04 - 2.36 = 0.68	Yes
Hands-on practice vs Sufficient resources	2.93 - 2.93 = 0	No
Hands-on practice vs Industry collaboration	2.93 - 2.65 = 0.28	No
Hands-on practice vs Access to BIM experts	2.93 - 2.64 = 0.29	No
Hands-on practice vs Theoretical courses	2.93 - 2.53 = 0.40	No
Hands-on practice vs Design studio emphasis	2.93 - 2.36 = 0.57	Yes
Sufficient resources vs Industry collaboration	2.93 - 2.65 = 0.28	No
Sufficient resources vs Access to BIM experts	2.93 - 2.64 = 0.29	No
Sufficient resources vs Theoretical courses	2.93 - 2.53 = 0.40	No
Sufficient resources vs Design studio emphasis	2.93 - 2.36 = 0.57	Yes
Industry collaboration vs Access to BIM experts	2.65 - 2.64 = 0.01	No
Industry collaboration vs Theoretical courses	2.65 - 2.53 = 0.12	No
Industry collaboration vs Design studio emphasis	2.65 - 2.36 = 0.29	No
Access to BIM experts vs Theoretical courses	2.64 - 2.53 = 0.11	No
Access to BIM experts vs Design studio emphasis	2.64 - 2.36 = 0.28	No
Theoretical courses vs Design studio emphasis	2.53 - 2.36 = 0.17	No

Source: Authors' Findings (2023)

From the pairwise comparisons in Table 7, significant differences in the integration of BIM across various aspects in architecture departments in Nigeria universities were revealed. BIM technology was found to have substantially higher integration compared to other aspects, with mean differences ranging from 0.85 to 1.64. These differences are statistically significant (Yes) when compared to BIM-related projects, research, faculty knowledge, hands-on practice, sufficient resources, industry collaboration, access to BIM experts, theoretical courses, and design studio emphasis.

Conversely, some other pairwise comparisons show no statistically significant mean differences (No), indicating similar integration between these aspects. For instance, comparisons like BIM-related projects vs BIM-related research, faculty knowledge vs hands-on practice, and hands-on practice vs sufficient resources do not exhibit significant differences.

These findings reveal that while BIM technology well-integrated in the curriculum across architecture departments in Nigeria universities, other aspects such as BIM-related projects, research, and faculty knowledge require more focused efforts to enhance their integration.

Discussion of Results / Findings

The interpretation of results obtained from the investigation into the integration of BIM in architecture education in NUC accredited departments of architecture in Nigerian universities reveals insights that extend beyond the immediate findings. This section considers the implications of the obtained results, to further provide understanding of the broader implications of BIM training within the Nigerian academic context. The discussion is structured in alignment with the stated objective of the study, offering insights into each research objective and hypothesis and corroborates with literature. The analysis of curriculum content across ten randomly selected NUC-accredited undergraduate architecture programs in Nigeria provides insights into the current state of Building Information Modelling (BIM) integration. This study examined courses spanning various undergraduate levels (100 to 400) and semesters (1st and 2nd) from universities across the six geopolitical zones. The findings illustrate a diverse landscape in how digital design skills, including BIM, are imparted to future architects.

Table 3 outlines the distribution of BIM-related courses among the selected universities. Notably, institutions like Ahmadu Bello University (ABU), Zaria, and Baze University offer comprehensive courses covering CAD, Computer Applications in Architecture, and specific BIM modules as early as the 100 level. In contrast, universities such as Abubakar Tafawa Balewa University (ATBU) and Federal University of Technology, Akure (FUTA), introduce BIM courses at more advanced stages, reflecting variability in curriculum design and implementation strategies.

The presence of courses like "Building Information Modelling I and II" at Covenant University highlights a deeper exploration of BIM concepts, emphasizing practical applications crucial for modern architectural practice. Conversely, the absence of BIM-related courses in certain universities or semesters suggests potential gaps in curriculum alignment with industry demands and educational standards.

The findings corroborate existing literature on BIM integration in architecture education. Scholars emphasize BIM's role in enhancing collaboration, improving design efficiency, and aligning educational outcomes with industry expectations (Asim et al., 2021; Ayman et al., 2019). The variability observed in course offerings and the timing of BIM integration resonate with previous studies, which highlight the need for standardized approaches and comprehensive curriculum reforms (Benner and McArthur, 2019; Tang et al., 2020).

Studies have consistently advocated for early exposure to BIM tools to foster digital literacy among students and prepare them for the complexities of contemporary architectural practice (Babatunde and Ekundayo, 2019; Wong et al., 2011). The current study's identification of early versus delayed BIM integration aligns with these recommendations, underscoring the importance of structured educational pathways that encompass foundational to advanced BIM competencies.

Implications for Architecture Education

The implications of these findings are significant for architecture education in Nigeria. While there is evidence of foundational BIM integration across surveyed universities, disparities in course offerings and institutional resources suggest opportunities for improvement. Enhancing faculty expertise, expanding access to BIM software and hardware, and fostering industry collaborations are essential steps towards standardizing and enhancing BIM education nationwide.

The moderate overall integration of BIM, as indicated by survey responses (Table 4), reveals both progress and areas for development. While core aspects like technology integration receive high scores, critical areas such as faculty training and the integration of BIM within design studios exhibit lower rankings, signalling areas that require focused attention. Statistical analyses including ANOVA and Tukey's HSD test (Table 5 and Table 7) confirm significant differences in BIM integration across various aspects, reinforcing the need for targeted interventions to address disparities and ensure comprehensive skill development among architecture students.

CONTRIBUTION TO KNOWLEDGE

This study on mapping BIM integration in architecture education in Nigerian universities contribute to knowledge by providing empirical data on the integration of BIM in Nigerian architecture education, highlighting regional disparities and curriculum variability. It highlights the need for alignment of BIM curriculum with industry demands, identifies critical areas for improvement such as faculty training and resource allocation, and establishes a replicable framework for future research. The findings have significant policy implications, advocating for curriculum reforms and enhanced academia-industry collaboration to better prepare students for modern architectural practice.

Conclusion

This study investigated the integration of Building Information Modelling (BIM) in architecture education across NUC-accredited departments in Nigerian universities. The analysis encompassed curriculum content from ten randomly selected institutions, examining BIM-related courses offered at various undergraduate levels. The study revealed significant variability in the integration of BIM across these universities. Notably, institutions like Ahmadu Bello University (ABU) and Baze University demonstrate comprehensive early integration of BIM, while others, such as Abubakar Tafawa Balewa University (ATBU) and Federal University of Technology, Akure (FUTA), introduce BIM at more advanced stages. The analysis also highlighted gaps in curriculum alignment with industry demands, particularly in faculty training and the integration of BIM within design studios. Statistical analyses, including ANOVA and Tukey's HSD test, identified significant differences in BIM integration across various aspects, with BIM technology receiving the highest scores and other aspects like faculty knowledge and hands-on practice showing lower integration.

Based on the findings of this study, the current state of BIM integration in architecture education in Nigeria universities can be categorized as moderate. The analysis of curriculum content from ten NUC-accredited departments of architecture reveals significant variability in the adoption and implementation of BIM-related courses. While some universities demonstrate early integration of Computer applications, particularly in institutions like Ahmadu Bello University (ABU) and Baze University, others introduce BIM at more advanced stages or show limited integration. The study identified substantial disparities in BIM integration across various aspects such as curriculum design, faculty training, access to resources, and industry collaboration. BIM technology itself shows the highest level of integration, whereas other crucial aspects like faculty knowledge and the integration of BIM within design studios exhibited lower integration. Statistical analyses, including ANOVA and Tukey's HSD test, confirmed significant differences in BIM integration among these aspects, highlighting areas that require focused attention and improvement.

Recommendations

These measures are crucial for bridging existing gaps and ensuring that architecture students receive comprehensive training aligned with contemporary industry standards. While progress has been made in integrating BIM into architecture education in Nigeria, the current integration remains moderate. Provide compulsory training programmes should be provided to ensure that faculty members are proficient in BIM tools and methodologies. This will address the current lack of trained instructors and improve the quality of BIM education.

i. Adequate financial resources should be allocated for the procurement of advanced BIM software and hardware. This will facilitate hands-on learning experiences for students and bridge the identified resource inadequacies.

ii. Support research initiatives related to BIM applications through grants and scholarships. This will not only advance knowledge in the field but also provide valuable learning experiences for students.

iii. Reform architectural curricula to incorporate BIM-centric modules, ensuring consistency across institutions and alignment with current industry standards and practices. Continuous curriculum assessment and improvement mechanisms should also be established.

iv. Create partnerships between academia and the architectural industry to provide students with practical BIM exposure through internships, workshops, and joint projects.

v. Implement policies to bridge regional disparities in BIM adoption, ensuring equal opportunities and resources for universities in less developed areas.

Addressing the identified disparities and implementing the recommendations will contribute to advancing BIM integration in architecture education and prepare future architects effectively to meet the evolving demands of the profession in Nigeria and globally.

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AN ASSESSMENT OF THE DETERMINANTS OF CONSTRUCTION PRACTITIONERS' KNOWLEDGE SHARING ATTITUDE

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Abstract
Individuals such as Construction Practitioners (CPs) are the focal point of Knowledge Sharing (KS). KS is recognised as one of the most crucial aspect of Knowledge Management (KM) which leads to better performance of organisations and construction projects. Literature has shown that KS success is largely driven by individual level variables such as attitude. Studies on KS largely neglect the individual level variables such as, perception, motivation which in turn determines attitude. Hence, there is a lack of knowledge on the assessment of the determinants of attitude of Construction Practitioners' (CPs'). Therefore, the aim of this research is to assess the determinants of CPs knowledge sharing attitude in construction projects. The determinants of KS Attitude and their components were identified from literature and were used to conduct a survey to assess the CPs KS perception, Motivation and Attitude. Quantitative approach was adopted for this research and data was collected using structured questionnaire administered to Construction practitioners. Data was analysed using statistical tools (SPSS) to determine Means and Percentages. The study identified four determinants of KS attitude (perceiver, target, intensity and persistence). It was found out that the CPs perceiver, target, intensity and persistence as determinants of KS has influence on KS attitude. The study also found that CPs correctly perceive KS in construction projects with a mean score of 4, CPs exhibit high level of intensity and persistence as measures of their motivation level with an average mean score of 4.2. The study concludes that Construction Practitioners' Perception do not affect their Knowledge Sharing Attitude, instead Motivation does. The study recommends that CPs should be educated about their perception of KS.
Keywords: *Construction Practitioners, Knowledge Sharing Attitude, Perception, Motivation*

Introduction

Knowledge sharing (KS) is an essential part of knowledge management (KM). It is considered one of the most important aspects of KM (Chandran and Alammari, 2021), as it can lead to improved organizational performance. Tserng and Lin (2004) found that KS can help construction organizations promote innovation, reuse experience, improve training, enhance job performance, increase intellectual assets, and reduce repetitive problems. Wang and Noe (2010) also found that organizations that practice KS are more likely to have successful KM initiatives (Seokyon, 2022). Wang et al. (2014) found that managers can improve organizational performance by enhancing knowledge sharing among employees. Love et al. (2005) agreed that KS can lead to better performance of construction projects.

There are several issues surrounding knowledge Sharing and quite a number of these issues revolve around five aspects, namely: concept, enablers, implementation, practice and processes. Researches that have worked on the implementation aspect of KS have channeled their effort on barriers and facilitators to successful KS implementation (Chedid, Alvelos and Teixeira, 2022; Frost, 2014 and Wang, & Meng, 2018), models for the implementation of KS (Ahmad,2010), Leadership and Motivation (Chedid, *et al*., 2022; Chi, Lan, and Dorjgotov (2012). Whilst some researches that looked at practices focused on best practices, KS and firm performance (Aiken, 2016 and Appiah, 2014). Others examine KS capabilities and KS practices in different part of the world, for example, China and Ghana.

Another area that researchers have worked on is KS Enablers and they worked on KS capabilities including KS capabilities and Firm's performance, KS and knowledge effectiveness, KS capabilities and adoption of KS concepts, enablers for KS such organisational culture, top management support, trust and so on. Finally, research about KS processes and determinants have discussed the antecedents of KS (Javaid, Soroya and Mahmood, 2020; Chandran and Alammari, 2021; Nazeem and Mukherjee, 2016). Amongst studies that looked at knowledge creation is (Hao and Xianhai, 2018), knowledge sharing (Issa and Haddad, 2008; Cummings, 2004; Wang and Noe, 2010 and Wang *et al*., 2014).

Several problems were addressed by researchers such as provision of systematic procedures for developing and applying KM systems, many KM models were developed to support KM activities, solutions to practical difficulties and challenges faced while implementing KM, performance issue problems, best practices in implementing KM, solutions to the problems faced and key success factors were established. KM practices were thoroughly investigated, improved organisational performance, the all-important concept, capabilities as prerequisite to adoption and implementation also explored, enabling factors for successful knowledge sharing and influence of factors on knowledge sharing.

Several studies that have been carried out on knowledge sharing enablers focuses on culture, management support, etc. (Javaid, et al., 2020; Chandran and Alammari, 2021; Alavi et al., 2005, Chakravorti, 2011; De Long and Fahey, 2000; Rai, 2011 and Saifi, 2015), without much focus on people, i.e., studies on KS largely neglects the individual level variables e.g., Perception, Motivation and Attitude.

However, generic literature has shown that KS success is largely driven by individual level variables such as, attitude (Chedid et al., 2022; Javaid et al., 2020; Sanboskani, Kiomjian & Srour, 2020; Zabidin, Belayutham, and Che Ibrahim, 2023 & Rowley & Fullwood, 2017). Behaviors exhibited by individuals such as motivation, perception and attitude are known to affect task performance (Robbins and Judge, 2017), in this case, knowledge sharing and attitude is dependent on process at the individual level of analysis. Furthermore, considering that the project team has an independent feature due to the dispersion of the construction site, which may lead to the difficulty and barrier about knowledge sharing between different project teams, strengthening the interaction and linkage between project teams seems to be an effective initiative (Rowley and Fullwood, 2017).

Despite what researchers are doing on knowledge sharing, little or no improvement was reported on people aspect of knowledge sharing. People (construction practitioners included) are the focal point of knowledge sharing, yet little is known about these individuals and that needs to be researched on. Hence, there is a lack of knowledge on the assessment of the determinants of attitude of Construction Practitioners' (CPs').

Literature Review

Antecedents of Knowledge Sharing

A review of the literature shows that studies on KS focused on KS at (1) individual level, i.e., KS between individuals (Chedid *et al*., 2022; Javaid *et al*., 2020; Connelly and Kelloway, 2003; Laupase, 2003; Rowley & Fullwood, 2017; Zarraga and Bonache, 2003), (2) group/team/unit level, i.e., KS between groups/teams/units (e.g., Hansen, 2002; Tsai, 2002), and (3) organisational level, i.e., KS between organisations (Javaid et al., 2020; Bell et al.,2002; Dyer and Nobeoka, 2000; Lee, 2001; Rowley & Fullwood, 2017; Spencer, 2003). These studies come from a variety of disciplines such as information systems, organisation theory, sociology, psychology and social psychology. However, as a starting point for exploring KS in an organisation, this research focuses more on factors related to individual level, as mentioned earlier that KS originates from individual organisational member. Drawing on the summary of literature, four major factors at individual level are identified as important to KS in organisations, namely self-efficacy, organisation commitment, interpersonal trust and attitude. Hence, for the purpose of this paper, attitude will be considered as it relates to people.

Attitude

Individual members in organisations are different and have different value systems. Such a value system can provide insights into one's attitude. According to Schermerhorn (2008), an attitude is "a predisposition to act in a certain way toward people and things in one's environment". A similar definition can be found from Robbins and Coulter (2013) that attitudes are evaluative statements either favourable or unfavourable concerning objects, people, or events. They reflect how one feels about something. There are three components in understanding attitude, namely, cognitive, affective or emotional and behavioural (Robbins and Coulter, 2009; Schermerhorn, 2008). From an organizational behaviour perspective, attitude influence people's behavior and influence how they interact with other organisational members. A study by Olatokun and Elueze (2012) about lawyers' attitude towards KS argued that a positive attitude to KS by workers of a law organisation would help

the law organisations identify its weaknesses and strengths. This is particularly important to knowledge workers and knowledge-intensive industries like law firms. By adopting the Theory of Reasoned Action model, the study demonstrated that if an organisational member has a favourable attitude towards sharing one's knowledge with other members, there is a high possibility that one will share available knowledge and thus confirmed that attitude was a determinant of the member's intention to share knowledge.

Likewise, similar research by Lavanya (2012) also posited attitude as one of the individual determinants in the study on antecedents of KS. Support is also gained from other literature such as Chedid et al., (2022); Javaid et al., (2020); Sanboskani et al., (2020) and Zhang and Ng's (2012). Study on KS in construction teams and Thanos et al.'s (2013) study on KS in employee weblogs. Both studies reveal that attitude towards KS significantly determined the intention to share knowledge, which then determines KS behaviour. Therefore, it is expected that the higher the level of favourable attitude towards KS, the higher the level of interpersonal KS in organisations. Hence, the Robins and Judge (2013) model of organisational behavior has a little difference from the normal theories/ models that exists such as the Theory of Planned Behavior (TPB) and the Theory of Reasoned Action (TRA). The model forms the basis of this research work.

Organisational Behavior Model

Several models have been used to study Knowledge Sharing Behaviours. Some of the models are Theory of Planned Behaviour (TPB) by (Ajzen, 1991) and Theory of Reasoned Action (TRA) by (Ajzen & Fishbein, 1980), and Organisational Behavior Model (OB Model) by Robbins and Coulter (2013). Organizational behavior is an applied behavioral science built on contributions from a number of behavioral disciplines, mainly psychology and social psychology, sociology, and anthropology. Psychology's contributions have been mainly at the individual or micro level of analysis, while the other disciplines have contributed to our understanding of macro concepts such as group processes and organization.

Using the Organisational behavior model in Robbins and Judge (2013), attributes exhibited by individuals affects their task performance, in this case knowledge sharing. There are Three proposed variables in OB model (Input, Processes and outcomes) at Three levels of analysis (Individual, Group and Organisational). The model proceeds from left to right, with inputs by the left leading to processes at the middle and processes leading to outcomes. Notice that the model also shows that outcomes can influence inputs in the future. From the model, it could be seen that attitude is influenced by four processes, namely: perceptions, motivation, moods and emotions. This work considered only two attributes in the processes variable of the organisational behavior model (i.e., Perception and Motivation) for time restriction.

Motivation

Luthan (1998) defined motivation as, a way that begins with a physiological deficiency or need which leads to a given behavior or action to satisfy a goal. Motivation is also defined as the processes that account for an individual's intensity, direction, and persistence of effort toward attaining a goal (Robbins and Judge, 2013). In their definition, there are three key elements that makes up motivation. They are intensity, direction and persistence. Intensity describes how hard a person tries and it is the element most of us focus on when we talk about motivation. However, it is unlikely that intensity alone will lead to favourable job performance outcomes unless the effort is channelled in a direction that benefits the organisation.

Therefore, both quality of the effort as well as its intensity is considered. For motivation to be high, Effort directed toward, and consistent with, the organisation's goals are the kind of effort that should be sought. Moreover, motivation has a persistence dimension which measures how long a person can maintain effort. Motivated individuals stay with a task long enough to achieve their goal.

Perception

Schacter,Gilbert, and Wenger, (2009) defined Perception as the organisation, identification, and interpretation of a sensation in order to form a mental representation (emphasis in original). Perception is a process by which individuals organise and interpret their sensory impressions in order

to give meaning to their environment (Robbins and Judge 2013). Robbins and Judge, (2013) also argued that, what is been perceived can be substantially different from objective reality. Perception is important in studying behaviour (KS) because people's behavior is based on their perception of what reality is, not on reality itself. In this sense, perception has three components which are Perceiver, Situation and Target and are referred to as factors that influences perception (Robbins and Judge, 2013).

Attitude

Generally speaking, an attitude is a person's relatively enduring affective orientation for an object. According to Ajzen and Fishbein's (1980) theory of reasoned action (TRA),a person's attitude toward a behavior is determined by a set of salient beliefs about certain outcomes caused by the behaviours and the corresponding evaluation on the outcomes. Robbins and Judge (2013) defined attitude as evaluative statements either favourable or unfavourable concerning objects, people, or events. They reflect how one feels about something. They also outlined that there are three components in understanding attitude, namely, cognitive, affective or emotional and behavioural. From an organizational behavior perspective, attitude influence people's behavior and influence how they interact with other organisational members.

To explain the three components of an attitude, the cognitive component is a description of or belief in the way things are. The cognitive is the opinion or belief segment of an attitude and it sets the stage for the more critical part of an attitude, that is the affective component. Affect is the emotional or feeling segment of an attitude and is reflected in the statement. Finally, affect can lead to behavioural outcomes. The behavioural component of an attitude describes an intention to behave in a certain way toward someone or something.

Research Methodology

This paper adopted a quantitative research approach. Quantitative approach was used because of the advantages it has over other approaches, like: being practical, measuring incidence of various views, opinions in a chosen sample, and quantifying of data and make the result general from a sample to the interest of the population. The data collection instrument used was questionnaire which was designed in a closed ended pattern because all the questions were stated for the respondents to indicate the extent they Agree or disagree to the statements provided using the scales: SD "Strongly Disagree", DL "Disagree to a lesser extent", ND "Neither agree nor disagree", AL "Agree to a lesser extent" and SA "Strongly agree". This is in line with previous studies carried out on Knowledge sharing Attitude (Chedid et al., 2022; Javaid et al., 2020; Chandran and Alammari, 2021).

The populations used for this study are construction practitioners particularly architects, builders, engineers and quantity surveyors (QS). According to Lawal and Adeyeye (2006), population is the total number of objects, units, or individuals used for the research which could be finite/limited or infinite/uncountable. There were a total population of 54,585 construction practitioners, and total sample frame of 46,395. Since the population size, *N* is known, and the type of data is categorical, Yamane (1967) provides a simplified formula to calculate the sample size with a 85% confidence level and precision level (e) of +/-15%.

$$n = \frac{N}{1+N(e)^2} \quad \text{.....1}$$

Where: **n =** required sample size, **N** = sample frame and **e =** level of precision.

Therefore, the total sample size was calculated from the frame and not population, this is because some professionals might not be active or they can be death, so the sample frame refers to the active number of the population, a total of 174 (for Architects 44; Engineers 43; Quantity Surveyors 44 and Builders 43) was derived and the most appropriate sampling technique adopted for this study is the Stratified Random Sampling was adopted because it establishes population in strata and takes samples from each stratum at convenience. The relevant CPs were gotten across through email addresses and some via online (using google forms). The data collected was analysed using descriptive analysis. The methods of data analysis employed for this study are desk review/research, frequency distribution and percentage, mean item score and standard deviation.

Results and Discussion

An assessment of determinants of KS (perceiver & target)

Table 1 An assessment of determinants of KS (perceiver & target)

Determinants of knowledge sharing	SD	DL	ND	AL	SA
Perceiver					
Contributes to positive changes and improvements	4.4			13.2	82.4
Greatly assist other participants in the organization	4.4		2.9	13.2	79.4
Is invaluable to the success of the project			5.9	22.1	72.1
Diminishes my competitive advantage	50	27.9	7.4	8.8	5.9
Target					
Enhances achieving project goals and objectives	4.4		2.9	16.2	76.5
Is dependent on participants' willingness and trust	2.9	5.9	1.5	29.4	60.3
Need not necessarily be engaged in a formalised process		13	5.8	53.6	26.1
Though seem as important but not considered a priority	20.6	5.9	4.4	42.6	26.5

SD – Strongly disagree, DL – Disagree to a lesser extent, ND – Neither agree nor disagree, AL – Agree to a lesser extent, SA – Strongly agree

First, the frequency distribution (percentage responses) of the data collected is presented. This gives a picture in terms of proportion of the extent they disagree/ agree that the statements measuring each of the determinants applies to or is a descriptor of them. The outcome is presented in Table 1. To assess construction practitioners' perception (perceiver & target) of knowledge sharing. For better description and interpretation, the results were merged to form two aspects, i.e., strongly disagree and disagree to a lesser extent were merged, while strongly agree and agree to a lesser extent merged also to give a cumulative percentage. Based on the perceiver, more than 90% of the respondents agreed that knowledge sharing in organisations "contribute to positive changes and improvements", "greatly assist other participants in the organisation" and is 'invaluable to the success of the project". Moreover, more than75% of the respondents disagree that knowledge sharing "diminishes my competitive advantage".

In investigating the target of what is been perceived, Table 1 reveals that more than 90% of the respondents agree that within the project organisation, knowledge sharing "enhances achieving project goals and objectives" while 80% of the respondents agreed that knowledge sharing "is dependent on participants' willingness and trust" and "need not necessarily be engaged in a formalised process". Up to 70% of the respondents agreed that knowledge sharing "though seem as important but not considered a priority".

Based on the responses above, construction practitioners' understanding about knowledge is right. Though once it is about the perceiver (i.e., the person perceiving it, in this case the practitioners'), more people tend to be more correct compared with the target. So, in terms of consideration relative to both the perceiver i.e., CPs understanding of KS and the target i.e., knowledge been shared in project organisations, there is a high propensity/ chance that knowledge sharing is perceived rightly by construction practitioners engaged in construction projects.

An assessment of determinants of KS (intensity & persistence)

Table 2 An assessment of determinants of KS (intensity & persistence)

Determinants of knowledge sharing	VU	UL	NU	TL	VT
Intensity					
I am a constant advocate for project participants' participation	1.5	4.4	5.9	19.1	69.1
I believe that Knowledge Sharing has an effect on project performance	5.9		1.5	14.7	77.9
Knowledge Sharing is always a priority for me and I make efforts to achieve it	1.5	1.5	1.5	27.9	67.6
Persistence					
No matter the demands on me I'll always make room to engage in Knowledge Sharing		2.9	5.9	26.5	64.7
Irrespective of the challenges faced, I will continue to engage in Knowledge Sharing	2.9		1.5	32.4	63.2
My satisfaction determines my engaging in Knowledge Sharing rather than project goals	17.6	8.8	16.2	30.9	26.5

VU – very untrue of me, UL – untrue of me to a lesser extent, NU – neither untrue/true, TL – true of me to a lesser extent, VT – very true of me

Moreover, Table 2 below shows the percentage distribution of responses for intensity and persistence determinants. Hence, for better interpretation, the results were merged to form two aspects, i.e., strongly disagree and disagree to a lesser extent were merged, while strongly agree and agree to a lesser extent merged also to give a cumulative percentage. It can be seen that more than 80% of the respondents said that it is true of them either to a lesser extent or completely that "I am a constant advocate of project participants' participation". While more than 90% describes the statements "I do not believe knowledge sharing has any effect on project performance" and "knowledge sharing is always a priority for me and I make efforts to achieve it" as either True of them to a lesser extent or very true of them.

More than 90% of the respondents with regards to knowledge sharing, states that it is true of them that "no matter the demand on me, I will always make room to engage in knowledge sharing". While 95% also answered as true of them that "Irrespective of the Challenges faced, I will continue to engage in knowledge sharing" and half of the respondents, up to 57% said that "my satisfaction determines my engagement in knowledge sharing rather than project goals".

From the responses, it is evident that when it comes to sharing knowledge, construction practitioners' persistence on knowledge sharing is high and in terms of consideration relative to both the intensity i.e., CPs trial in engaging in KS and the persistence i.e., how long they try to share knowledge been shared in project organisations, there is a high propensity/ chance that construction practitioners see knowledge sharing as something to be done in construction projects. As such, their intensity and persistence are high. Therefore, motivation may be seen to have a positive influence on construction practitioners' knowledge sharing.

Assessment of Construction Practitioners determinants of Attitude Perceiver and Target

Table 3 Mean of Construction Practitioners' Perception (Perceiver &Target)

Perception		
Perceiver	**Mean Statistic**	**Std. Deviation Statistic**
Contributes to positive changes and improvements	4.66(5)	0.971
Greatly assist other participants in the organisation	4.54(5)	1.043
Is invaluable to the success of the project	3.74(4)	1.608
Diminishes my competitive advantage	2.32(2)	1.309
Target		
Enhances achieving project goals and objectives	4.47(5)	1.113
Is dependent on participants' willingness and trust	4.07(4)	1.111
Need not necessarily be engaged in a formalised process	3.90(4)	1.148
Though seem as important but not considered a priority	3.62(4)	1.487

1 –very untrue of me, 2 – untrue of me to a lesser extentt,3 – Neither untrue/true, 4 – true of me to a lesser extent, 5 – very true of me

The mean values from analysis performed on variable measuring the perceiver under the perception construct, provides three distinct characteristics in the response pattern. For instance, for two of the measures, respondents indicated that these measures are "very true of me" having mean values that approximates to 5.00. In the other instances, for the two remaining measures, the respondents indicated that, the statements are "True of me to a lesser extent" with mean value that approximates to 4.00 and "untrue of me to a lesser extent" mean value approximate to 2.00 respectively. The standard deviations also explain how clustered the data are around the mean and that high standard deviation indicates that data are more spread out while a standard deviation close to zero indicates that data points are close to the mean. This can clearly be seen from the Table 3.

Similarly, the mean values measuring the target still under the perception construct, gives two different features. For the first measure, the respondents indicated that the measure is "very true of me" (i.e., a mean score of 4.66). for the remaining three measures, they responded that the statements are "True of me to a lesser extent" (i.e., mean scores of 4.07, 3.90 & 3.62 respectively).

It can be deduced that, on the average, considering the mean scores, Construction Practitioners' perception of Knowledge Sharing is right (average mean score of 3.91 which approximates to 4.00) since they agree to the measures of perceiver and target.

Assessment of Construction Practitioners determinants of Attitude Intensity and Persistence

Table 4 Mean of Construction Practitioners' motivation (intensity & persistence)

Motivation		
Intensity	**Mean Statistic**	**Std. Deviation Statistic**
I am a constant advocate for project participants' participation	4.47	1.000
I do not believe Knowledge Sharing have any effect on project performance	4.44	1.238
Knowledge Sharing is always a priority for me and I make efforts to achieve it	4.60	0.775
Persistence		
No matter the demands on me I'll always make room to engage in Knowledge Sharing	4.43	0.759
Irrespective of the challenges faced, I will continue to engage in Knowledge Sharing	4.50	0.889
My satisfaction determines my engaging in Knowledge Sharing rather than project goals	2.90	1.613

The mean values obtained from the analysis performed on the variables measuring the Intensity component of motivation, shows that the respondents believe that the statements are "very true of me" (4.47, 4.44 & 4.60) which means it is a true descriptor of them.

Furthermore, the mean values obtained on the variables measuring persistence under the motivation construct, gives three different values. Firstly, the respondents show that the measures are "true of me to a lesser extent" (4.43), "very true of me" (4.50) and "Neither untrue/true" (2.90). It can be seen from Table 4 that the average mean score for intensity and persistence is 4.20 and that may mean Construction Practitioners' Motivation to engage in Knowledge Sharing maybe high since they responded true of them to measures of motivation.

This paper through extensive literature review identified six determinants of KS attitude in construction projects: perceiver, target, intensity, persistence, cognitive and affective. The result indicates that motivation (Intensity and Persistence) is what encourages construction practitioners to share knowledge rather than their perception (perceiver and target). Motivation refers to the processes that account for an individual's intensity, direction, and persistence of effort toward attaining a goal (Robbins and Judge, 2013). In this definition, the three key elements that makes up motivation are intensity, direction and persistence. Intensity describes how hard a person tries and it is the element most of us focus on when we talk about motivation. However, it is unlikely that intensity alone will lead to favourable, (knowledge sharing) outcomes unless the effort is channelled in a direction that benefits the organisation. Knowledge sharing occurs only when members are motivated to share their knowledge. This finding is in line with the findings of (Chedid, et al., 2022) in their study titled Individual factors affecting attitude towards knowledge sharing, they found out that motivation was the factor that positively affects knowledge sharing attitude but it is in disagreement with the findings of Chandrann and Alammari (2021) because they found out that the relationship between people self-motivation and knowledge sharing attitude is insignificant. A major and an important factor that affects knowledge sharing are individual factors, in which it has been ascertained and supported by the findings of (Jayaid, et al., 2020) where those factors played a vital role in enhancing the knowledge sharing attitude of construction practitioners.

Conclusion and Recommendations

The study was aimed at assessing the determinants of knowledge sharing attitude in construction project. Knowledge sharing Attitude was explored and the determinants of Attitude were identified from literature and assessed by construction practitioners based on their level of agreement the extent to which the factors describing the determinant of attitude are true of them. The determinants (Perception and Motivation) were then classified in to (perception: perceiver and target; motivation: intensity and persistence).

This study enables further studies to be directed at these determinants to be able to improve on knowledge sharing attitude. The research findings would help construction practitioners in Nigeria to know where or at what determinants they should channel their efforts towards improving knowledge.

The study recommends that CPs should be educated about their perception of KS and their level of motivation should be increased because Motivation is what derives them to share Knowledge rather than perception. It is also recommended to widen the coverage of the research to other construction Practitioners not covered by this research (such as Contractors), in order to compare and justify the recent findings.

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FRAMEWORK FOR APPLICATION OF CONTEMPORARY GROWTH-EXPLICIT MODELS IN DETERMINING MARKET PRICES OF RESIDENTIAL PROPERTIES

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Abstract
This study sought to develop a framework for using the most relevant contemporary growth-explicit model appropriate for application in the Nigerian property market for investment valuation within the south-south geo-political zone of Nigeria. The primary source of data collection was through a structured 36-question questionnaire administered to principal partners of 342 firms operating within the south-south geo-political zone of Nigeria. Among the type of data collected were: valuers' level of knowledge of the formula used in deriving the model, valuers' awareness of the variables used in each of the given models, valuers' knowledge of how and where to obtain information on specific variables used in the model, valuers' understanding of how to apply the contemporary growth-explicit models. The study carefully analyzed the sample using the simple percentage table. The result shows that the most relevant contemporary growth-explicit model to apply in the Nigerian property market is the dialectic model. To use this valuation model, the valuer needs to understand the provisions of the Land Use Act, 1978 (now cap. 202 1990 Laws of Federal Nigeria).

Background of the Study

A framework for the application of contemporary growth-explicit models during investment valuation is a veritable tool as acknowledged by Udo (2019). Within this premise, many schools of thought such as Ibanga *et al.* (2016) have advocated that with the observed complexity emanating from conventional approaches, the application of these mathematical formulas under a standardized guideline is pertinent so as to enable Nigerian valuers undertake rational valuations to determine market prices of properties subjected to economic forces. Therefore, it is reasonable for Nigerian valuers to determine the most relevant contemporary growth-explicit model appropriate for application in the Nigerian property market. Hence, if formulas for the given contemporary growth-explicit model could be well-examined, it would enable them be aware of the variables to be applied in each of the given models itself. With these data, the valuers could understand how to apply the contemporary growth-explicit model and arrive at given results. After their reconciliation, where any of them had earlier applied two or more models, real estate researchers could compare the property values obtained for the application of contemporary growth-explicit models and market prices found in the Nigerian property market to ascertain either their variance or otherwise. Deducing from these property value comparisons, a framework could be adopted for the application of these models in determining market prices of residential properties. Based on this understanding, rationality could be achieved even when the property may be transacted after a long time from the valuation practice.

Reasoning on the attainment of rationality in valuation through a framework, many authors such as Diala and Ogwueleka (2018) and Udoekanem (2009) opined that it could only be formulated if real estate researchers would find out if property value estimates obtained from the application of each model could rationally determine market prices within their particular property market circumstances. The authors therefore preempted that this achievement would enable Nigerian valuers determine which model to apply at a given circumstance based on the underlying principles of the model itself and its appropriateness to the valuer's instant property market, examine the formula of the given contemporary growth-explicit model, appraise the variables to be used in the application of each contemporary growth-explicit model, identify information source of specific variables, apply the given model and compare the property values obtained from the application of contemporary growth-explicit models and market prices and thus, enhance rationality through a framework. However, the research gap left unaddressed by many of these real estate researchers and other interested parties is that they have not formulated the framework itself nor have they demonstrated it within their market circumstance.

Bello and Bello (2007) observed that 98% of Nigerian valuers are still attuned to conventional approaches, and as such the existence of complexity still persist. More so, after their study on valuation methods, many schools of thought have advocated that there should be uniformity among valuers within the Nigerian property market despite the complexity now prevalent (Ibanga *et al.*, 2016). This simply means that in trying to determine market prices of a given number of properties, Ajayi (1998) had earlier inferred that Nigerian valuers did not follow the same procedure, did not apply the same models, did not use the same variables and could not obtain the variables for the application of each contemporary growth-explicit model. So, it was difficult for them to understand how to apply the models in an attempt to rationally determine market prices, especially in residential property valuations. More so, when comparison was made between the property values of these conventional approaches applied and their market prices, variances were observed. This is unacceptable to the suggestion made by IVSC (2018) that property values should be within ±15% of the market prices in lieu of residential properties developed as investments.

A scientific method of enabling all Nigerian valuers rationally determine market prices is to formulate a framework for the application of these contemporary growth-explicit models as purported by Udo (2019). It is advantageous to think that this framework would guide all of them in rationally applying the contemporary growth-explicit models and unify them when seeking to determine market prices as all would achieve the same property value estimate through a common procedure. This would be based on the fact that when comparison is made between property values obtained from the application of contemporary growth-explicit models and market prices, both would be correlated. Hence, this study aimed at formulating a framework for the application of contemporary growth-explicit models in determining market prices of residential properties. Further, it was projected to help Nigerian valuers to determine the most relevant contemporary growth-explicit model appropriate for application in the Nigerian property market, examine their level of knowledge of the formula used in deriving the model, appraise their awareness of the variables to be applied in each of the given model, identify their knowledge of where to obtain information on specific variables applied in each of the model, find out their understanding of how to apply the contemporary growth-explicit models and arrive at a given result, and compare the property values obtained from the application of the contemporary growth-explicit models and market prices.

Within this background, a framework for the application of these contemporary growth-explicit models could be formulated and adopted for universal application. Hence, it designed a framework based on valuer's articulation of the contemporary growth-explicit models, their responses to surveyed questionnaires and researcher's computed data obtained from field work, comparison of the obtained property values and property market prices, and literature related to the subject matter. Thus, the framework involved analyzing a series of steps and approaches which would educate the Nigerian valuers on how to identify and apply the most appropriate contemporary growth-explicit model peculiar to their property market circumstances and determine rational market prices. Each step in the framework critically examined a set of variables simultaneously with the intent of pictorially showing its relativity to the entire research work, and other sub-sets. More so, the framework through an inter-linking flowchart would enable the Nigerian valuers understand how the variables used in the application of each contemporary growth-explicit model such as rental growth, inflation and yield should relate to each other in the model itself. Their imputation into the model and appropriateness of each variable was necessary so as to determine their correlation or otherwise when applying the models. Hopefully, this would be valuable to the Nigerian valuer in dispensing his duties and enable him to be rational, to the satisfaction of the client. Hence, the study aimed at formulating a framework for the application of contemporary growth-explicit models in determining market prices of residential properties. Further, it was projected to help Nigerian valuers to determine the most relevant contemporary growth-explicit model appropriate for application in the Nigerian property market, examine their level of knowledge of the formula used in deriving the model, appraise their awareness of the variables to be applied in each of the given model, identify their knowledge of where to obtain information on specific variables applied in each of the model, find out their understanding of how to apply the contemporary growth-explicit model and arrive at a given result, and compare the property values obtained from the application of the contemporary growth-explicit models and market prices.

Review of Related Literature

It is reasonable to first review conventional approaches in investment method of valuation with a view to determining its limitations to contemporary practice. Apart from paying full rental value, Udobi *et al*. (2016) and Udoekanem (2009) acknowledged that in investment valuation, the freeholder may be receiving rent below full rental value because he has let at full rental value some years earlier and as rents have increased subsequently, he let the property at a premium or the lessee is a sitting one and the lessor gives him some rent concession in view of this situation. The implication of this scenario is the adoption of four conventional models used perhaps in determining market prices, namely, term and reversion method, the layer method, hardcore and the equivalent yield method. Baum and Crosby (2012a) showed that in the term and reversion approach, the underlying assumptions are that the period for which the rent is fixed is called the term and the period in which the rent reverts to full rental value sequel to the term is known as the reversion.

Hence, as specifically noted by Ogunba (2012), the property value required is the property market price of the term plus that of the reversion. To achieve the calculation, French (2004) showed that the yield for the term is usually taken as lower than that for the comparable properties recently let at full rental value because of the lower risk attached to paying a lower rent, the rent adopted for the reversion is the current estimate of full rent value, and the property market price of the reversion is obtained by capitalizing today's full reversion value in perpetuity. However, it is reasonable to think that this provides a property market price as at the date of reversion, whereas what is required is the property market price now, which is a source of variance. As such, the author further expressed that today's estimate of reversionary price should be obtained by applying present market value to the property market price obtained for the reversion. An alternative approach postulated by Baum and Crosby (2012a) would be to use the years' purchase single rate for reversions to perpetuity, which is years' purchase deferred by the period of the term.

However, sources of variances postulated by Bruggeman and Fishers (2011) are that the yield for the term is usually lower than that for the reversion, ostensibly, because the term rent is of increased security. However, this might not always be the case for Udo (2003) refuted that if the property is of major quality, the increased rent at the reversion might not affect the lessee's inclination to continue in occupation, especially when the lessee is a big company like Shell Petroleum, Exxon Mobil, Chevron, etc. Secondly, Ogunba (2012) is of the thought that even if one accepts the principle of yield reduction for the term, it is more reasonable to adjust the term yield by the proportion of rent payable in the terms relative to the full rental value than to adopt a "rule of thumb" (k-1) yield. Another path of reasoning by the author is that a mathematical error results when two capitalization rates are used for the same period as noted by Bowcock (1983) also. So "rule of thumb" (k-1) yield is used to capitalize the term while the normal yield k is used for the same period in the reversion. Also, the term is overvalued since a growth prone yield (k+1) is used to capitalize it. Further, the full rental value at reversion is taken as the current estimate of full rental value rather than the full rental value at reversion. Lastly, the yield rate is not easily relatable to the equated yield because rental growth is not incorporated into the former. Indeed, there is no use of equated yield in the calculation which creates a problem of cross investment comparison for valuers. To solve this problem, Jefferies (2015) suggested that layer yield variable could be adjusted to suit local valuation practice.

For the layer approach, Udobi *et al.* (2016) opined that the initial rent is capitalized into perpetuity and the incremental rent receivable at reversion is also valued into perpetuity but deferred for the period of the term. Reasonably, if the same yield rate is employed for the term and reversion, and the layer, an identical result ensures. However, Jefferies (2015) noted that different rates are normally employed. Therefore, it could be argued that the layer method uses "rule of thumb" (k-1) and growth-prone (k+1) yields for the layer and margin respectively. The higher yield for the margin is to reflect the higher risk for that slice of rent. The rent for the margin is the full rental value minus the rent currently paid. However, French (2004) showed that its variance criticism is based on the fact that the yield used to capitalize the top slice is criticized because it is derived in a non-market and rather arbitrary manner and thus causing a variance with market prices found in the property market. From this justification, it has been observed that valuation thought therefore has developed in the direction of hardcore approaches in a bit to solve the existing variance and intended to achieve more rationality in the valuation of investment properties.

Ogunba (2012) further showed that the hardcore approach is a variant of the layer approach. Like earlier said, it was developed to address a major fault of the layer model, namely that the layer model determines the yield for the top slice (*k*+1) by means of a subjective rule of thumb. Baum and Crosby (2012a) noted that the attempt with the approach is to provide a more objective derivation of the rate to be used in the capitalization of the top slice. Rent for the layer would still be capitalized at the "rule of thumb" (*k*-1) in the hardcore model since this could be rationally defended. However, the criticism lay on the layer and hardcore approaches by authors such as Opara (2013) are that the split of the reversionary rents into two parts is arbitrary since valuation thought suggest that risk of non-receipt of the reversionary rent should apply to the whole reversionary rent, and not just a part of it. Hence, both the layer method and its modification should not rely on rules of the thumb (*k*-1 and *k*+1 for the layer and *k*-1 for the hardcore).

As earlier stated, it is more rational to adjust the bottom slice yield by the proportion of rent payable relative to the full rental value than to adopt a "rule of thumb" (*k*-1) yield. Further, the layer is over-valued since a growth prone (*k*+1) yield is used to capitalize it. Also, the full rental value at reversion should be taken as current estimate of full rental value rather than the full rental value at reversion since mathematical error results when two interest rates are used for the same period as noted by Bowcock (1983). With this view, the author argued that the "rule of thumb" (*k*-1) yield should be used to capitalize the layer while growth-prone (*k*+1) yield should be used for the hardcore method. Lastly, Pagourtzi *et al.* (2018) noted that the yield is not easily relatable to the equated yield and there is no use of yield in the calculation since it would also create a problem of cross-investment comparison for valuers.

Further, Ataguba (2017) stated that the equivalent yield is also a conventional approach in investment valuation, and usually called the "equated yield without growth". It was with this knowledge that Jefferies (2015) confirmed that it is the yield applied to all rental cash-flows, producing a present value equal to the capital of the investment. Pagourtzi *et al.* (2018) further observed that the approach to investment valuation is patterned after the term and reversion approach, and the layer approach. The difference is in the fact that the same yield rate is used for both the term and reversion or for both the layer and the margin.

Having examined conventional approaches in detail and extracting their limitations, it would be reasonable to question the validity of these approaches generally to contemporary practice based on many authors' view. Firstly, Diala and Ogwueleka (2016) resorted that these conventional approaches in investment valuation are still relevant to valuation practice and Nigerian valuers are still attuned to them even with their major criticism of creating either over or under-valuations and arbitrary variable derivation as deducted from other authors. However, having taken a critical examination of them, Baum and Crosby (2012a) noted that the inappropriate applications of these conventional approaches to current investment valuations and the complexity in contemporary practice calls for a discussion based on two issues, rationality and comparable properties, especially when trying to determine market prices found in the property market.

Derivation of yield in terms of rationality towards clients is the first part, which Hornby (2018) defined as "reasonability". Baum and Crosby (2012a) showed that it could be observed that there is little evidence to suggest that the approaches cannot be currently applied to reflect the reasonable thinking of clients since they are not facilitated with variable components calculation such as inflation, yield and rental growth. On the side of comparable properties used as a yield derivation technique, Baum and Crosby (2012a) argued that why the conventional approaches are still surviving is because of the perceived role in fixing market price levels. A further opinion by Baum and Yu (2013) showed that comparison with identical properties has long been accepted as the best basis for assessing likely market price as typified in the direct market comparison method but the argument boils down to the question of which conventional approach in the investment method of valuation makes best use of comparable properties and whether there is a better way of utilizing comparable information using these approaches.

Observably, of the four models, namely, term and reversion, layer, hardcore and equivalent methods, Udobi *et al.* (2016) opined that only equivalent yield seems to be totally objective in its analysis of investments, as it calculates the equated yield of the current cash-flow assuming a reversion to current rental value only. However, it could be observed that it does not rationally amend term or bottom-slice yields as compared to reversion or top-slice yield. Hence, by removing these

arbitrary adjustments to yields, it is the only true capitalization rate approach. With this view in mind, Ataguba (2017) noted that the equivalent yield is a measure of the qualities of the comparable and the Nigerian valuer needs to adjust for the differences inherent in the lease structure of the property and for any other differences. Even within this purview, all are encompassed within the yield rate, and this is the only thing that could be changed in the formula as against the flexibility of contemporary growth-explicit models, which cannot reasonably convince any client that the conventional approaches are better able to apply comparable properties. Hence, as already noted and pointed out by Udo (2019), the over-valuation of the term and the under-valuation of the reversion in the conventional approaches are the main existence of variances of conventional approaches in investment valuation. Inherent causes of variance within the approaches calls for the identification of contemporary growth-explicit models for given market circumstances and their formulas.

With complexities arising in practice due to continuous increasing inflation, fluctuating yield, inability to determine rental growth as a result of earlier market crash in the 1950s, and subsequently, inappropriateness of the conventional approaches for contemporary investment valuation, Jefferies (2015) posited that beginning from the 1970s and 1980s, numerous alternative models were proposed for the capitalization of rents. In this study, three of them would be analyzed, namely, real value, dialectic and arbitrage models.

i. Real Value Model

Baum and Crosby (2012a) showed that the real value model was formed by Wood as part of his Ph.D. research in 1972 and subsequently published in 1973. Udoekanem (2009) and Udo (2003) showed that it starts from a simplifying premise that rent would be reviewed at each rent payment date to a new rent that matches inflation over an intervening period, known as inflation-proof investment. This is contrasted with another type of investment period known as inflation-prone, which IVSC (2018) stated that it is an investment period in which its rent does not grow over a long time even in the presence of inflation. Within this background, Udobi *et al.* (2016) had earlier acknowledged that in a volatile economy like Nigeria, the real value model views income profiles of investments in real terms only and recognizes two types of rents from property, namely, inflation-prone rent and inflation-proof rent earlier commented upon by IVSC (2018). However, Richmond (1993) explained that inflation-prone rent is a rent that cannot grow with inflation. Hence, if a rent is fixed over a long period of time, it is inflation-prone. Furthermore, Baum and Crosby (1988) showed that an inflation proof rent is a rent that could amend itself for inflation over the intervening period and would have static real value profile into perpetuity.

Having a broad knowledge of this two types of income profile, Udoekanem (2009) noted that the yield rate required on such a rent that is inflation-proof would be the interest rate required for giving up capital, taking into account all risks attached to the property but excluding any extra return for the effects of future inflation. Wood termed this real return the inflation risk-free yield made up of time preference (*l*), expected inflation (*i*) and risk (*rp*). With this view, the yield rate should reflect the fact that on each rent payment date the same sum of money would be paid, regardless of the fact that if inflation was present, the purchasing power of the last payment would be less than the previous payment. Further, Udobi *et al.* (2016) opined that the client would require an added return to make up for the decline in purchasing power using this equation: $(1 + l)(1 + i)(1 + rp) - 1$, where l = time preference, f = expected inflation and rp = risk

Baum and Crosby (2012a) showed that the yield differential between fixed-interest and index-linked gilts could be used as being illustrations to explain the difference between the inflation-prone and an inflation risk-free yield. Hence, the valuation of an inflation-proof rent would be undertaken at inflation risk-free yield (q). If the rent was receivable in one years' time, the valuation would be: PV ₦1 in 1 year at $q = \frac{1}{(1+q)}$. With this the valuation of an inflation-prone rent receivable at the end of the year would be at a higher yield. The inflation risk-free yield would be supplemented by the inflation rates: the two rents differ only insofar as in one case the rent could rise with inflation, while the fixed rent cannot.

In valuation terms, the term rent between reviews is capitalized as rent $x \frac{1}{(1+q)}$. Observably, this rent has now been adjusted for inflation and is equivalent to inflation–proof rent, and could now be

discounted at the inflation risk-free yield (q) as shown in this equation: $rent\ x\ \frac{1}{(1+i)(1+q)}$. Hence, the valuation of an inflation-proof rent would be = $\frac{1}{(1+q)}$, while the valuation of an inflation-prone rent would be $\frac{1}{(1+i)(1+q)}$. The determinations of yields for the inflation-proof and prone rents are then incorporated into the valuation of a periodic rental flow. Assuming *t* is the rent review term and *n* the whole term, the valuation could be built up in blocks of the review pattern as $\frac{1-PV}{r}$. More so, this could be logically substituted for the formula when the rent is to remain static in monetary terms, but declining in real value. When the rent is assumed static, the yield is adjusted as $\frac{1-\left(\frac{1}{(1+q)}(1+i)\right)}{(1+q)(1-i)-1}$. Practically, the rent is assumed to remain static at each review in real terms and the market price of each block is discounted at the inflation risk-free yield. Also, the valuation of a periodically reviewed rent is undertaken by constructing a series and summating to obtain the real value formula of Wood for the years' purchase of a rising rent. In this instance, the 1st and 2nd *t* years rent are calculated as$\frac{1-\left(\frac{1}{(1+q)}(1+i)\right)}{(1+q)(1-i)-1}$, but for last *t* years rent would be $\frac{1}{(1+q)^{n-1}}$. Summating this progression leads to the following years' purchase equation: $b = \left[1 - \frac{1}{(1+e)^n}\right]\ x\ \left[\frac{1-\frac{1}{(1+q)^n}}{1-\frac{1}{(1+q)^t}}\right]$.

In applying the real value model to the Nigerian property market, based on an understanding of the Land Use Act, 1978 now cap. 202 1990 Laws of Federal Nigeria, Udo (2019) proposed the dialectic model after observing that in tenant properties, lessors did repairs in 55.10% of them and external repairs in 32.2% of them. This showed that lessor's involvement in repairs was about 87.3% of all let properties. The remaining 12.7% largely comprised of detached or semi-detached properties in which lessees carried out all repairs. Arising from these findings, the author sought to determine the effects of repairing liability on both conventional and contemporary property valuation models, basically, using a modified real value to deduct capitalized repairs from capitalized gross rent. Here in, the dialectic model differs from real value by its use of gross rent for valuation practice, but it is the basis for contemporary explicit growth model application in the Nigerian property market.

However, in Baum and Crosby (2012a)'s perspective, the real value model has suffered from its complexity, for example, Trott (1980) cited by the author was of the opinion that for any valuation approach to be accepted by the profession, it must be easily understood and easy to be used, but this is not the case with this contemporary growth-explicit model. Hence, its theoretical soundness cannot be matched by a practical application. Unlike the equated yield model, and theoretically similar dialectic model, in terms of equated yield analysis, many authors have acknowledged that the real value model is difficult to use. Another difficulty described by the author is to obtain the years' purchase in perpetuity, which requires that the Nigerian valuer must know the inflation risk-free yield, the inflation risk rate per cent and the rent review period. However, Udo (2003) is of the opinion that these criticisms could be countered when applied to the Nigerian property market. The author's reasoning was based on the fact that in Nigeria, the index-linked investment could provide suitable measures of comparative real returns because from year 2000 to 2005, it was quite stable with a constant average rise of 8% annually. Even with this view, the typical rent review period is something all Nigerian valuers should be aware as the analysis of future inflation rates would be the necessary subject of research.

ii. Dialectic Model

This model was developed by Udo in 1993 after observing that in leased properties lessors did all repairs in 55.10% of them and external repairs in 32.2% of them. The author showed that lessor's involvement in repairs was about 87.3% of all let properties. The remaining 12.7% largely comprised of detached or semi-detached properties in which tenants carried out all repairs. Discussion with tenants indicated that the landlords carried out some aspects of internal repairs where this was the tenant's obligations. Arising from these findings, it was necessary for the conceptor to determine the effect of repair liability on property valuation models. He therefore proposed that capitalized repairs should be deducted from capitalized gross rent, which he earlier postulated (Udo, 2019). Further, the

conceptor constructed a composite Nigerian building material index and used it as an aid to determine the growth in building material cost as 47.33% (1970), 65.39% (1975), 100% (1980), 162.66% (1985), 255.25% (1987) and 412.18% (1990). Further, the conceptor observed that within the period of 1970 to 1987 in Nigeria, growth rates were between 6.68% and 25.27%. The deduction from this was that while the highest growth increase was recorded in the period 1985-1987, market prices increased between the periods of 1985 to 1990 out of pace with steady increases of the previous 15 years (1970 – 1985). In fact, 1970 – 1985 registered an average price increase of 8.58% compared to 7.77% recorded for the ten-year period 1970 to 1980. The post-1985 price was blamed on structural adjustment program and foreign exchange market which resulted in high prices of imported building components. Even with this market circumstance, the client would require more money to undertake repairs and reduce his structural risk, but repair liabilities may increase at 11.43% (1970-1990) or 20.44% (1985-1990). Therefore, the conceptor accepted the argument of the real value model, but differed, in the first instance, by using the gross rent for property valuation. Hence, the conceptor modeled a formula to accept this logic as: b = $a\ x\ YPt@e\ x\ \frac{YPn@i-(m\ x\ YPn\ @\ k)}{YPt@i}$, where a = rent, i = inflation risk-free yield (IRFY), e = equated yield, k = all-risk yield, n = lease term, t = rent review and m = repair in the current year.

Arising from the irrationality resulting from the adjustment of rent to a net basis, there is the necessity to treat repair liability separately. This modification reflected empirical findings because 87.3% of tenancy arrangements, residential properties were not based on full repairing terms. The landlords were responsible for either all repairs (55.1%) or external repairs (32.2%). Consolidating the empirical findings and analytical results confirmed that capitalized repairs could be deducted from capitalized gross income which is valued on the basis of the real value model. However, this contemporary model has been criticized as having limited application by Nigerian valuers who are not equipped by the professional bodies on the sourcing and obtaining data information for its applicability. Hence, valuation practice in Nigeria is still in its conservative form as most valuers and clients do not have a proper record of purchase items, material cost and not engaging competent professionals to assigned projects (Diala and Ogwueleka, 2016).

iii. Arbitrage Model

A final model in the discussion of contemporary growth-explicit models is the arbitrage model. Baum and Crosby (2012a) showed that in the mid-1990s, French and Ward developed the model and joined with Neil Crosby to develop its applications. French and Ward (2005) attacked the reliance of all the other contemporary growth-explicit models on the "all comprising" equated yield and suggested that the financial analyst known as "arbitrage" lends itself to segregating the market value of the cash-flow which is appropriate for the valuer. This led them to take a different view of the contracted cash-flow, suggesting that the property value of the inflation-proof rent under the lease would be determined by the security of that inflation-proof rent, based on the same principle as valuing repayments under a loan secured on the lessee's covenant strength. As a result, the discount rate would be of the same order as that applied to such repayments (Crosby *et al.*, 1997). French and Ward (2005) further suggested that the risk premium should be in the order of one to two percent above the risk-free rate, which was lower than the traditional view of the risk premium of two to three percent. Because of this, the conceptors termed the capitalization rate as the 'low-risk yield'. Having valued the term rent at this low-risk yield, the arbitrage model developed the market price of each subsequent tranche of rent between rent reviews by summation formula. This effectively capitalized the reversion at the yield rate, but deferred the property value at another rate termed the "deferred capital yield" *DCY*. This yield rate is then applied to the reversion value based on the current estimated rental value, not the expected rental value including growth, in effect adopting the same principle as for the real value model (Udo, 2003 and Udoekanem, 2009).

According to French and Ward (2005), because the low-risk yield values the term more highly, the outcome was that the deferred capital yield would be higher than the inflation risk-free yield used in the real value/equated yield. However, Udo (2003) showed that this model suggest that the contract rent has been undervalued by a discounted cash-flow formula, and implied that the risk of achieving the estimated property market price upon reversion has been underestimated and therefore reversion over-valued. The deferred capital yield rate is derived from the equation: $c = (1 + DCY)^t =$

$\frac{1}{1-\left(f\ x\ ((1-(1+n)^{-t})/n)\right)}$, where *DCY* is the deferred capital yield, *f* is adjusted inflation, *n* is the lease term and *t* is rent review.

In essence, this model determines the market prices of properties using deferred capital yield and it is limited by application in developing countries like Nigeria. However, in Nigeria, postponed yields are rarely rational and there is no databank for the collation of inputs as shown by Ibanga *et al.* (2016). Observably, this fact alone makes the application of this contemporary growth-explicit model a subject of controversy among Nigerian valuers, and causes variance when compare to market prices found in the property market. More so, its application in the Nigerian property market is slim as it is not in tandem with the Land Use Act, 1978 now cap. 202 1990 Laws of Federal Nigeria which stipulates for continual rent reviews between periods of five years.

Application of Contemporary Growth-Explicit Model to Arrive at Given Results

An application of the contemporary growth-explicit models begins with the real value model in respect of rack rented freeholds. Using the example, Baum and Sams (2007) showed a current rental value of ₦100,000.00 on five-year review pattern. Comparisons also showed that initial yields for similar properties let at rack rent on five-year patterns are five percent. If the property market could pay a market price showing a five percent initial yield for a similar property, then the property valuation would be ₦100,000.00 x YP perp. at 5% (20) = ₦200,000.00. When such comparisons are available the need to use the three years' purchase to obtain the multiplier is unnecessary.

Another example by the author is to assume the same comparison, but the property to be valued is let at a rack rent of ₦15,000.00 per annum. on a three-year review pattern. Intuitively the valuer would feel that the initial yield should be lowered to reflect the better review pattern, but by how much? Assuming that the equated yield is approximately 2% over gilts, which is say 13%. The growth rate is 8.7%. Therefore, the inflation risk free yield is IRFY = $(^{1+e}/_{1+g}) - 1 = (^{1.13}/_{1.1087}) - 1 =$ 0.03956or 4% approximately. The current rental value can now be capitalized. It has an equated yield of 13%, an IRFY of 4%- and three-year review pattern. The valuation showed a market value of ₦318,919.00.

It is already known that the multiplier for a five-year review pattern is 20. The three-year review pattern would increase this to 21.26, an initial yield of 4.7%. A five-year pattern was analyzed starting at 5% to show a return of 13% if rents increased at 8.7% and were reviewed every five years. The method of three years' purchase would therefore show a multiplier of 20 for a five-year pattern at 13% and growth at 8.7%. Using the formula: YP = YP 5 years at 13% $x\frac{YP\ perp\ at\ 4\%}{YP\ 5\ years\ at\ 4\%} = 3.52\ x\ \frac{25}{4.45} =$ 19.8. The three years' purchase is useful when comparisons are not perfect in terms of review patterns. The advantage in the method is that the variable which changes, in this case review pattern is the one which is amended. Traditionally, if the review pattern changes, it is the yield which is intuitively amended. This application could be exemplified by Nigerian valuers who follow this property valuation pattern.

To help the reader understand the practical application of dialectic model, Udo (2019) gave an example by assuming a valuation exercise of a block of 6 no. three-bedroom flats located in Uyo. The rent passing on the property is ₦10,800.00 p. a., exclusive of all liabilities except all repairs. Current rental passing on similar properties ₦13,000.00 (gross repairs) and rent passing is due for review two years from now. Five-year rent review is usual for such properties. Expenditure on repairs in the current year is estimated at ₦800.00. A nearly-perfect comparable property was recently sold for ₦230,000.00. This property had an unexpired term of four years at a gross rent of ₦11,500.00 and repair cost of ₦500.00 in the year of sale, assuming that the equated yield for this type of properties is 17.66% and the valuation date was 2019.

The author showed that the dialectic model requires a separate analysis of rent and repairs. As discussed earlier, this is done with two subjective equated yields. Using empirical data from previous analysis (g = 11.43%), growth adjusted yields are as follows:

1. At e = 15%, r = 15% - 11.43% 3.5%
2. At e = 20%, r = 20% - 11.43% = 8.5%

Capitalization of repairs on the comparable property given the following values:

1. Given that e = 15% and t = 5 years; k = 5.5295%, i = 3.9638% and g = 10.6154%
2. Given that e = 20% and t = 5 years; k = 5.4688%, i = 3.6363% and g = 15.7895%

The data is then used to value the subject property

1. When e = 15%, valuation = ₦212,666.00
2. When e = 20%, valuation = ₦228,488.00
3. Conventional valuation using equivalent yield method = ₦225,561.00

The valuations were within 7.44% of each other. Where the properties fully let freehold properties, the variation would have been much less. The issue at this point is not the closeness of the answers but the logic of the models. The researcher noted that the conventional approaches cannot handle imperfect comparable. Assuming that subject which we need to value had an unexpired term of 30 years the following valuations were obtained: conventional valuation – ₦196,988.00, contemporary valuation at e = 15% - ₦121,751.00; e = 20% - ₦125,851.00. The conventional valuation is now out of step with market price while contemporary valuations are within 3.36% of each other.

Baum and Crosby (2012a) further gave an example of arbitrage model using this case study: value the freehold interest in a shop property just let on a 25-year lease with five-year review at its current net rental value of ₦100,000.00 per annum. Using an equated yield of 7.75%, capitalization rate were around five percent. Assume a holding period of 30 years, the growth rate is 3.02%. Adopting the deferred capital yield calculation became$(1 + DCY)^5 = \frac{1}{1-\left(0.05\, x\, \frac{1-(1+0.0775)^{-5}}{0.0775}\right)}$ = 4.59%. The property valuation equally gives a market price of ₦2,000,000.00.

Formulation of Framework

Ekung (2019) showed that a framework is a term which lacks consensus in definition due to the proliferation of views of many authors. However, overarching understanding supports the meaning which suggest that a framework is a highlight of procedures, rules, processes, strategies, guiding principles, and plans of requisite actions to achieving a goal developed using mathematical formulas, graphical representation and diagram as confirmed by Udo (2019). As used in this study, the researcher intends to name them as steps. Based on the goal of this study, framework is acknowledged as a set of steps developed to assist Nigerian valuers to apply the contemporary growth-explicit model, having reviewed its overwhelming benefit against the conventional approach. It pinpoints to a step-by-step procedure for which if the Nigerian valuers follow it, it would enable them to successfully achieve rationality when applying the contemporary growth-explicit models which are supposed to be correlated with market price or within the ±15% margin of error suggested by IVSC (2018). The development of a framework in the study is to achieve rationality among Nigerian valuers, which would be done in procedural steps and the resultant framework would be known as 'Contemporary Growth-Explicit Model Framework' (CGEMF) in a top-down format. Notably, in investment valuation, a framework originates from the premise of a property valuation process as shown by Ajayi (1998). Hence, to enable the formulation of this framework, a framework was adopted from the work of Ogunba (2012) which set a standard for property valuation procedure, no matter whatever valuation model could be applied. The author postulated a number of strategic steps for undertaking property valuations, namely, instruction and terms of reference, adoption of basis and methodology, inspections, variable collection and analysis, application of one or more of the formulas to property value, reconciliation of property value indications and report writing of final estimate of defined property value. From a critique of literature review, the author discussed the following steps, namely, receipt of instruction and terms of reference (property valuation brief), adoption of a property valuation basis and methodology, property valuation and market inspection, data analysis, application of one or more of the approaches to property value, reconciliation of property value indications and report preparation. From this property valuation steps postulated by Ifediora (2005), the researcher adopted step five, step six or stage three respectively and would expand on the application of one or more of the approaches to property value, which in this study is the CGEMF as steps for its formulation.

Research Design

In this study, the research design that was employed to formulate a framework for the application of contemporary growth-explicit model in determining market price of residential properties was the longitudinal type. Using this design type, data adopted from this timeframe of 10-year (2009–2018)

was covered and analysis included inflation indices, rental growth and yield rates, among others. Each of these variables was applied for contemporary growth-explicit models of real value, dialectic and arbitrage models. Using already existing formulas, the market price of each of the property was determined by the valuers based on collected data already established. However, each of the models did not apply all the data at the same time, but from each model, the data required was selected and imputed for results following a specific mathematical process. Noteworthy, these contemporary growth-explicit models were already known by the researcher who acquired them from the original conceptor. The researcher only showed a step-by-step approach to achieve this result, which makes it easier and eliminates fear from its latter application to a valuation practice. Further, the researcher also used the explanatory (research based on explanation of a particular theory, laws or principle), descriptive (research based on describing the fact or data acquired from fieldwork) and applied (research based on the utilization of data in practice) design approaches in achieving his study aim. This involved a detailed study of the subject matter and therefore he related same to practice in accordance with the thoughts of Singh (2000).

The population for this study comprises registered estate valuers located within the south-south geo-political zone of Nigeria. According to the NIESV (2018), there were a total of 2,394 registered estate valuers' firms operating within the study area. Table 1 shows their State allotment.

Table 1: Number of Property Valuers and their State Allotment

State	Number of Valuers	Percentage
Akwa Ibom State	356	14.87
Cross River State	478	19.97
Rivers State	366	15.29
Bayelsa State	279	11.65
Delta State	493	20.59
Edo State	422	17.63
Total	2,394	100.00

Source: NIESV (2017)

Since the researcher was not be able to study the entire population, a sample size of 342 valuers was determined using the Taro Yamane formula - $n = \frac{N}{1+N(e)^2}$, where n = sample size, N = finite population, e = level of significance and I = unity. According to the percentage of their state's allotment shown in Table 2.

Table 2: Sample Size and their State Allotment

State	**Number of Property Valuers**	**Percentage**
Akwa Ibom State	50	14.87
Cross River State	68	19.97
Rivers State	52	15.29
Bayelsa State	40	11.65
Delta State	71	20.59
Edo State	61	17.63
Total	342	100.00

Source: Researcher's Computation (2019)

Using random sampling technique, the choice of each respondent valuer was based on whether he had transacted on the required residential property type – two-bedroom. The rationale for using this property type was because of its preference among investment's choice made it a good reflection of the property market. To gather information on this residential property type, the researcher analyzed records of transactions in these firms undertaken by these valuers and confirmed them with their buyers/sellers. However, the researcher adhered to the 10-year limit, which was between 2009 and 2018 in his collection of data. With this, the choice of the valuer was based on the fact that he needed to have transacted in the property type.

From here, the researcher analyzed not more than two residential properties from each firm. He also established the model that was used to show a property value for comparing the market price. This meant that he assigned all the valuers the task of applying contemporary growth-explicit model that could be used for determining market price. The computation was carried out by the valuers themselves and confirmed using the Microsoft Excel 2016 program. Explaining further, the researcher gave all the Nigerian valuers the problem of valuing a property whose market price was already known and very recent. The question for which he sought to elicit information was related to the reasoning behind the process of valuing the subject property.

Data Presentation and Analysis

Applicability of Contemporary Growth-Explicit Model

The study sought to find out from the valuers the applicability of contemporary growth-explicit models in determining market price. The summary is presented in Table 3.

Table 3: Applicability of Contemporary Growth-Explicit Model

Items	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	336	98.8	98.8	98.8
Not sure	4	1.2	1.2	100.0
Total	**340**	**100.00**	**100.00**	

Source: Researcher's Computation (2020)

Steps to Formulate Framework

The study sought to find out what strategies the valuers would adopt in formulating a framework. The summary is presented in Table 4.

Table 4: Steps to Formulate Framework

Items	Frequency	Percent	Valid Percent	Cumulative Percent
Adaptation from a valuation process	320	94.1	94.1	94.1
No idea	20	5.9	5.9	100.0
Total	**340**	**100.00**	**100.00**	

Source: Researcher's Computation (2020)

To Determine the Most Relevant Contemporary Growth-Explicit Model Appropriate for Application in the Nigerian Property Market

The study sought to determine the appropriate contemporary growth-explicit model appropriate for application in the Nigerian property market. The summary is presented in Table 5.

Table 5: Determination of Model for the Nigerian Property Market

Item	Frequency	Percentage
Understanding of the Land Use Act, 1978 now cap. 202 1990	206	60.59
Property market determinations	72	21.18
Economic forces	62	18.24
None of the above	0	0
Total	**340**	**100**

Source: Researcher's Fieldwork (2020)

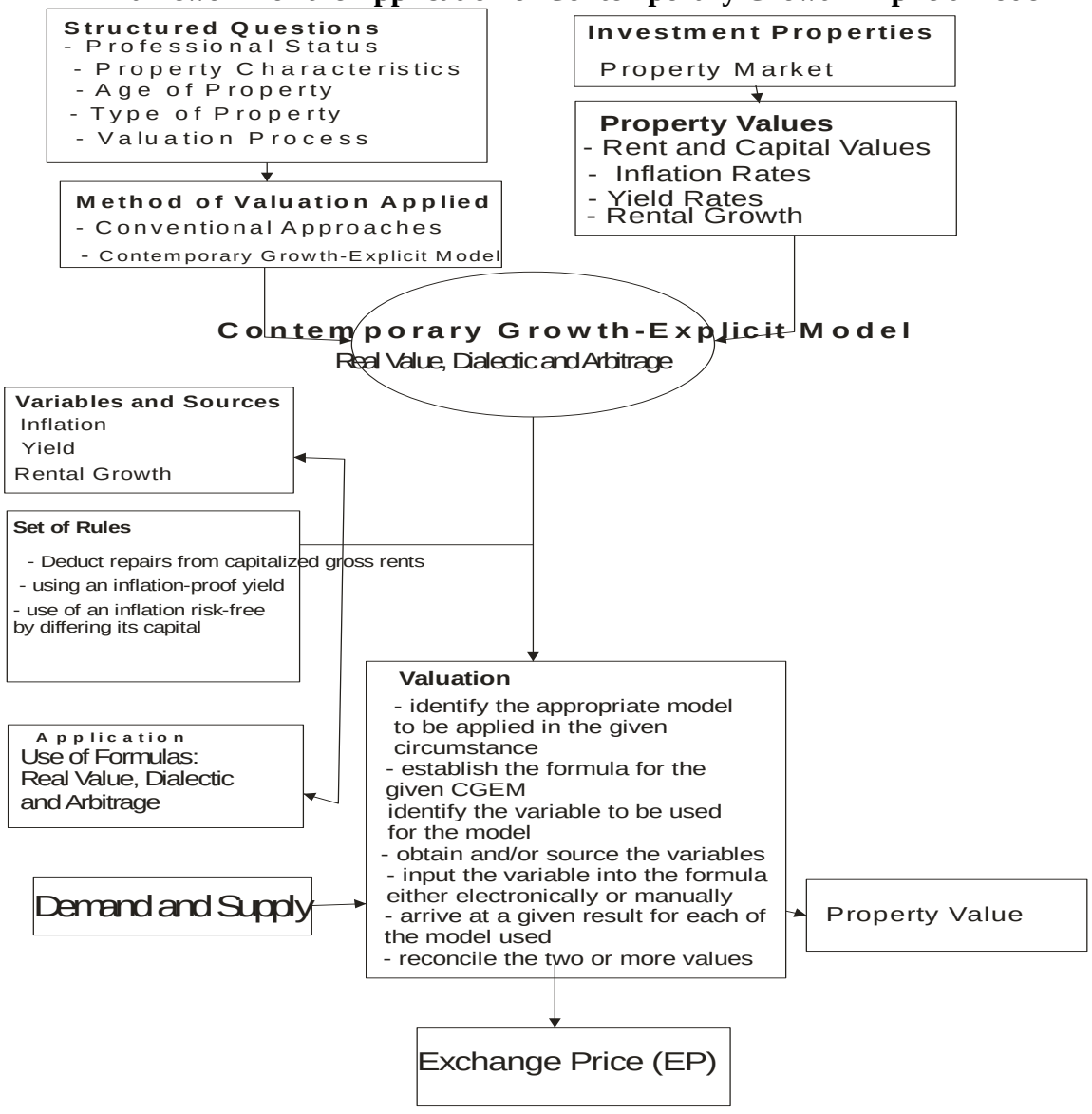
To Examine Valuers' Level of Knowledge of the Formula used in Deriving the Model
The study sought to examine valuers' level of knowledge of the formula used in deriving the model. The summary is presented in Table 6.

Table 6: Examination of Formula used in Deriving the Model

Item	Frequency	Percentage
Understanding the principle behind the model	115	33.82
Determining the logic and assemblage of the model	112	32.94
Abreast with the conventional approaches	113	33.24
None of the above	0	0
Total	340	100

Source: Researcher's Fieldwork (2020)

Framework for the Application of Contemporary Growth-Explicit Model



Discussion of Results

To Determine the Most Relevant Contemporary Growth-Explicit Model Appropriate for Application in the Nigerian Property Market

Numerous alternative models have been proposed for the capitalization of rental income. In this study, three of them were analyzed from literature, namely, real value, dialectic and arbitrage models with particular focus on the Nigerian property market, and valuers were asked to identify the appropriate contemporary growth-explicit models and their formula that they would apply in determining market price of residential properties. With respect to the real value model, they appreciated that it would enable them articulate the inflation free yield, the inflation risk rate per cent and the rent review period, thus they would be applying a model based on inflation-proofed inflation. In terms of the dialectic model, they stated that it would enable them calculate the repair liabilities involved since Nigerian property market is based on landlord and tenant relationship. And lastly, the arbitrage model would help them determine the market price of properties using deferred capital yield rate as shown by Diala and Ogwueleka (2018).

However, identification of these contemporary growth-explicit models where based on understanding of the Land Use Act, 1978 now cap. 202 1990 Laws of Federal Nigeria, as responded by 60.59% of the respondents agreed for which the dialectic model is the most appropriate. This was in line with the thoughts of Udo (2019) who stated that in Nigeria, the provisions of the law in respect to land gives a consensus for rent reviews and renegotiation to the ownership of land after payments known as rents. This allows a leaseholder to have breaks in the lease and subsequent rent reviews. At that point, it is worthy to note that the contemporary growth-explicit models in general are pertinent as the equated yield is derived in such a way to absorb any variables changes that may occur. For the Nigerian property market, an application of the dialectic model is most important as it is based on the provisions of the Land Use Act, 1978 now cap. 202 1990 Laws of Federal Nigeria as stipulated by Ibanga *et al.* (2016).

To Examine Valuers' Level of Knowledge of the Formula Used to Derive the Model

115 (33.82%) respondents agreed that to examine the formula for each model, the valuer should understand the principle behind the model, 112 (32.94%) respondents felt that the valuer should determine the logic and assemblage of the model, while 113 (33.24%) respondents reasoned that the valuer should be abreast with the conventional approaches. The three responses where beneficial for the establishment of the formula for each of the given model since Ogunba (2012) and Kalu (2005) had shown that every model, whether conventional or contemporary, were based on principles. The valuer would need to determine the logic and assemblage of the contemporary model. This he could start by studying how the conventional approaches were built, meaning, from the known to the unknown. In this study, the researcher has adequately dealt with the conventional approaches to show how the contemporary growth-explicit model developed.

To Appraise Valuers' Awareness of the Variables to be Applied in Each of the Given Model

311 (91.47%) respondents appraised that from the formula, they could deduce the variables to be applied, 22 (6.47%) respondents reasoned that it could be ascertained from a discussion from other practicing valuers, while 7 (2.06%) respondents agreed that it could be ascertained from literature. With this statistic, one could reasonably agree that once the valuer could establish the formula, he could ascertain the variables to be applied in each of the given models. Bello and Bello (2009) had earlier postulated that the fundamental reason for which many valuers are not applying the contemporary growth-explicit models is because they do not know the variables to be used for computation. However, Effiong (2011) debugged this idea by saying that the formula speaks for itself. Once there is accuracy in formula establishment, the variables are inbuilt. Hence, all the valuer has to do is to obtain them accordingly (Diala and Ogwueleka, 2016).

To Identify Valuers' Knowledge of Where to Obtain Information on Specific Variables Applied in the Model

114 (33.53%) respondents agreed that they could obtain variables for model application from web and internet pages, 113 (33.24%) respondents agreed that they could source it from property records and records of transactions from firms, among others. In this study, the researcher exemplified his sourcing by adopting data from the Central Bank of Nigeria website and by searching into the property files available in the valuation firms. Much exercise was involved, but was a fruitful one, hence can be replicated by any valuer in need of this application. More so, Udo (2019) suggested that in applying the contemporary growth-explicit model, adequate care should be exercised by the valuer who needs to involve extra effort in accruing the variables. Hopefully, this would help him achieve accuracy, unlike the study of Bello and Bello (2007) who found out that only 1% of valuers apply the conventional approaches since the remaining are afraid of obtaining the data to apply the contemporary growth-explicit models (White, 1995).

To Find Out Valuers' Understanding of How to Apply the Contemporary Growth-Explicit Models and Arrive at A Given result

Application of the contemporary growth-explicit models and arriving at a given result is most important. 170 (50%) respondents each could apply the model either manually or electronically. This is typified in the examples of Crosby (2007) using the real value model, Udo (2019) using the dialectic model and Baum and Crosby (2012a) using arbitrage model. Though these authors computed the contemporary growth-explicit models manually, the researcher confirmed the valuation exercise electronically to determine whether the valuers could be rational in their computations. The result revealed that contemporary growth-explicit models could be applied either manually or electronically by computing the variables step by step.

To Deduce a Value Comparison from the Application of these Contemporary Growth-Explicit Models and Market Prices found in the Nigerian Property Market

All the respondents agreed that values obtained from the application of contemporary growth-explicit models are not at variance with market prices found in the property market. According to Pagourtzi *et al.* (2018), Ashaolu (2016), Ibanga *et al.* (2016), Jefferies (2015), Baum and Crosby (2012a) and Ogunba (2012) by comparing the conventional approaches with these contemporary growth-explicit model, one would observe that both utilize similar analytical framework of separately capitalizing term rent below full property market worth and then, the reversionary rent into perpetuity before discounting at an appropriate yield rate; while conventional calculations only utilize current rent for the distant reversion. Based on rationality, Ogunba (2012) showed that the conventional approaches do not make clear reference to the existence of other investment media competing with the market for investible fund which any rational client would often put into consideration. The contemporary growth-explicit model concentrates on upward rent review without taking cognizance of aging of the income-producing physical developments that could reduce or even neutralize any real growth in rental income, but it recognizes repair liability and even overhauling which are peculiarities in investment valuation. Though White (1995) stated that the major difficulty in applying contemporary growth-explicit model to estimate property market price is that it adds three new variables to the equation of market value, Nigerian valuers in particular are not likely to adopt it. However, with this understanding, it could be presumed that neither of the two sets of models is sufficiently scientific in their consideration of yields, the risks associated with income cash-flow and other fundamental variables that could affect market value such as capital depreciation allowance, allowance for void, etc. Rather evidences pinpoint to the fact that contemporary growth-explicit model are more attune to market prices determination than its conventional counterpart (Diala and Ogwueleka, 2018 and Udo, 2019), and this is the basis of postulation by the researcher.

Conclusion

In conclusion, Nigerian valuers agreed that a valuation process should be adopted, and this was in line with the thoughts of Ogunba (2012) which set a standard for valuation procedure, no matter whatever technique could be applied. The author postulated a number of strategic steps for undertaking valuations, namely, instruction and terms of reference, adoption of basis and methodology,

inspections, variable collection and analysis, application of one or more of the formulas to market value, reconciliation of value indications and report writing of final estimate of defined market value. From a critique of literature review and administered questionnaire on the respondents, the author discussed the following steps for the formulation of framework, namely; identify the appropriate model to be applied in the given circumstance, establish the formula for the given contemporary growth-explicit model, identify the variables to be used for the models, obtain and/or source the variables, input the variables into the formula either manually or electronically, arrive at a given result for each of the model used and apply in the valuation and reconcile the two or more values.

Recommendations

It has been revealed that the application of contemporary growth-explicit models in investment valuation would enable a detailed analysis of client's investment, foster unity among Nigerian valuers and determine market prices of investments rationally, therefore, the researcher recommends the adoption of this framework by the estate management regulatory bodies, namely, NIESV and ESVARBON. This adoption would educate valuers on potential variances that may exist in their application of the models, while using a set of rules to guide their application. Hence, there would be a relationship among the variables used in the construction of each model and would help them compare their values with the market price found in the property market. Most specifically, the dialectic model has been recommended for application when valuing residential properties as investment since it aligns itself according to the provisions of the Land Use Act, 1978 now cap 202 Laws of Federal Nigeria, which is the subsisting land law existing in Nigeria.

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ASSESSMENT OF URBAN VILLAGE SECURITY OF TENURE FOR INCLUSIVE DEVELOPMENT IN NORTH-WEST NIGERIA

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Abstract
Rapid urbanization has led to the proliferation of urban villages with precarious tenure in most cities of North-West Nigeria posing challenges to attainment of development goals such as inclusive development. The study aimed at assessing the security of tenure of urban villages with the intent of identifying strategies that would improve the socio-economic development of these settlements. Objectively, it examined the socio-cultural and economic characteristics of urban villages; the tenurial arrangements existing therein; the impacts of tenurial arrangements on the socio-economic development of urban villages; the level of security of tenure; the relationship between security of tenure and inclusive development in urban villages and the strategies for improving security of tenure and inclusive development in urban villages and the strategies for improving security of tenure in urban villages. The research adopted mixed method using multiple and purposive sampling technique. A sample size of 2093 consisting of household heads and key informants from 20 villages in Kaduna, Sokoto, Kano, Zamfara and Katsina States of North-West Nigeria was utilized. Data was presented using Likert scale. Findings revealed economically active close knit mainly low skilled inhabitants employed in the formal sector with rights to land chiefly through de facto channel. Furthermore, residents of urban villages place a high value on security tenure but their low-income status and lack of titles inhibits access to funds for development from formal institution. Chief amongst the intervention strategies for improving security of tenure include strengthening collaboration between public-private-civil societies, empowering communities (finance and acquisition) and involvement of local organization in policy-making and implementation. The study recommends the adoption of a policy of inclusion that encourages initiatives which creates assets, jobs and enhance skills to improve the livelihood of residents of urban villages.

Introduction

It has been observed that the rapid urbanization in Asia and Africa has led to the proliferation or urban villages which are characterized by insecurity of land tenure. This has posed serious challenges to global development objectives such as “inclusive development”. Therefore, this situation necessitates a need for an immediate assessment. More so, urbanization through complex dynamics tends to irreversibly change everything in its path including customs and lifestyle (Berrisford and MacAuslan, 2017). The creation of this urban spatial phenomenon with its uncertain security of tenure cannot enhance “inclusive development” especially as the teeming population continually mounts more pressure on land utilization. This is because security of tenure which is defined by United Nation Habitat (2012) as “the rights of all individuals and groups to effective protection by the State against forceful eviction” would be tampered. Hence, this situation would not be widely accepted as a precondition for household investment in construction, improvement and development of low-income settlements.

Moreover, fallout of increasing urbanization could be the exacerbation of the gap between urban and rural areas, and thus, causing the increasing outflow of rural residents seeking employments sand better livelihood to nearby cities (Zhao, 2020). These immigrants as a result of shortcomings in housing provision by city authorities face limited possibilities and end up in the proliferation of urban villages. Observably, Nigeria’s urban growth is one of the highest in Africa, and it has been estimated that more than half of its population are living in urban areas such as Lagos, Port Harcourt, Kano, amongst others (Miller, 2014). This urban growth and its subsequent population increase are as a result of rural-urban migration, declining mortality, persistent high fertility and urban natural increase. All these variables and much more play a significant role in accelerating urbanization in Nigeria as shown by Bloch *et al.* (2015). Sadly, this rapid urbanization has led to massive homelessness, growth of slums, social vices and city overcrowding, as well as the phenomenon of urban villages existing in cities.

Meditatively, other countries such as Indonesia, Brazil, Jordan, India, Tunisia, Philippines and China have already devised strategies such as "bottom-up community-based" approach, which involved empowering the local government authorities and agencies for urban development processes (United Nation Habitat, 1999). In Africa, South Africa has floated sustainable livelihood programmes for slum improvements and Egypt has adopted a participatory development strategy aimed at recording some elements of success in the upgrading of settlements (Cities Alliance, 2008). However, in Nigeria, the government has experimented with approaches such as benign neglect, repressive options, resettlement or relocation, slum upgrading and regularization programmes. However, all this programmes have not been sustainable, most not being executed even at the end of the administration. This has raised serious challenges and therefore calls for an assessment. Thus, this study examines urban village's security of tenure with the aim of developing strategies which would improve the socio-cultural and economic status of inhabitants through "inclusive development" strategy.

Notwithstanding the benefits of security of tenure to property right holders, gaps in literature still exist such as those which show an insufficient understanding of what security of tenure actually means to individual households in the urban villages and how security of tenure impacts on the socio-economic development of the villages. Further, the strength and indeed direction of the relationship of security of tenure in urban villages and "inclusive development" has not yet been examined. This has amounted to a gap in the body of knowledge since very few studies, if any, have examined the relationship between security of tenure and "inclusive development" of urban villages. Although, Turok and Visagie (2018) alluded to the fact that there might be a scholarly link between security of tenure and "inclusive development", it could be deduced that the empirical research on this relationship would relatively be scarce and no study of this nature is yet known in the study area. Thus, the urgent need arose to investigate empirically whether security of tenure influences "inclusive development" in urban villages, especially in developing economies like Nigeria.

The aim of this research was to assess the security of tenure of urban villages with the intent of developing strategies that would improve the socio-cultural and economic status of inhabitants through "inclusive development" ideology. The specific objectives were to identify the socio-cultural and economic characteristics of urban village residents in the study area; to examine the tenurial arrangements existing in urban villages of the study area; to determine the tenurial arrangements on the socio-economic development of the urban villages of the study area; to determine the factors affecting security of tenure in the urban villages of the study area; to determine the relationship between security of tenure and "inclusive development" in the urban villages in the study area and to assess intervention strategies for improving security of tenure of residents of urban villages for "inclusive development".

Review of Related Literature

Ikurekong (2007) opined that the basic characteristics of the urban village environment are formed by combining the characteristics of the village and urban environment. Thus, they exhibit a combination of urban and village traits. More so, Chongqing *et al*. (2007) believed the urban villages share some important characteristics with formal settlements which include buildings that violate urban and planning regulations, inadequate infrastructure and service, substandard buildings and populated by averagely literate long-term indigent residents mainly employed in the informal sector. These are further highlighted in the following reviewed articles. Wu (2016) conducted a study on "Housing in Chinese Urban Villages: The Dwellers, Conditions and Tenancy Informality". The study employed survey research design using data from 1,208 questionnaires administered in 20 urban villages from the cities of Beijing, Shanghai and Guangzhou. Data was analyzed using regression analysis. The study revealed that houses in urban villages were more family-oriented, over half of dwellers work in the tertiary sector and although they had relatively stable jobs, few had job security with contracts. For analyses, the dependent variable (whether there is a written agreement or not) was regress over a set of explanatory variables (resident's socio-economic and demographic status, investment in the neighborhood and residential status as rural migrants). On the whole, the analysis of tenancy suggested that for the majority of urban village tenants, their demographic and socio-economic status is irrelevant to tenancy formality. Informality of tenancy is the norm rather than the exception. Hence, along with the increasing length of living in the same village and the increasing age of tenants, the need for a formal contract disappears.

It was observed that the modes of allocation of title and rights to land in any given society is an important indicator of the type, character and organization of that society since rights to land could be held to reflect rights in other areas of public life. Based on this assertion, Payne and Durrand-Lasserve (2012) posited that there are many systems of land tenure as there are societies, which give a great deal of emphasis on communal interest. This would reflect on the forms of tenure which are officially recognized, while those who give priority to the rights of individuals would encourage private tenure systems. Each of these tenure systems has its benefits and drawbacks, but of note is globally there is a decline in the State property in favour of private tenure due to economic activity, accelerated vanishing demographic and market pressures on rural lands, and a reduced adaptation of common property regimes in urban and peri-urban areas. Also, in these areas, several tenure categories may exist within a single settlement and individual household may move from one category to another without moving home (Payne, 2004). The typologies of tenure in urban villages were highlighted in the following articles.

Urban village's developments are particularly found in district centres and near major transportation modes forming many clusters. However, studies have shown that these settlements are separated from the urban areas due to the insecure tenurial arrangement existing therein. Furthermore, the impact of tenurial arrangement on the overall development of urban villages cuts across spatial, social and particularly, on the economic developments. More so, studies had shown that it has a negative impact. These are further illustrated in the following articles reviewed on the impact of tenurial arrangements existing in urban villages on the socio-economic development of the settlements.

A purview of literature revealed that the degree of tenure security provided by any of primary tenure types varies and depended upon a number of factors like system of land governance, policy orientation of governments with regards to social integration and inclusiveness. It was also influenced considerably by the degree of social legitimacy that a tenure system enjoyed with those operating within it. Be it as it may, the factors that affected security of tenure was further elaborated on the following articles.

From literature, it had been observed that security of tenure is recognized as a development priority and one of the human rights at the international level and by many national governments. This is because access to secure an affordable land is a precondition for social and economic development for human dignity. Accordingly, the world development agencies believed that the achievement of security of tenure by the disadvantaged inhabitants of informal settlements such as the urban villages located in the peri-urban areas is a sine qua non for economic development and poverty reduction. This is also because security of tenure was regarded by them as one of the key focal point for international development as echoed in Goal 7 of MDGs, which was aimed at achieving a significant improvement in the lives of at least 100 million slum dwellers by 2020 (United Nation Habitat, 2020). Furthermore, improving security of tenure and property rights for millions of the urban poor is an enormous task that needs to be tackled by all. The main task of the movement for secured tenure is to improve the conditions of people living and often working in major urban centres of the world by promoting security of their residential home. The strategy for achieving this is to advocate and operationalize agreed-upon action plans through inclusive strategic planning and decision-making processes. These assertions are echoed in the articles on the relationship of security of tenure and "inclusive development".

Research Methods

Using data from 2006 housing census, Kaduna, Kano, Katsina, Sokoto and Zamfara States posted figures from housing tenure of 1,115,968; 1,603,335; 1,066,316; 688,648 and 591,446 houses respectively. Since the researcher was not able to study the entire population, a sample size was determined using Taro Yamane formula - $n = \frac{N}{N(e)^2}$, Where n signifies the sample size, N = the population under study, e signifies margin of error/level of significance

The researcher employed Yamane (1967) sample table at ±5% error margin at 95% confidence level for population above 100,000. Hence, the researcher arrived at sample size of 398 and was rounded up to 400 each for the five selected States. This was further spread across evenly among the four selected settlements in each of the State. Thus, a total of 100 questionnaires were

administered in each selected urban village settlements. The 20 urban villages from the five States in the region were selected to provide rich information about issues of central importance to the research. These selected settlements were those found at the periphery on the four geographical points (north, south, east and west) along entry/exit point into selected State capital. Selected urban villages in which the proposed study was carried are shown in Table 1.

Table 1: Selected Urban Villages for the Study

State/Location	Kano	Kaduna	Sokoto	Zamfara	Katsina
North	Panisau	Rigachukun	Arkilla	Gada Biyu	Shinkafi
South	Ungwan Uku	Gonin Gora	Denge	Damba	Dan Dagoro
East	Dorayi	Dan Bushiya	Gawan Nama	Janyau	Kambarawa
West	Panshekara	Rigasa	Dundaye	Ungwan Gwaza	Babbar Ruga

Source: Researcher's Compilation (2020)

The research adopted a multi-staged or cluster sampling technique in obtaining information from heads of households and purposive sampling method for village heads and informants. The multi-staged technique was adopted because of its flexibility and suitability where the frame is not sufficiently detailed or reliable for under-developed areas such as of urban villages. Another vital reason for selection of the technique was that it permitted the fieldwork to be concentrated and yet a large area was covered. The urban villages were first divided into clusters consisting of district wards (Ungwa). The second stage division gave rise to streets (Layi). The last stage involved the households in the selected streets. The questionnaire was answered by heads of households. The selected urban villages shared a number of similarities which included high concentration of urban poverty, critical shortages of infrastructure and services, large-scale informal urbanization, kaleidoscope of tenure types with insecure right and they had little or no industry and other important employment sources in locations away from the urban centres.

Methods of Presentation

Quantitative data gathered through questionnaire was presented using Likert scale

Analyzing data using Likert Scale, the key and their values were as SA – Strongly Agreed (5), A – Agree (4), N – Neutral (3), D – Disagree (2) and SD – Strongly Disagree (1). Computation of mean using weighted average formula was given as $Mean = \frac{\sum fx}{\sum x}$.

Data Presentation and Analysis

Residency Classification of Household Heads

The residency status, being an indigene or a settler determine to a large extent determine the opportunities and tenure arrangements that could be enjoyed by household heads in urban villages. Literature attests to the fact that, urban villages are a safe haven to new immigrants seeking for better life opportunities in the cities. Thus, the study seeks to determine the proportion of immigrants/settlers in the urban villages. Responses to residency status by respondents are shown in Table 2.

Table 2: Status of Residence of Household Heads in Urban Villages

States	Settlements	Indigene	Settlers	Total
Kaduna	Rigachukun	64	32	96
	Gonin Gora	19	78	97
	Dan Bushiya	69	25	94
	Rigasa	48	46	94
Kano	Panisau	58	30	88
	Ungwan Uku	58	34	92
	Dorayi	41	50	91
	Panshekara	52	43	95
Sokoto	Arkilla village	56	35	91
	Denge	31	43	74
	Gawan Nama	68	21	89
	Dundaye	40	43	83
Zamfara	Gada Biyu	12	83	95
	Damba	85	12	97
	Janyau	57	40	97
	Ungwan Gwaza	54	39	93
Katsina	Shinkafi	36	46	82
	Dan Dagoro	47	39	86
	Kambarawa	51	39	90
	Babbar Ruga	26	46	72
	Total	**972 (54%)**	**824 (46%)**	**1796 (100%)**

Source: Researcher's Computation (2020)

Mode of Property Acquisition in Urban Villages

The Act being the overarching law on land, chronicles the rules and principles of land ownership in Nigeria but, it has only a passive recognition for the oral based and court-codified customary tenure (Tagliarino *et al*., 2018). Household heads were asked question on how they acquired their property to determine the most used and convenient channel of acquisition for inhabitants of urban villages and the responses are presented in Table 3.

Table 3: Mode of Property Acquisition by Household Heads

States	Settlements	Customary Allocation	Statutory Allocation	Inheritance	Purchase	Pledge/ Foreclosure	Gift	Total
Kaduna	Rigachukun	3	3	46	44	-	-	96
	Gonin Gora	9	-	18	70	-	-	97
	Dan Bushiya	37	24	11	22	-	-	94
	Rigasa	13	4	23	42	7	15	94
Kano	Panisau	25	-	30	28	-	5	88
	Ungwan Uku	15	-	26	44	-	7	92
	Dorayi	13	-	42	36	-	-	91
	Panshekara	2	-	52	41	-	-	95
Sokoto	Arkilla village	21	6	51	13	-	-	91
	Denge	9	2	26	30	-	7	74
	Gawan Nama	12	12	52	12	-	1	89
	Dundaye	9	7	36	28	3	-	83

Zamfara	Gada Biyu	41	9	32	10	-	3	95
	Damba	5	12	75	-	-	5	97
	Janyau	25	9	35	15	4	9	97
	Ungwan Gwaza	7	-	56	30	-	-	93
Katsina	Shinkafi	29	12	31	10	-	-	82
	Dan Dagoro	25	7	31	10	7	6	86
	Kambarawa	7	-	53	30	-	-	90
	Babbar Ruga	14	9	26	23	-	-	72
	Total	**320 (18%)**	**116 (6%)**	**753 (42%)**	**538 (30%)**	**21 (1%)**	**48 (3%)**	**1796 (100%)**

Source: Researcher's Computation (2020)

The type of ownership right and mode of acquiring statutory property rights in Table 4.

Table 4: Type of Ownership Right and Mode of Acquiring Statutory Property Rights

		Types of Ownership Right			Mode of Acquisition of Right				
States	**Settlements**	**Statutory Right of Occupancy**	**Customary Right of Occupancy**	**Total**	**Government Allocation**	**Purchase**	**Inheritance**	**Others**	**Total**
Kaduna	Rigachukun	3	-	3	-	-	-	-	3
	Gonin Gora	-	-	-	-	-	-	-	-
	Dan	21	3	24	24	-	-	-	24
	Bushiya Rigasa	2	2	4	3	-	-	1	4
Kano	Panisau	-	-	-	-	-	-	-	-
	Ungwan	-	-	-	-	-	-	-	-
	Uku	-	-	-	-	-	-	-	-
	Dorayi Panshekara	-	-	-	-	-	-	-	-
Sokoto	Arkilla	2	4	6	-	6	-	-	6
	village	-	2	2	-	2	-	-	2
	Denge	8	4	12	-	12	-	-	12
	Gawan Nama Dundaye	1	6	7	5	2	-	-	7
Zamfara	Gada Biyu	-	9	9	3	-	6	-	9
	Damba	-	12	12	7	5	-	1	12
	Janyau	-	9	9	8	1	-	-	9
	Ungwan Gwaza	-	-	-	-	-	-	-	-
Katsina	Shinkafi	4	8	12	8	2	2	-	12
	Dan	-	7	7	1	6	-	-	7
	Dagoro	-	-	-	-	-	-	-	-
	Kambarawa Babbar Ruga	2	7	9	-	2	2	5	9
	Total	**43 (37%)**	**73 (63%)**	**116 100%**	**62 (53%)**	**38 (33%)**	**10 (9%)**	**6 (5%)**	**116 100%**

Source: Researcher's Computation (2020)

Legal Title/Document Possessed by Respondents

Tenure security is strengthened by the possession of a property title which most of inhabitants of informal settlements do not possess. Household heads were asked to indicate the type of title/document that they possess which supports their ownership claim and their answers are shown in Table 5.

Table 5: Title Documents Possessed by Head of Households

States	Settlements	Certificate of Occupancy	Sales/Deed of Agreement	Agreement Certified by Community Head	Tenancy Agreement of R of O	No Document	Total
Kaduna	Rigachukun	13	6	75	2	-	96
	Gonin Gora	27	3	49	17	1	97
	Dan Bushiya	-	-	54	17	23	94
	Rigasa	36	2	26	17	13	94
Kano	Panisau	3	9	75	-	1	88
	Ungwan Uku	33	11	46	-	2	92
	Dorayi	3	-	87	-	1	91
	Panshekara	1	1	93	-	-	95
Sokoto	Arkilla village	13	15	63	-	-	91
	Denge	11	63	-	-	-	74
	Gawan Nama	31	28	22	4	4	89
	Dundaye	46	3	9	11	14	83
Zamfara	Gada Biyu	-	23	65	7	-	95
	Damba	53	16	18	2	8	97
	Janyau	27	5	35	22	8	97
	Ungwan Gwaza	-	-	93	-	-	93
Katsina	Shinkafi	5	20	38	19	-	82
	Dan Dagoro	6	13	58	9	-	86
	Kambarawa	6	20	45	4	15	90
	Babbar Ruga	21	22	19	5	5	72
		335 (19%)	**260 (14%)**	**970 (54%)**	**136 (8%)**	**95 (5%)**	**1796 (100%)**

Source: Researcher's Computation (2020)

Tenability of Proof of Ownership in Court

Inhabitants of urban villages were comfortable with the present de facto recognition of their rights to land which had been arranged at a considerably cost lower than the contemporary formal land title registrations being imposed on them as shown in Table 6.

Table 6: Tenability of Proof of Ownership

States	Settlements	Yes	No	Total
Kaduna	Rigachukun	96	-	96
	Gonin Gora	97	-	97
	Dan Bushiya	93	1	94
	Rigasa	56	38	94
Kano	Panisau	86	2	88
	Ungwan Uku	90	2	92
	Dorayi	91	-	91
	Panshekara	95	-	95
Sokoto	Arkilla village	34	57	91
	Denge	3	71	74
	Gawan Nama	53	36	89
	Dundaye	39	44	83
Zamfara	Gada Biyu	51	44	95
	Damba	23	74	97
	Janyau	73	24	97
	Ungwan Gwaza	27	66	93

Katsina	Shinkafi	73	9	82
	Dan Dagoro	25	61	86
	Kambarawa	63	27	90
	Babbar Ruga	49	23	72
	Total	**1219 (63%)**	**577 (32%)**	**1796 (100%)**

Source: Researcher's Computation (2020)

Factors Affecting Security of Tenure in Urban Villages

The study sought to find out the factors that affects security of tenure in urban villages. Table 7 presents information on the factors that affects security of tenure in urban villages.

Table 7: Factors Affecting Security of Tenure in Urban Villages

States	Settlements	Provisions of Land Use Act	Activities of Land Speculators	Unfavorable Land markets	Expropriatory Acts of Government	High Cost of Land	Total
Kaduna	Rigachukun	23	-	6	67	-	96
	Gonin Gora	86	-	4	2	5	97
	Dan Bushiya	25	-	-	20	49	94
	Rigasa	34	10	23	20	7	94
Kano	Panisau	38	-	3	44	3	88
	Ungwan Uku	41	-	2	49	-	92
	Dorayi	33	-	-	57	1	91
	Panshekara	41	-	5	49	-	95
Sokoto	Arkilla village	69	-	9	11	2	91
	Denge	17	-	55	-	2	74
	Gawan Nama	36	5	23	17	8	89
	Dundaye	37	-	31	10	5	83
Zamfara	Gada Biyu	43	-	1	15	36	95
	Damba	43	-	4	25	25	97
	Janyau	34	1	13	38	11	97
	Ungwan Gwaza	47	7	10	29	-	93
Katsina	Shinkafi	27	4	17	32	2	82
	Dan Dagoro	42	5	9	30	-	86
	Kambarawa	43	8	10	29	-	90
	Babbar Ruga	29	11	15	17	-	72
		788 (44%)	**51 (3%)**	**240 (13%)**	**561 (31%)**	**156 (9%)**	**1796 (100%)**

Source: Researcher's Computation (2020)

Results and Discussion

To identify the Socio-Cultural and Economic Characteristics of Urban Village Residents in the Study Area

This study revealed that, male headed household dominated by a very wide margin female household as a result of authoritative positions such as household headship, land matters and other matters being regarded as the exclusive preserve for men. This is in line with earlier studies highlighting the dominance of males at the helm of affairs in our societies (Ikurekong, 2007; Aluko, 2011; Amao, 2012 and Olajide, 2015). The study reveals an economically active population of household heads with the predominance of middle-aged adults heading houses in urban villages with 88 percent members between the ages of 20-60 years and supports earlier studies such as Amao (2012). Furthermore, the ethnic groups that dominated in the survey sample are the Hausa Fulani ethnic group while other household heads are a varied mix of ethnicities from across the different region of Nigeria. The study also revealed that inhabitants of urban villages have average literacy level with majority of the respondents being able to communicate effectively with the researcher in English, pidgin and Hausa languages. As a result, a high number of respondents representing 88% were educated enough to responding to the items on the questionnaire without aid. Furthermore, in

line with previous studies (Aluko, 2011) the research revealed that the informal sector serves as the main employer of active labor in north-west part of the country as they provide employment to 89% of the populace in urban villages. However, most of the sampled population are particularly, employed in retail and business/trading enterprises. This information contradicts the notion that the agricultural sector is the largest employer in the country particularly in the north because it accounts for only 26% while, business/trading accounts for the majority which is 34%. The majority of the household heads are low income earners, in line with findings of Changqing *et al.* (2007) as the majority of the respondents are earn ₦50,000 and below.

To Examine the Tenurial Arrangements Existing in Urban Villages of the Study Area

Findings from the study revealed that most settlers in urban villages are first generation migrants with most households belonging to the lower income groups, and they work as wage laborers in construction, transportation, privately owned small-scale industries, and in informal enterprises. Furthermore, the commonest form of property acquisition is by inheritance, as 42% of household heads indicated that this was the channel through which they achieved access to ownership of their property. This finding supports findings of Eboiyehi and Akinyemi (2016). After acquisition, purchase is the next commonest form of property acquisition in urban villages, as 30% of the respondents affirmed it as the channel used to acquire ownership rights to land. The dominance of access to land through the customary channel is in line with previous findings of Tagliarino *et al.* (2018). The study also disclosed that the most common document possessed by household heads as document supporting their ownership is the agreement certified by community head. This is because most of the respondents simply do not see the importance of legal title as they have a high perception of security of tenure. For most of the household heads, just like evidenced from earlier studies (Ikejiofor, 2017 and Chimhowu, 2019) land transactions takes place by the buyer and the seller consulting with the local village head, who witnesses the transaction and issues his "paper", which he signs and stands as the approval of the sale in return for a payment or token. This local approval is then taken to the next chiefdom level, the district head, who also adds his seal of approval to the transaction, and again takes a small commission.

The study further reveals that, the dominant property right available to household heads is the rights to inherit property from relatives with about 43% of household heads while the right to occupy accounts for 36% of the population of study. Not surprisingly the right to disposal of property is negligible as only 3% of household heads claim to have such right. This is because of the embargo on the disposal of customary land. Household heads are very confident of their rights as majority of the respondents representing 79% of the respondents claim to possess the highest rights possible, the right to be compensated in the event of compulsory acquisition. About 10% of household heads accounting for 10% claim to have the right to exclusive occupation while the least right claimed by the study population is the statutory right to alienate. This is because of the laborious bureaucracy involved in getting the governor consent as stipulated in the Act.

To Determine the Impact of Existing Tenurial Arrangements on the Socio-Economic Development of Urban Villages of the Study Area

The analysis of data revealed that only 14% of household heads affirmed to the use of their property to secure funding. This is largely due to customary restriction on the sales and use of communal/family property as collateral for accessing credit facilities and limited access to formal (banking) credit source. Household that used their property to access credit stated that, the most preferred credit source is that of friends and relatives which accounts for 69% of the total respondents of the study. This supports assertions of Ali *et al.* (2016) on the use of informal credit sources of finance by low income households. About 14% of the respondents of the study reported that sourcing for credit from thrift societies as their preferable source of credit facilities. Loans from corporate bodies such as banks accounts for only 9% of the sampled household heads.

To Determine the Factors Affecting Security of Tenure in the Urban Villages of the Study Area

Surprisingly, the findings of this study revealed that the law that is supposed to guide, manage and control land for the benefits of all Nigerians including the inhabitants of urban villages, is the same law that its provisions are regarded by 44% of household heads as the key factor that affects

security of tenure in urban villages. Expropriatory acts by governments where villages‟ agricultural and surrounding lands are converted for urban use accounts for 31% of the study respondents. The activities of land speculators is not a major factor that affects security of tenure as only 3% of household heads regarded it as a factor that affects security of tenure. As stated by a key informant, the provisions on ownership and control is in the hands of the governor of States, the need for consent from the governor on alienation and other land transactions like mortgages and compulsory acquisition are their major concerns especially with the flagrant abuse of these provisions by the political class. These discoveries align with critical literatures on factors affecting security of tenure (Zhang, 2020) Also, inhabitants of urban villages have a high perception of their security of tenure as high and very high perception of security having responses of 57% and 17% of household heads respectively which cumulatively accounts for 74% of the population of study. Only 2% and 3% claimed to have very low and low perception of security of tenure in urban villages. The high level of security of tenure is shown with numerical scores from 6-10 accounts for 85.5% of the population of study. This assertion proves that security of tenure is about the perception i.e. how the inhabitants of urban villages feel about their rights to property irrespective of having title to the property or not and it also proves the efficacy of customary laws and the efficiency of the enforcement mechanisms of the customary land tenure system.

To Determine the Relationship between Security of Tenure and Inclusive Development in the Urban Villages in the Study Area

The findings of this research reveal that majority of the household heads, about 70% reported that the security of tenure does not make any meaningful contribution towards community development and supports Nagpal (2018)'s findings of secured rights not being associated with higher investment in housing and environment. On the other hand, 39% of responding head of household affirmed that security of tenure had contributed towards community development. Furthermore, only 40% of the population of study affirmed that they made provisions for setbacks, while 60% of the household heads denied making provision for setbacks. Surprisingly, the reverse is the case for right of way as 73% of household heads claimed to have made provision for right of way, while only 27% said they had not made provision for right of way. Findings from the study contradict earlier studies on provisions made for right of way but affirmed findings made as regarding setbacks.

Household heads affirm access to infrastructural facilities, government policies, educational facilities and health facilities as 73%, 57%, 55% and 68% of household heads affirm access to them respectively. On the other hand, only 38% household heads claim that they had access to job opportunities, while the majority of household, about 62% of them denied having access to job opportunities. Conclusions about access to infrastructure, education and health facilities are inconsistent with previous studies (Olajide, 2013 and Udoudoh and Ofem, 2016) and may be due to a variety of factors, such as their rural existence, their satisfaction with basic facilities and social amenities, and the rise of private informal provision of facilities such as education and health facilities. Majority of the population of study claim that measures taken by government in urban villages includes provision of basic services and amenities, infrastructural facilities, registration/records of village population and voters roll as seen by household heads frequency figures of 1,130, 1,243, 1,079 and 1,092 accounting for 63%, 69%, 60% and 60% respectively. As gleaned by the interaction with a key informant, who stated that, though these measures are in place, the problem is with the functionality and adequacy of these measures which leaves much to be desired.

To Assess Intervention Strategies for Improving Security of Tenure of Resident of Urban Villages for Inclusive Development

Majority of the settlements accepts that creating an inclusive framework to foster enterprises as a strategy for improving security of tenure for inclusive development. 11 of the urban villages believe that public-private-civil partnership as an important strategy that may ensure inclusive development in urban villages. Consequently, this overall strategy is deemed as a likely strategy that will improve security of tenure in urban villages. Also, the strategy of empowering communities through skills acquisition and financially has a high level of acceptability as it is accepted by responding household heads in 16 urban villages. Result also shows that involvement of local organization in policy making and implementation is the most acceptable strategy selected by

household heads in urban villages as the strategy is accepted by population of study of 19 urban villages. Also, the strategy of fostering affordable housing as a tool for improving security of tenure has a very high acceptability as it is accepted by the study population in 18 urban villages. These findings support previous studies such Singh (2018).

Recommendations

The residents of urban villages are economically active close-knit residents that are majorly low skilled and employed in the informal sector. Thus, the government should adopt of a policy of inclusion that encourages initiatives which will create assets, jobs and enhance skills to improve the livelihood of residents of urban villages at different levels, within communities, cities and regions. This is expected to mobilize the energy and talents of inhabitants of urban villages in order to bring about inclusive development of urban villages and adjoining cities at large. Doing this has become pertinent because the residents of urban villages are growing impatient with the social progress and the pertinacious skewed distribution of wealth, opportunities and development which could manifest in to extreme political rhetoric about change as seen in the orange revolution.

The residents of urban villages place a high value on security of tenure and thus policy makers need to accept urban villages and adopt inclusive development strategies instead of the aggressive demolition redevelopment programmes which replaces them with formal neighbourhoods as this will reduce inequality and exclusion of inhabitants of these urban villages as well as the uncertainties brought by insecurity of tenure which is detrimental to investment in property. Most especially as urban lands become increasingly scarce and expensive, the potentials of urban villages have grown and its revitalization has become imperative and popular. The stakes are high and rising because of the fragile state of the economy (low oil revenue, COVID-19, rising budget deficit, escalating government debt, slowdown in growth), political malaise and policy paralysis.

More also, underlying factors for inclusive development such as skills and community development, employment opportunities and availability of infrastructural and social amenities suggest the need for government to adopt a policy of inclusion as an important requirement for meeting the need of inhabitants of urban villages and in creating safer and sustainable urban centers. Identified intervention Strategies for improving security of tenure in urban village such as empowering communities (finance and skills acquisition), strengthening collaboration between public-private-civil societies and involvement of local organizations in policy making and implementation needs to effected by the government. The implementation of these strategies would enhance inclusive development in urban villages in line with United Nation Habitat's sustainable development goal of making cities more inclusive, safe, resilient and sustainable.

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COST OPTIMIZATION STRATEGIES AT PROJECT PHASES AND PUBLIC PROJECTS' COST PERFORMANCE IN SOUTH-SOUTH, NIGERIA

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Abstract
Cost overruns in building construction projects has been a major challenge to stakeholders. Managing cost of public building projects at all phases of construction projects is important to achieve overall success of the projects. This paper assessed the cost performance of public building projects in south-south, Nigeria, it established effective cost optimization strategies at different phases for enhancing cost performance and determined the relationship between the two with a view to optimising cost performance in the study area. The research methodology was through literature review and questionnaire for data collection. Data collected were analysed using mean score, simple percentages and ordinal logistic regression. Findings revealed that 64.69% of completed projects reviewed had poor cost performance indicating poor cost performance of public building projects in the study area. Thirteen cost optimization strategies which had their Wald's statistics significant at p-value ≤ 0.25 were selected out of the thirty-eight initially imputed into the model. It is therefore concluded that adequate attention and priority have not been given to the cost optimization strategies at the various phases of public building projects in the study area. The study recommends that construction practitioners should take note of identified significant cost optimization strategies in order to optimise cost and improve public project delivery in the study area.
Keywords*: Cost optimization Strategies, Cost Performance, South-South, Nigeria*

1.0 Introduction

The importance of the construction industry in the economic growth and development of any nation cannot be overemphasised. The sector plays a vital role in the social and economic development of a nation as well as its urban and rural development. According to Muhamid (2021), the construction industry is a conglomeration of diverse fields and participants that have been loosely lumped together as a sector of the economy, and plays a vital role in national welfare and development of residential housing, office buildings, industrial plants and the restoration of a country's infrastructure and other public facilities. In the same vein, Oynaka (2020) stressed on the importance of the construction industry as it contributes significantly to the overall GDP of a country and improves the quality of life by providing the necessary infrastructure such as roads, hospitals, schools and other basic facilities. The construction sector worldwide plays an important role in driving economic growth and development.

According to Oburu (2020), a project is defined as a temporary endeavor or undertaking aimed at creating a unique product, service, or result. Specifically, a construction project is a temporal endeavor that involves a series of planned activities that consume resources, aimed to produce specific construction deliverables, within constraints like time, quality and cost for economic, social and environmental fulfilment of human needs.

Construction projects as resource consuming activities are deemed successful when completed on schedule, within budget and at a standard of quality that exceeds the owner's expectations (Waziri, 2012). Thus, it is imperative to systematically manage construction projects by providing adequate cost optimisation strategies at various phases of building projects. The successful management of cost of public building projects is important in order to achieve overall success of the project. Construction projects are often intricate and involving several phases, each with distinct challenges that can significantly impact cost performance. Every construction project owner's desire is to see their project through successful completion. According to Sa'ad (2011) construction projects comprises of different phases also known as life cycles that start with a concept and end with utilization.

Cost overrun of public building projects is on the increase and this is a common problem globally. This can be attested to, based on previous works by various authors. For instance, the Humber bridge in the United Kingdom had a cost overrun of 175% (Flyvbjerg *et al*., 2003). This situation is not different in Nigeria as construction projects are generally characterised by cost and time overruns which ultimately leads to disputes, substandard work and abandonment (Ogunsemi and

Aje 2020). Adu and Akpan (2016) opined that the ongoing trend of poor cost performance of construction project is a worrisome problem that needs to be tackled. Cost performance is basically measured by comparing the final contract sum against the initial contract sum (Aghimien and Awodele, 2017). Azhar *et al*. (2008) stated that while cost overrun is a serious problem in both developed and developing countries, the pattern is more severe in developing countries where cost overruns sometimes exceeds 100%. This is buttressed by Oluyemi-Ayibiowu *et al*. (2019) who acclaimed that in Nigeria, cost overruns are a frequent problem in public building projects and can have several detrimental consequences such as project delays, abandonment and poor-quality construction if cost optimization strategies are not adopted. Rajguru and Mahatme (2016) defined cost optimisation as "the process of optimising the expenses of cost in a project, from the starting of client's idea to the completion and final payment on site". Cost optimization of building projects is not necessarily about the techniques that are adopted to reduce cost but rather the proper and efficient management of these techniques to enhance cost performance. The importance of cost optimization strategies in the overall performance of building projects cannot be overemphasised as it ensures that resources are utilised efficiently and effectively throughout the planning, design, procurement and construction phases of building projects. According to Asada *et al*. (2023), cost optimization strategies focus on maximising the value of project investments by minimizing expenses while maintaining or enhancing project quality, cost and overall performance.

Cost performance of public building projects in South-South, Nigeria is an important aspect that requires attention in order to improve the efficiency and effectiveness of public building projects in the area. Poor cost performance of public building projects often times have negative impacts such as delay in project completion as well as reduced quality of the finished product. It is imperative therefore to put in place adequate cost optimization strategies at the planning, design, procurement and construction phases of building projects in order to enhance cost performance. Previous studies have reviewed factors affecting cost performance of building projects, causes of cost overruns in building projects and cost control measures for improving cost performance. However, literature is scarce of holistic review of the effects of cost optimization strategies at different phases on cost performance and the existing relationship between the two variables. This study filled the existing gap in knowledge by assessing and identifying effective cost optimization strategies at the planning, design, procurement and construction phases as well as overall cost performance and thereafter established the relationship that exists between cost optimization strategies and cost performance of public building projects in the study area. The call for improved cost performance in the south-south zone of Nigeria necessitated the need for this study in the area. The study was aimed at establishing effective cost optimization strategies at different phases of building projects with a view to improving cost performance in the study area. The specific objectives are; (i). to establish effective cost optimization strategies at different phases in the study area. (ii). to assess the cost performance of public building projects in the study area and (iii). to determine the relationship between cost optimization strategies and cost performance of public building projects in the study area.

2.**0 Literature Review**

Cost is one of the most crucial factors to be taken into account throughout the construction project life cycle and it is also one of the key performance indicators for project success (Odediran and Windapo, 2014). Effective cost optimization strategies adopted at all phases of building projects is a fundamental element in successful project delivery. According to Kerzner (2017), cost optimization strategies acts as a proactive strategy in ensuring that project expenses remain within stipulated budget while minimizing the possibility of cost overruns. Cost performance is a measure of how well general conditions encourage the completion of a construction project within the expected budget by comparing the current costs allocated for work against budgeted costs (Vyas and Kulkami, 2013). Construction projects are resource consuming activities that translates into large sums of money and this makes it necessary to adopt effective cost optimisation strategies at the planning, design, procurement and construction phases of building projects in order to enhance cost performance. Azis *et al.* (2012) opined that one of the most important factors in any construction project's success is completing the project within the estimated cost. Regrettably, the construction industry is faced with the problem of cost overruns globally. In Nigeria, the tendency of cost overruns is more noticeable with cost overruns exceeding 100% of the projects' original budget (Obianyo *et al.,* 2022). Cost

overrun is the difference between the final contract sum and the initial contract sum and is basically the most significant factor that affects the entire project success. Previous studies revealed that the problem of cost overruns is one of the fundamental issues in the construction industry and generates researchers interest in determining the root causes as well as providing the necessary measures in avoiding or minimizing such occurrence of cost overruns (Inuwa, 2014, Abdulkadir *et al*., 2017 Obianyo *et al*., 2022). Oyewobi *et al*. (2018) stressed on the need for construction costs to be controlled right from the planning phase as this will guarantee cost-saving opportunities without compromising project quality which leads to better cost performance. Shar *et al*. (2023) opined that carrying out adequate cost optimization strategies has a significant effect on cost performance, consequently reducing risk and improving performance. Cost optimization strategies at the planning phase include target costing, value engineering, life cycle costing, risk management and adequate cost planning (Cunningham, 2015, Garimella, 2018, Opatunji, 2018 and Karn and Dahal, 2021). At the design phase, cost optimization strategies include activity-based-costing, adopting a proactive approach, adopting passive design strategies, risk-based estimating (Rahman *et al*., 2012, Hafex *et al*., 2016, 2015, Opatunji, 2018, Ekung, 2019), Fulse and Zoleka, 2021. Cost optimization strategies adopted at the procurement phase are selecting adequate procurement options, optimise project selection, implement cost effective competitive processes, selecting competent contractors (Cunningham, 2015, Garrimella, 2018 and Ekung, 2019), while cost optimization strategies adopted at the construction phases include material management, adequate cost reduction techniques, replacing conventional materials with alternative materials, value engineering, using locally soured affordable materials (Ekung, 2019, Karn and Dahal, 2021, Fulse and Zoleka, 2021).

3.0 **Methodology**

The study adopted a quantitative research design based on the set objectives through the administration of well-structured questionnaire. The sample was drawn from construction professionals who are registered with their professional bodies such a Quantity Surveyors, Architect, Builders and Engineers in the study area. The instrument was tested for reliability and validity and found to be of high level with Cronbach α of 0.83 for 38 items on cost optimization strategies indicating that the items had good internal consistency and were reliable. Out of the 741 copies of questionnaire administered on the sampled study population through simple random sampling, 546 were correctly completed and returned. The respondents were asked to rank the effect of each of the cost optimization strategies at different phases on cost performance on a Likert scale from very high effect (5), high effect (4), moderate effect (3), low effect (2) and very low effect (1). Similarly, respondents were asked to provide the initial and final contract sums of completed public building projects they handled covering the period of ten years (2012-2022). Percentage cost overrun was determined from the difference between the final contract sum and initial contract sum of 546 completed public building projects in order to arrive at the cost performance of building projects in the study area. Data collected were analysed using Mean Score, simple percentages and Ordinal Logistic Regression (OLR). Mean score was used to assess the most effective cost optimization strategies at different phases on cost performance, simple percentage was used to analyse the cost performance of building projects and ordinal logistic regression was used to determine the relationship that exists between cost optimization strategies and cost performance of public building projects.

The Mean core formula is given by

$$MS = \frac{5N5+4N4+3N3+2N2+1N}{n} \qquad \text{Equation 1}$$

Using a five-point Likert scale as follows:

5 = very high effect, 4 = high effect, 3 = moderate effect, 4 = low effect and 5 = very low effect.

Where N = no of respondent to a particular scale

N = total number of respondents

The basis of ranking the significance of factors using the Mean Score is based on the fact that the variables are classified as "Effective" (significant) variables that have mean scores higher than 4.0, those with 4.0-3.0 mean scores were classified as "Moderately effective", while those with mean score less than 3.0 were classified as "Not effective" as adapted by Ejohwomu, *et al*., (2016), Ekanem (2019) and Ujene and Inyang (2020).

The dependent variable used in this study is cost performance. Cost performance is an outcome of the effectiveness of cost optimization strategies because it measures the extent to which cost optimization strategies have achieved the aim of enhancing cost performance. Cost performance was originally measured on a continuous scale using percentage cost deviations which were then categorized into five classes as 5 = 0% - 20% (very good cost performance), 4 = 21% - 40% (good cost performance), 3 = 41% – 60% (moderate cost performance), 2 = 61% - 80% (poor cost performance) and 1 = 81% - 100% (very poor cost performance. This method of classification was also adopted by Sesay *et al*. (2021). The categorization was done in order to enable the use of OLR for the analysis since OLR is used to measure the relationship between a categorical dependent variable and one or more independent variables. OLR (proportional odds model) was used to model the data. It determines the probability of an observation fall into a specific category when there are two or mor ordered levels of the response variable. The ordinal response variable has three or more distinct levels increasing in magnitude. This can be seen in Equation 2, 3 and 4.

$$\log\left(\frac{p1}{1+p1}\right) = \alpha_k + \beta`X \qquad \text{Equation 2}$$

$$\log\left(\frac{p1+p2}{1-p1-p2}\right) = \alpha_k + \beta`X \qquad \text{Equation 3}$$

$$\log\left(\frac{p1+p2+\cdots.+pk}{1-p1-p2-pk}\right) = \alpha_k + \beta`X \qquad \text{Equation 4}$$

The regression coefficients are assumed to be the same for all logits in ordinal logistic regression and the null hypothesis states that the coefficients of the variables are the same across all response categories. The test of parallelism checks the assumption that regression coefficients are the same for all logits in OLR. A high significance value of $p > 0.05$ indicates that the null hypothesis cannot be rejected. The Wald statistics checks how well each predictor contributes to the model individually, therefore a statistically significant Wald's Statistics for a variable indicates that it should be included in the model. Hosmer and Lemeshow (1989) recommended raising the significance values higher than the standard values of 0.05 or 0.01 to values such as 0.2 or 0.25. This method was adopted by previous authors (Kavade, 2009 and Ekanem *et al*., 2020). This study employed the use of Wald's Statistic significance p – value cut-off points of 0.25 in order to identify variables known to be important (Mickey and Greenland, 1989).

4.0 **Data Presentation and Discussion of Results**

This section consists of the effective cost optimization strategies for enhancing cost performance of public building projects in south-south, Nigeria, cost performance of building projects and the relationship that exists between cost optimization strategies and cost performance of public building projects.

Table 1 shows the effectiveness of cost optimization strategies at different phases on cost performance. At the planning phase, 40% of the cost optimisation strategies based on respondents' perceptions were deemed effective for enhancing cost performance, while 60% were deemed moderately effective. Value engineering (4.64) was ranked first, closely followed by cost advise (4.52), target costing (4.09) was ranked third while cost planning was ranked fourth. This finding is in line with Karn and Dahal (2021) and Shar *et al.* (2023) who in their study identified adequate planning and scheduling as having a significant effect on cost performance. At the design phase, 62.5 % of cost optimization strategies were deemed to be effective for enhancing cost performance while 37.5% of strategies were deemed to be moderately effective. Adopting passive design strategies and methods to reduce cost (4.54), value engineering (4.51), adopting an integrated design practice to enhance team integration (4.44), adopting a proactive approach (4.12) and target costing were deemed effective for enhancing cost performance. This finding is in line with that of Mahadik (2015) whose study identified value engineering as an effective cost optimization strategy and Ekung (2019) whose

findings revealed adopting passive design strategies at the design phase as being a cost-effective strategy. At the procurement phase, 33.33% of cost optimization strategies where found to be effective while 66.67% were perceived to be moderately effective by respondents. Selecting team members based on understanding of cost optimization strategies (4.62), selecting competent contractors (4.31) and use open and transparent procedure (4.26). The findings at this phase suggests the importance of selecting team members base on their understanding of cost optimization strategies as well as selecting competent contractors at this phase cannot be overemphasised. This is in line with the study of Jimoh *et al.* (2016) who acclaimed that stakeholders have a different and complex task when choosing appropriate procurement practices for construction projects and clients generally face the difficult task of making the right selection criteria to be used in a particular project. At the construction phase, 36.6% of cost optimization strategies were perceived to be effective for enhancing cost performance while 54.55% of the strategies were moderately effective. The cost optimization strategies perceived to be effective for enhancing cost performance are adequate cost reduction techniques (4.52), adopting activity-based-costing (4.51), use continuous value engineering process (4.44) and material management (4.07). This is in line with Karn and Dahal (2021) who identified value engineering process as an important cost optimization strategy to be adopted during the construction phase.

Table 1: **Effective Cost Optimization Strategies for Enhancing Cost Performance**

S/N	Cost Optimization Strategies	Mean	S.D	Rank	Remarks
	PLANNING PHASE				
1	Adequate feasibility studies	3.94	1.14	5	ME
2	Adopt integrated approach	3.41	1.22	10	ME
3	Target costing	4.09	0.83	3	E
4	Life cycle costing	3.73	1.29	9	ME
5	Improving knowledge, education and skill	3.86	1.21	7	ME
6	Value engineering	4.64	0.52	1	E
7	Objectively prioritize project goals at inception	3.92	1.09	6	ME
8	Cost advice	4.52	0.66	2	E
9	Effective cost planning	4.02	0.98	4	E
10	Optimizing owner's commitment through clear vision and objectives	3.78	1.09	8	ME
	DESIGN PHASE				
1	Target costing	4.07	1.12	5	E
2	Value engineering	4.51	0.73	2	E
3	Activity-based-costing	3.87	1.22	6	ME
4	Adopting a proactive approach	4.12	1.11	4	E
5	Involve early experienced key contractors and subcontractors	3.60	1.23	7	ME
6	Adopting an integrated design practice to enhance team integration	4.44	0.75	3	E
7	Adopting passive design strategies and methods to reduce cost	4.54	0.65	1	E
8	Risk based estimating	3.54	1.18	8	ME
	PROCUREMENT PHASE				
1	Selecting adequate procurement options	3.94	1.20	4	ME
2	Optimizing project objectives	3.72	1.12	7	ME
3	Implementing cost effective competitive process	3.54	1.28	8	ME
4	Selecting competent contractors	4.31	0.89	2	E
5	Adoption of E-procurement	3.81	1.24	5	ME
6	Use open and transparent procedure	4.26	0.99	3	E
7	Select team members based on understanding of cost optimization strategies	4.62	0.52	1	E
8	Select contractors based on understanding of cost optimization strategies	3.75	1.15	6	ME
9	Use collaborative based contract forms	3.29	1.17	9	ME
	CONSTRUCTION PHASE				
1	Adequate cost reduction techniques	4.52	0.73	1	E
2	Material management	4.07	1.24	4	E
3	Adopting a cost effective and innovative eco-friendly technique	3.96	1.07	5	ME
4	Replacing conventional materials with alternative materials	369	1.32	9	ME
5	Use continuous value engineering process	4.44	0.64	3	E
6	Use materials with low maintainability	3.45	1.23	11	ME
7	Adopt activity-based-costing	4.51	0.62	2	E
8	Use locally sourced affordable materials and perform material price comparison	3.86	1.09	7	ME
9	Adopting integrated project delivery	3.91	1.02	6	ME
10	Improving cost drivers and constraints	3.66	1.36	10	ME
11	Adopt target costing	3.82	1.29	8	ME

The study also assessed the cost performance of 546 completed public building projects in the study area. Construction professionals were asked to provide information on the initial and final contract sums of public building projects they handled between the period of 2012 and 2022. 546 completed public building projects were reviewed. Table 2 is a section of the results obtained showing the initial contract sums, final contract sums and percentage cost overrun of some of the projects executed by the respondents during the period. Poor cost performance was recorded in most of the projects reviewed. In project 11, for instance, the final contract sum rose from ₦415,430,192 to ₦687,500,234 giving a cost overrun of 65% while in project 17, final cost rose from ₦193,110,520 to ₦370,500,412 with a cost overrun of 92%. Total initial cost for the 546 selected completed projects in the study area was one hundred and seventy-seven billion, eight hundred and sixty-four million, seven-hundred and forty five thousand, two hundred and thirty-one naira (₦ 177,864,745,231.00), while total final cost was two hundred and seventy-four billion, nine hundred and forty-four million, nine hundred and fifty-four thousand, one hundred and ninety-seven naira (₦274,944,954,197.00) resulting in a cost variance of seventy-seven billion, eighty million, two hundred and eight thousand, nine hundred and sixty-six naira (₦97,080,208,966.00) which translates to 64.69% variability. The high variability between the initial and final contract sums is not surprising as according to Mbabuike *et al*. (2021), most building construction projects executed in Nigeria experience high variations between their initial and final contract sums. A reason for this could be as a result of construction practitioners not applying effective cost optimization strategies at the planning, design, procurement and construction phases of the projects under construction. In the same vein, as mentioned earlier, cost performance was categorized into five categories. Table 3 shows the result of the categorization. 23.8% representing 130 completed building projects had very poor cost performance, 49.8% representing 272 completed building projects had poor cost performance, 10.8% representing 59 completed building projects had moderate cost performance, 9.5% representing 52 completed building projects had good cost performance and 6.0% representing 33 completed building projects had very good cost performance). This is a clear indication that cost performance in the study area is poor. A similar study by Otali and Essien (2017) revealed an alarming rate of cost overrun on virtually all the selected projects reviewed in the Niger Delta region of Nigeria.

Table 2: Initial contract sum, final contract sum and percentage cost overruns

Project No.	Initial Contract Sum (₦)	Final Contract Sum (₦)	Cost Overrun (%)
1	94,200,000	152,400,000	62
2	86,520,000	146,300,000	69
3	96,460,000	178,900,000	85
4	110,390,000	182,650,000	65
5	120,000,000	197,000,000	64
6	96,500,000	118,450,000	23
7	110,000,000	192,000,000	75
8	110,000,000	192,000,000	75
9	126,420,213	194,580,436	54
10	164,000,000	296,000,000	80
11	415,430,192	687,500,234	65
12	425,200,431	560,200,144	32
13	106,230,119	150,350,337	42
14	164,321,430	196,700,265	20
15	195,275,419	253,580,114	30
16	126,450,234	190,920,300	51
17	193,110,526	370,500,412	92
18	295,330,120	541,650,230	83
19	400,000,100	458,500,190	15
20	470,110,220	752,200,000	60

Table 3: Cost Performance of selected Building Projects

Cost Performance	Classification	Frequency	Percentage
Very poor cost performance	81-100%	130	23.8%
Poor Cost Performance	61-80%	272	49.8%
Moderate Cost Performance	41-60%	59	10.8%
Good Cost Performance	21-40%	52	9.5%
Very Good Cost Performance	0-20%	33	6.0%
Total		546	100.0%

In order to determine the relationship between cost optimization strategies and cost performance of public building projects, OLR was applied. The first stage of the regression was run by imputing the 38 cost optimization strategies as the independent variables and cost performance as the dependent variable. An iterative process of variable selection was carried out where covariates were removed from the model one after the other if they are non-significant, and the process repeated until all the variables in the model were significant.

Table 4: Final Parameter Estimates

	Variable Code	Estimate	Std. Error	Wald	Df	Sig	Lower Bound	Upper Bound
Threshold (DV)	[cost perf. = 1.00]	2.501	1.434	3.042	1	.081	.309	5.311
	[cost perf. = 2.00]	4.883	1.447	11.395	1	.001	2.048	7.718
	[cost perf. = 3.00]	5.581	1.450	14.812	1	.000	2.739	8.423
	[cost perf. = 4.00]	6.667	1.458	20.902	1	.000	3.809	9.525
Location (IV)	COP 2	-.458	.184	6.208	1	.013	-.818	.098
	COP 6	.505	.326	2.395	1	.122	-.135	1.144
	COP7	.987	.328	9.035	1	.003	.343	1.631
	COP10	.368	.216	2.900	1	.089	-.055	.791
	COD2	-.787	.418	3.550	1	.060	-1.606	.032
	COD7	-.646	.058	6.257	1	.012	-4.720	-.573
	CPR6	.952	.398	5.790	1	.016	.176	1.727
	CPR9	-.398	.135	8.645	1	.003	-.663	-.133
	COC5	.968	.105	7.214	1	.007	.802	5.133
	COC 7	.488	.376	1.682	1	.195	-.249	1.225
	COC8	.388	.177	4.802	1	.028	.041	.735
	COC10	-.789	.317	6.198	1	.013	-1.410	-.168
	COC11	-.875	.355	6.088	1	.014	-1.571	-.180

The relationship between the explanatory (independent) variables and the outcome (dependent) variable is specifically indicated in the table of Parameter Estimates. Table 4 shows the final parameter estimates. The cost performance model was developed using thirteen (13) cost optimization strategies that were significant based on the Wald's Statistics at p-value ≤ 0.25, with the model fitting information of 405.958 of -2 Log Likelihood, Chi-Square of 65.193 and the significance level of 0.000, showing the fitness and suitability of the variables to the model. The goodness-of-fit test consists of Pearson's chi-square statistic for the model and the deviance. The result of the goodness-of-fit tests shows Pearson Chi-Square of 207.916 and (p-value = 0.758) while the Deviance is198.429 and (p-value = 0.880). The large p-values indicate that the model fit the data well and the null hypothesis which states that the fit is good, is accepted. The result of the test of proportional odds showing a p-value of 0.416 indicates that the main assumption of the ordinal regression is checked. This is shown in Tables 5 and 6.

Table 5: Final Model Fitting Information for Cost Performance

	Chi-Square	Df	Sig.
Pearson	207.916	223	.758
Deviance	198.429	223	.880
Link function Logit			

Table 6: Final Model for Cost Performance Test for Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	Df	Sig.
Null Hypothesis	405.958			
General	214.342[b]	191.616[c]	39	0.416

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.
a. Link function: Logit
b. The Log-likelihood value cannot be further increased after maximum number of step-halving
c. The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model.

Thirteen (13) cost optimization strategies had their Wald's statistic significant at a p-value ≤ 0.25. At the planning phase, the significant variables are adopting an integrated approach (COP2), life cycle costing (COP6), objectively prioritize project goals at inception (COP7), and optimising owner's commitment through clear vision and objectives (COP10). It is important to adopt an integrated approach at the early stage of the project as this promotes collaboration amongst the construction professionals and ensures costs are managed efficiently. Life cycle costing at the planning phase enable project managers make informed decisions about the cost of the project while objectively prioritizing goals and objectives enhances clarity of work to be carried out throughout the complete building process. At the design phase, (COD2) and (COD7) which are value engineering and adopting passive design strategies and methods to reduce cost were found to be significant cost optimization strategies. ABC at this stage of the project specifically allocate costs to specific activities of the project and identifies areas where resources are not properly used or overused. At the procurement phase, (CPR6) and (CPR9) which are using an open and transparent procedure and use of collaborative contract forms were found to be statistically significant for enhancing cost performance. At the construction phase, (COC5), (COC7), (COC8), (COC10) and (COC11) which are use continuous value engineering process, adopt activity-based-costing, using locally sourced affordable materials and performing material price comparison, improving cost drivers and constraints and adopting target costing were found to be statistically significant.

5.0 Conclusion and Recommendations

The study provided insight into the cost performance of public building projects in south-south, Nigeria, effective cost optimization strategies at different phases of building projects as well as the relationship between cost optimization strategies and cost performance of public building projects in the study area. The study assessed the cost performance of public building projects and found a variability of 64.69% between the initial contract sums and final contract sums of 546 selected completed building projects in the study area. Cost performance was found to be poor as 23.8% of completed building projects reviewed had very poor cost performance while 49.8% had poor cost performance based on the categorization of cost performance done in the study. Regrettably, it was revealed that 73.6% of the completed projects reviewed had poor cost performance.

The relationship between cost optimization strategies and cost performance of public building projects in the study area was determined by applying ordinal logistic regression analysis. The variables which had their Wald's statistics significant at p-value < 0.25 were selected for fitting the model. The study revealed Thirteen (13) out of thirty-eighty cost optimization strategies imputed into the model to be statistically significant for enhancing cost performance. The most significant strategy at the planning phase was objectively prioritizing goals and objectives to reduce cost while the most significant strategy revealed at the design phase was adopting passive design strategies and methods to reduce cost. At the procurement phase, the most significant strategy was use of collaborative contract forms while value engineering was the most significant cost optimization strategy at the construction phase. The study concludes that adequate attention and priority have not been given to cost optimization strategies at the various phases of building projects in the study area resulting in poor cost performance.

Based on these conclusions, it is recommended that stakeholders in the construction industry should utilise effective cost optimization strategies such as value engineering at the planning phase, adopting passive design strategies and methods at the design phase, select competent contractors at the procurement phase and adopting adequate cost reduction techniques at the construction phase of building projects amongst others in order to reduce the incessant cases of cost overruns in the study area. The identified significant cost optimization strategies for enhancing cost performance at various phases should also be noted in order to improve cost performance.

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RELATIONSHIP BETWEEN MACROECONOMIC VARIABLES AND REAL ESTATE RETURNS IN UYO, AKWA IBOM STATE

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Abstract
Real estate investment is a critical sector of any macro economy, as it provides housing for individuals in a particular country and beyond. However, it is interlinked with macroeconomic variables such as inflation, GDP and interest rates, and requires a continuous analysis to help investors understand how the broader affects its returns and further enable them make an informed decision of them. Using a sample size of 83 respondent estate surveyors and valuers and REDAN members, the study administered questionnaires to collect analytical data to determine the relationship between macroeconomic variables and real estate investment returns through a multiple regression. It was found that while positive GDP growth and low interest rates were found to simulative activity by increasing property prices, moderate inflation contributed to the long-term value appreciation. Therefore, the study recommended that the data should cover a significant period and represent different stages of the economic cycles so as capture a holistic understanding of the relationship between the variables of the study.
Key words: *Macroeconomic variables, real estate returns and relationship*

Background of the Study

Real estate investment, which had been defined by Investopedia (2021), National Association of Real Estate Investment Trust (NAREIT) (2021), United States Securities and Exchange Commission (USSEC) (2021) and Diala *et al.* (2019) as the process of investing in properties such as land, buildings and other structures with the anticipation of earning returns, is a critical sector of any macro economy, as it provides housing for individuals in a particular country and beyond. Nwosu (2020) and Grum and Govekar (2015) opined that more than 85% real estate investors' objectives of developing these investments is to protect their currency value against inflationary trends, high interest rates and allow them to continually enjoy a positive flow of returns as added national earnings. This perspective was also confirmed by another school of thought, Durer and Koten (2021), who postulated that the importance of real estate investment is significant in terms of directing limited funds by investors in order to benefit from increased future returns. Based on this purview, one would agree that globally, real estate investment has a leading role in the economic growth of any given macro economy such as Nigeria, and Uyo, Akwa Ibom State to be specific.

Notably, the macro economy is driven by variables such as inflation, interest rates and GDP, for which scholars such as Phillippe and Patrick (2020) and Wahab *et al.* (2017) had agreed that they affected significantly on real estate investments returns. Specifically, Wahab *et al.* (2017) had postulated that findings from other empirical studies had shown that these variables had significantly affected real estate investment returns in Europe, more than 82% (Giussani *et al.*, 1992; Lizieri and Satchell, 1997; Brooks and Tsolacos, 1999 and Sinbad and Mhlanga, 2009), in America, up to 95% (Abraham and Hendershott, 1996; Ling and Naranjo, 1997 and Eldelstain and Tsang, 2007), in Asian, 78% (Peng and Hudsin-Wilson, 2002; Peng *et al.*, 2005 and Joshi, 2006) and in Africa as a developing continent, 65% (Clark and Daniel, 2006; Kwangware, 2010; Ojetunde *et al.*, 2011; Bouchouicha and Ftiti, 2012; Ojetunde, 2013; Udoekanem *et al.*, 2014; Udoekanem *et al*, 2015; Diala *et al.*, 2019). Deductively, one would preclude that within the interaction between macroeconomic variables and real estate investment returns, there is an existence of a long-run relationship (Eldelstein and Tsang, 2007; Sinbad and Mhlang, 2009; Kwangware, 2010; Gutpa *et al.*, 2010 and Ojetunde, 2013), which has to be verified regionally. Therefore, since real estate investment is an aspect of the global investment market, it has become a focal point of research so as to enable investors determine their effect on its returns since they help in shaping their decisions as expressed in the thought of Giussani *et al.* (1992) (Hoesli and MacGregor, 2000; Kalu, 2001 and Lim and McAleer, 2002).

More so, it had been further observed that the relationship between macroeconomic variables and real estate investment has led to a fall and rise in the future of these returns in different regional property markets such as Uyo, Akwa Ibom State causing a source of contention among real estate investors (Onakoya *et al.*, 2018, Okeke *et al.*, 2019 and Diala *et al.*, 2019). All of these contentions necessitated the aim of studying the effect of macroeconomic variables on real estate investment returns,

specifically in Uyo, Akwa Ibom State, with the purpose of providing investors with a better understanding of how the broader economy affects these returns in the study area (Kalu, 2021; Diala *et al.*, 2019). Specifically, in Uyo, Akwa Ibom State, the problem is that national level macroeconomic factors impact the study area's real estate market, but it also recognizes the influence of local Uyo-specific factors. So, understanding how national economic trends interplay with local factors is crucial for real estate investors in Uyo, Akwa Ibom State. More so, macroeconomic data for Nigeria is generally obtainable, while Uyo-specific real estate data might require local surveys or collaboration with estate agents. Therefore, there is need to tailor specific macroeconomic variables such as inflation, interest rates and GDP growth data based on availability and local relevance. Further, local market factors of vacancy rates, rental yields and specific property type or infrastructural development projects in Uyo need to be considered with respect to the timeframe, hence, data collection that captures enough economic cycles to reveal meaningful patterns should be involved. Addressing these patterns in Uyo, the study provides valuable insights for investors looking to make informed decisions about the Uyo real estate market.

Literature Review - Relationship between Macroeconomic Variables and Real Estate Investment Returns

Macroeconomic variables are key economic indicators that provide insight into the overall state and returns of a country's economy. These variables represent the aggregate behavior and trends of various economic factors on a national scale as defined by Balter (2019). It is with this perspective that the author further showed that they are used to measure and analyze the growth of an economy, as well as to make informed policy decisions. According to Song and Zhou (2017) and Kamweru and Ngui (2017), some commonly monitored macroeconomic variables include GDP, which represents the total value of all goods and services produced within a country's boarders over a specific period. Hence, one would agree that it is a widely used measure of economic activity and serves as an indicator of economic growth in every country. Another variable is inflation, which refers to the general increase in prices of goods and services over time. Durer and Koten (2021) agreed that it is usually measured by consumer price index (CPI) or producer price index (PPI) and indicates changes in purchasing power and the cost of living of the citizenries. Lastly, interest rates, which represents the cost of borrowing money and the returns earned on savings or investments. Central banks use interest rates as a tool to control inflation and stimulate or restrain economic activity (Akingunola and Akinlabi, 2019). Interestingly, these macroeconomic variables, namely, inflation, GDP and interest rates, among others, specifically used in this study, are closely monitored by investors to assess the current state of the economy, make informed decisions and predict future performances. Analyzing these indicators helps in understanding economic cycles, formulating monetary and fiscal policies, and adjusting business strategies accordingly.

Notably, these activities are also used for real estate investment analysis. Real estate investment refers to the act of managing properties with the goal of generating returns over time (Barbosa, 2018). Crosby (2019), Diala *et al.* (2019) and Ogunba (2015) showed that it involves investing capital in real estate assets. It could take various forms, including residential properties, commercial properties, industrial properties and even undeveloped land. With this school of thought, investors may choose to acquire properties directly or indirectly through real estate investment trusts (REITs), partnerships, or other investment vehicles. Also, according to NAREIT (2021) and National Association of Realtors (NAR) (2018), real estate investment has long been recognized as a lucrative avenue for individuals seeking to grow their wealth and generate a sustainable return stream. With its potential for appreciation, rental income, and tax advantages, real estate investment offers a diverse range of opportunities for investors. Notably, Ogunba (2015) showed that the benefit include an increase in cash flow, which is the rental income from real estate properties. Another benefit is appreciation, which simply means that real estate investment has historically shown the potential for long-term appreciation, allowing investors to benefit from increased property values over time. In terms of tax advantages, real estate investors takes advantage of tax deductions, including depreciation, mortgage interest, property taxes, and expenses, thereby reducing their taxable income. Lastly, portfolio diversification, which means that real estate investment offers diversification benefits by adding a tangible asset class to an investment portfolio, reducing overall risk (Liow and Chen, 2010; Liow and Newell, 2010 and Kalu, 2021).

One could ask, is there a positive or negative relationship between each macroeconomic variable and real estate investment returns? Various authors such as Phillippe and Patrick (2020), PwC (2019), Peterson (2019), Radonjic *et al.* (2019), and Robert and Hurd (2014) confirmed that the relationship between macroeconomic variables and real estate investment returns is complex and depends on a variety of factors. However, there are some general trends that have been observed in academic literature and linked to Uyo, Akwa Ibom State by the researcher. In terms of inflation, the relationship between inflation and real estate investment returns is generally mixed. Some studies have found a positive relationship between inflation and real estate prices, as inflation leads to an increase in demand for real estate as a hedge against inflation (Adair *et al.*, 1996 and Akpansung *et al.,* 2018). However, other studies such as Peterson (2019) have found a negative relationship between inflation and real estate investment returns, as inflation leads to higher interest rates, which increase the cost of borrowing for real estate investment. Ogonna *et al.* (2021) showed that there is inflation when prices of commodities rise over time. With this thought, inflation is not to be measured by an increase in the cost of one commodity or even several commodities; rather, it could be seen as the overall increase in the price level of the commodities in the country. However, it is measured as an annual percentage rise in the prices. The available money in the hand of real estate investors loses value as inflation rises and this negatively or positively affects real estate investment returns. The effect of inflation on the economy is diverse and could be positive or negative, but the more pronounced is the negative effect which involves a decrease in the total value of money as well as other monetary variables over time (Blanchard, 2000). Consequently, uncertainty about future inflation rates hinders savings and investment, and when inflation levels increase rapidly, there may be decrease in real estate investment returns as investors begin to hoard out of anxiety and real estate prices rises in the near future (Kimani and Mutuku, 2013; Diala *et al.*, 2019).

In essence, inflation has a direct effect on real investment returns. Observably, during periods of high inflation, the cost of construction materials, labor, and other inputs typically increases. These rising costs affect the profitability of real estate projects and leads to lower returns on investment. Akpan *et al.* (2019) found that high inflation periods corresponded to a decline in property values, suggesting a negative effect of inflation on real estate investment returns. Inflation also influences the affordability of properties and, consequently, the demand for real estate. Hence, when inflation rises, the general cost of living increases, and the purchasing power of investors decline. This decrease in affordability dampens the demand for real estate, affecting property values and investment prospects. Okorie and Ajie (2017)'s findings indicated a negative relationship, suggesting that inflation adversely affect the demand and affordability of housing, which, in turn, influences real estate investment. Inflation also affects the cost of financing for real estate investment. Central banks often respond to inflationary pressures by raising interest rates to control the money supply. Higher interest rates increase borrowing costs, making mortgages and other forms of financing more expensive for investors. Owolabi and Aderemi (2019) revealed a positive correlation, indicating that inflation contributes to higher interest rates. This relationship increases the cost of financing real estate investments, affecting investment decisions. In summary, the relationship between inflation and real estate investment returns is characterized by various interrelated factors. Inflation affect property values, investment returns, affordability, and financing costs. The author advised that investors should closely monitor inflation trends and consider its effects on investment decisions. More so, strategies such as property risk assessment, proactive pricing and prudent financial planning help navigate the challenges posed by inflation and enhance the resilience of real estate investment.

For interest rates, the relationship between interest rates and real estate investment returns is generally negative (Adair *et al.*, 1996 and The Balance, 2021). Higher interest rates increase the cost of borrowing for real estate investment, making it less attractive. Ogonna *et al.* (2021) showed that interest rate is the major effect on the real estate investment returns. An investor's ability to invest in real estate is greatly affected by the changes in interest rate. The reason for this is that as the interest rate decreases, the cost to obtain a mortgage for investment falls and this creates a higher demand for real estate property. On the other hand, if the interest rate raises, the cost for obtaining a mortgage increases, thereby lowering demand and prices of real estate. However, when assessing the effect of interest on equity investment like real estate investment, other than on residential real estate, the relationship could be thought of as similar to a bond's relationship with interest rates. As the interest rate falls, the value of a bond raises due to its coupon which becomes more desirable, and when

interest rate rises, the value of bond falls. In the same vein, when the interest rate falls in the market, real estate investment's yield becomes more attractive and their values went up. As the interest rate rises, the expected return on the real estate investment becomes less attractive and this pushes their property value down (Nguyen, 2011).

Interest rates directly affect mortgage affordability, thereby influencing the demand for real estate. Nguyen (2011) emphasized that when interest rates are low, borrowing costs decrease, making mortgages more affordable for investors. This stimulates demand for real estate as investors find it more attractive to enter the real estate market. Conversely, when interest rates rise, mortgage affordability decreases. Also, it has been observed that higher interest rates lead to increased borrowing costs, making mortgages less accessible for investors. This decline in affordability dampen demand for real estate and affect investment prospects in any given study area. Ekpenyong (2018)'s findings indicated a negative relationship between interest rates and housing demand, suggesting that higher interest rates negatively affect the demand for housing and consequently affect real estate investment. Interest rates also play a crucial role in determining the profitability of real estate investments. When interest rates are low, investors obtain financing at a lower cost, allowing for higher returns on their investment. Lower interest rates reduce the cost of borrowing for real estate investors, increasing their profitability. Conversely, rising interest rates erode profitability. Higher interest rates increase borrowing costs, reducing the return on investment. This discourage real estate investors from undertaking new projects, ultimately affecting the investment landscape. Ayedun and Salau (2020) also revealed a negative relationship between interest rates and investment returns, suggesting that higher interest rates have an adverse effect on the profitability of real estate investments.

Interest rates also influence market stability and investor confidence in the real estate sector. When interest rates are low and stable, it fosters a favorable investment environment. Low borrowing costs encourage investors to enter the market, driving up demand and stabilizing property values. This creates a positive cycle of growth and attracts further investment. However, volatile interest rates introduce uncertainty and dampen investor confidence. Fluctuating interest rates lead to market instability, making real estate investment riskier. Investors hesitate to commit to long-term investments, affecting the growth and development of the real estate sector (Akpan *et al*, 2019). Therefore, it has been observed that interest rates influence mortgage affordability, demand for properties, and the profitability of investments. Additionally, interest rates affect market stability and investor confidence. The author suggested that real estate investors should closely monitor interest rate trends and consider their effects on investment decisions. Presumably, this awareness has helped shape strategies to navigate interest rate fluctuations and optimize real estate investment opportunities.

On the part of GDP growth, CHRE (2021) showed that the relationship between GDP growth and real estate investment returns is generally positive. Higher GDP growth lead to an increase in demand for real estate as businesses expand and the population grows. There are also non-linear relationships and threshold effects between macroeconomic variables and real estate investment returns. Some studies have found that the relationship between macroeconomic variables and real estate investment returns is non-linear and that there are threshold effects (Girun and Govekar, 2015 and Harvard Business Review, 2018). Regarding GDP growth, some studies have found that there is a non-linear relationship between GDP growth and real estate investment returns. For example, one study found that the relationship between GDP growth and real estate investment returns is positive up to a certain threshold level of GDP growth, beyond which the relationship becomes negative. This may be because high levels of GDP growth lead to overheating in the real estate market and an increase in supply, which lead to a decrease in real estate prices. Hence, with this background, one may assume that GDP growth has a direct effect on real estate investment returns. Kalu (2021) further showed that when GDP is expanding, it signifies a thriving and growing economy. This economic growth often leads to increased business activities, job creation, rising incomes, and improved consumer confidence. These factors contribute to higher demand for both residential and commercial properties, driving real estate investment in any given study area as shown in Akinyemi *et al.* (2018), who examined the relationship between GDP and real estate investment. The research found a positive and significant relationship, suggesting that higher GDP growth rates are associated with increased real estate investment activities.

GDP growth also influences return levels and affordability of properties. For example, it has been observed that as GDP expands, it often leads to increased returns and purchasing power for investors. This improved affordability drive demand for real estate as individuals seek to invest in properties or upgrade their living conditions. Conversely, during periods of low GDP growth or economic downturns, return levels may stagnate or decline. This affect the affordability of properties, leading to a decrease in demand for real estate investment as shown in Onakoya *et al.* (2018) who examined the relationship between GDP and the real estate market. The findings revealed a positive correlation between GDP and the real estate market, highlighting the influence of GDP on real estate investment.

GDP growth further affects investor's confidence and market stability, which, in turn, affect real estate investment. It is on this basis that one may agree that a growing GDP reflects a stable and promising economic environment, attracting both domestic and foreign investors. Also, a positive GDP growth leads to increased investment in real estate projects, supporting the growth and development of the sector. Furthermore, GDP growth contributes to market stability. However, it presumed that a thriving economy reduces uncertainty and fosters a favorable investment climate, attracting investors and stimulating real estate activity as shown by Adesoye and Raji (2019) who investigated the relationship between GDP and real estate investment. The findings indicated that GDP has a positive effect on real estate investment, with higher GDP growth rates associated with increased investment activities. In summary, one may say that the relationship between GDP and real estate investment returns is significant. Economic growth, return levels, investor confidence, and market stability are all influenced by GDP. Kalu (2021), Akpan *et al.* (2019), Diala *et al.* (2019) and Nguyen (2011) suggested that real estate investors should closely monitor GDP trends and consider its effects on investment decisions. Within this purview, investors' growth is the relationship between GDP and real estate investment returns.

Above all, the relationship between inflation, interest rate and GDP and real estate investment returns are a negative relationship, suggesting that inflation adversely affect the demand and affordability of housing, which, in turn, influences real estate investment (Okorie and Ajie, 2017); a negative relationship between interest rates and investment returns, suggesting that higher interest rates have an adverse effect on the profitability of real estate investments (Ayedun and Salau, 2020); a positive relationship between GDP and the real estate market, highlighting the influence of GDP on real estate investment and development (Onakoya, Adeniyi, and Bakare, 2018), respectively. It is with this background that many researchers have concluded that macroeconomic variables have a significant relationship with real estate investment returns.

Research Design

In studying the "Effects of Macroeconomic Variables on Real Estate Investments Returns in Uyo, Akwa Ibom State," a suitable research design was the cross-sectional research design. According to Udo (2003), cross-sectional research design refers to a type of research that involves collecting data from the same subjects or participants once over an extended period of time, in this case, from 2013 to 2022. Moreover, in this research design, researchers observed and measured variables of interest rate repeatedly over time to examine patterns, changes, and trends that occur within individuals or groups. The primary objective of this research design was to investigate the cause-and-effect of relationships, developmental trajectories and temporal changes in variables over an extended period. Following the same subjects over time, researchers could track individual or group-level changes, identify the factors that contribute to these changes, such as interest rate, inflation indices and GDP, and better understand the dynamics of various phenomena.

Units of Data

The required units of data included:

Macroeconomic Variables: These variables included GDP growth, interest rates and inflation rates. To measure GDP, the following formula is used: GDP = C + I + G + (X - M), where the data unit would be C representing private consumption expenditures, which includes personal consumption expenditures on goods and services by individuals and households, I representing gross private domestic investment, which includes business investment in capital goods, residential investment, and changes in business inventories, *G* representing government spending on goods and

services and (X - M) represents net exports, which is the difference between exports (X) and imports (M).

To measure inflation, the following formula applies: $\text{Inflation} = \frac{\text{Current Price Index} - \text{Previous Price Index}}{\text{Previous Price Index}} x\ 100$. So the data units would be CPI, which refers to the average price level of goods and services in the current period and PPI, which refers to the average price level of goods and services in the previous period. To calculate the inflation rate, one would subtract the PPI from the CPI, divide the result by the PPI, and then multiply it by 100 to express it as a percentage. For example, let's say the price index in the previous year was 150 and the price index in the current year is 165. Using the formula, the calculation would be inflation rate = ((165 - 150) / 150) * 100 = (15 / 150) * 100 = 10%. This means that the inflation rate for the given period is 10%, indicating a general increase in the average price level of goods and services.

The bank rate where obtained from secondary sources.

Real estate investments property prices where measure by naira, transaction volumes was measured by the amount sold, types of properties where specified by either residential, commercial, among others.

Research Population and Sampling Design

The research population included all principal partners of estate surveying and valuation firms (numbering 72 registered members) and all head of practice of Real Estate Development Association of Nigeria (REDAN) (numbering 32 registered members) operating in Uyo, Akwa Ibom State being respondents relevant to the study. Altogether, there were 104 respondents studied in this research work. The choice of incorporating principal partners and head of practice was because they were the stakeholders in real estate investment decisions. They were also in position to determine the rental values of each of the properties chosen for sampling, taking into account the historical and existing knowledge of records of transactions and had expertise relating to real estate matters.

Sampling Frame: This involved a comprehensive list of all 2-BDR and 3-BDR block of flats that were sold or rented by the firms/office between 2013 and 2022. 30 properties for each type of residential property was randomly picked from among transactions undertaken by the sampled respondents. However, the researcher ensured that they meet the criteria to be used in terms of amount sold or rented.

Sample Size: The formula for sample size (n) when using Taro Yamaro: $\frac{N}{1+N(e^2)}$, where N = Population size, n = sample size and e = significance coefficient at 95% (0.05). Using the formula, inputted data would be n = $\frac{104}{1+104(0.05^2)}$ at 95% level of confidence. So, n = 82.5 rounded to 83 respondents. From here, 83 respondents would be analyzed. Estate surveyors and valuers would be 57 respondents because $\frac{72}{104} x\ 83$, while REDAN members would be 26 respondents because $\frac{26}{104} x\ 83$.

Sampling Method: Probability sampling (simple random sampling). This ensured that each property in the population had a known and equal chance of being included in the sample.

Techniques of Data Analysis

It was important to calculate real estate investment returns, the researcher considered both the income generated from the investment (such as rental income) and the change in the property's value over time. The total return on real estate investment is commonly expressed as a percentage and is calculated using the following formula. Total Real Estate Investment Returns: $-\left|\frac{(\text{Ending Capital Value} - \text{Initial Capital Value} + \text{Income})}{\text{Initial Capital Value}}\right|$ * 100, where ending value refers to the current market value of the real estate investment, initial value represents the original cost or purchase price of the property, income includes any cash flow generated from the investment during the holding period, such as rental income. Multiple regression analysis was used to find the relationship with the formula: y = a + b1*1 + b2*2 + b3*3 + *e*, where y = dependent variable, a = y-intercept, b1, b2 and b3

are the regression coefficient and 1, 2 and 3 are independent variables. The researcher then applied the formula to the subject matter as follows: ∑real estate investment returns = b0 + b1*∑inflation (Appendix III) + b2*∑interest rate (Appendix IV) + b3*∑GDP (Appendix V) + *e*. The relationship could be expressed as;

2-BDR: $y = 189.12a + 14.36b_1 + (-12.66)b_2 + (-0.39)b_3 + e = 2{,}186.382$ (Appendix VI)

3-BDR:$y = 168.68a + 11.38b_1 + (-25.21)b_2 + (-0.30)b_3 + e = 2{,}954.632$ (Appendix VI)

Discussion of Results

The analysis showed that there is a significant relationship between macroeconomic variables and real estate investment returns for which many scholars agree. For inflation, Akpan *et al.* (2019) showed that periods of high inflation correspond to a decline in property values, indicating the positive relationship inflation on real estate investment returns. For interest rates, Madugba and Onyeukwu (2020)'s findings indicated a negative relationship, suggesting that higher interest rates negatively relates to the demand for housing, thereby influencing real estate investment returns and for GDP, Nseobot *et al.* (2018) highlighted the significant relationship of GDP on housing affordability, emphasizing the importance of economic growth for real estate investment returns. Conclusively, macroeconomic variables have a significant relationship on real estate investment returns.

Conclusion

On the basis of the findings, the following conclusion is made that the macroeconomic variables of GDP growth, interest rates, and inflation play a crucial role in shaping real estate investments in Uyo, Akwa Ibom State. Positive GDP growth and low interest rates were found to stimulate investment activity and increase property prices, particularly in residential real estate. Similarly, moderate inflation was seen as a favorable factor, contributing to the long-term value appreciation of properties. Moreover, low unemployment rates and positive consumer confidence were found to drive demand for real estate, leading to stable rental markets and potential rental rate growth.

Recommendations

The study recommended that the data should cover a significant period and represent different stages of the economic cycle to capture a holistic understanding of the relationship.

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Appendix I: Sales Prices of Selected 2-BDR and 3-BDR Houses

Property Number	2-Bedroom		3-Bedroom	
	Year Sold	Cost (₦)m	Year Sold	Cost (₦)m
1	2019	15	2020	20
2	2014	8	2014	14
3	2018	13	2018	17
4	2021	17	2016	16
5	2015	10	2013	14
6	2019	15	2020	18
7	2014	8	2014	13
8	2018	13	2018	19
9	2021	17	2016	16
10	2015	11	2013	15
11	2019	15	2020	20
12	2014	8	2014	14
13	2018	13	2018	16
14	2021	16	2016	16
15	2015	12	2013	14
16	2019	15	2020	20
17	2014	8	2014	14
18	2018	13	2018	15
19	2021	17	2016	16
20	2015	11	2013	14
21	2019	15	2020	20
22	2014	8	2014	14
23	2018	13	2020	19
24	2021	16	2014	14
25	2015	12	2018	18
26	2019	15	2016	16
27	2014	8	2013	14
28	2018	13	2020	20
29	2021	14	2014	14
30	2015	10	2018	17
	Total	**379**	**Total**	**489**
	Average Cost	**37.9**	**Average Cost**	**48.9**

Appendix II: Total Returns of Real Estate Investments
2-BDR Flats

Property Number	Initial Value	Ending Value	Average Income	Real Estate Investment Return
1	9,000,000	15,000,000	250,000	69.44
2	4,000,000	8,000,000	220,000	105.50
3	9,000,000	13,000,000	220,000	46.89
4	14,000,000	17,000,000	240,000	23.14
5	6,000,000	10,000,000	230,000	70.50
6	9,000,000	15,000,000	250,000	69.44
7	4,000,000	8,000,000	220,000	105.50
8	10,000,000	13,000,000	220,000	32.20
9	12,000,000	17,000,000	240,000	43.66
10	8,000,000	11,000,000	230,000	40.37
11	11,000,000	15,000,000	250,000	38.63
12	5,000,000	8,000,000	220,000	64.40
13	9,000,000	13,000,000	220,000	46.88
14	14,000,000	16,000,000	240,000	16.00
15	8,000,000	12,000,000	230,000	52.87
16	12,000,000	15,000,000	250,000	27.08
17	4,000,000	8,000,000	220,000	105.50
18	11,000,000	13,000,000	220,000	20.18
19	12,000,000	17,000,000	240,000	43.66
20	9,000,000	11,000,000	230,000	24.78
21	12,000,000	15,000,000	250,000	27.08
22	5,000,000	8,000,000	220,000	64.40
23	11,000,000	13,000,000	250,000	20.45
24	12,000,000	16,000,000	220,000	35.17
25	8,000,000	12,000,000	220,000	52.75
26	12,000,000	15,000,000	240,000	27.00
27	5,000,000	8,000,000	230,000	64.60
28	9,000,000	13,000,000	250,000	47.22
29	10,000,000	14,000,000	220,000	42.20
30	4,000,000	10,000,000	220,000	155.50
∑	**268**	**379**	**6,960,000**	**1,583.04**
Average	**26.8**	**37.9**	**696,000**	**158.30**

Source: Researcher's Fieldwork (2023)

3-BDR Flats

Property Number	Initial Value	Ending Value	Average Income	Real Estate Investment Return
1	13,000,000	20,000,000	300,000	56.15
2	9,000,000	14,000,000	250,000	58.33
3	12,000,000	17,000,000	280,000	44.00
4	14,000,000	16,000,000	260,000	16.14
5	9,000,000	14,000,000	290,000	58.77
6	12,000,000	18,000,000	300,000	52.50
7	9,000,000	13,000,000	250,000	47.22
8	14,000,000	19,000,000	280,000	37.71
9	12,000,000	16,000,000	260,000	35.50
10	11,000,000	15,000,000	290,000	39.00
11	12,000,000	20,000,000	300,000	69.16
12	8,000,000	14,000,000	250,000	78.12
13	11,000,000	16,000,000	280,000	48.00
14	13,000,000	16,000,000	260,000	25.07
15	10,000,000	14,000,000	290,000	42.90
16	17,000,000	20,000,000	300,000	19.41
17	11,000,000	14,000,000	250,000	29.54
18	11,000,000	15,000,000	280,000	38.90
19	12,000,000	16,000,000	260,000	35.50
20	9,000,000	14,000,000	290,000	58.77
21	14,000,000	20,000,000	300,000	45.00
22	9,000,000	14,000,000	300,000	58.88
23	13,000,000	19,000,000	250,000	48.07
24	11,000,000	14,000,000	280,000	29.81
25	16,000,000	18,000,000	260,000	14.12
26	12,000,000	16,000,000	290,000	35.75
27	10,000,000	14,000,000	300,000	43.00
28	13,000,000	20,000,000	250,000	55.76
29	11,000,000	14,000,000	280,000	29.81
30	12,000,000	17,000,000	260,000	43.83
∑	**350,000,000**	**487,000,000**	**8,290,000**	**1294.72**
Average	**35.0**	**48.7**	**829,000**	**129.47**

Source: Researcher's Fieldwork (2023)

Appendix III: Inflation Rate (2013-2022)

Year	**Rate (%)**	**Annual Change (%)**
2013	8.45	-3.74
2014	8.06	-0.41
2015	9.01	0.95
2016	15.68	6.67
2017	16.52	0.85
2018	12.09	-4.43
2019	11.40	-0.70
2020	13.25	1.85
2021	16.95	3.71
2022	17.78	0.83
Total	129.19	5.58
Average Rate/Annual Changes	12.92	0.56

Source: NBS (2023) and CBN (2023)

Appendix IV: Interest Rate (2013-2022)

Year	Interest Rate
2013	3
2014	4
2015	10
2016	11
2017	11
2018	12
2019	13
2020	14
2021	15
2022	17
Total	**110**
Average Interest Rate	**11**

Source: NBS (2023) and CBN (2023)

Appendix V: GDP Growth Rate (2013-2022)

Year	GDP Growth Rate	Per Capita	Growth (%)
2013	520.12B*	2,977	6.67
2014	574.18B	3,201	6.31
2015	493.03B	2,680	2.65
2016	404.65B	2,145	-1.62
2017	375.75B	1,942	0.81
2018	421.74B	2,126	1.92
2019	448.12B	2,204	2.21
2020	432.20B	2,075	-1.79
2021	440.83B	2,066	3.65
2022	450.72B	2,095	1.61
Total	**4561.34**	**23,511**	**22.42**
Average GDP Growth Rate/per Capital/Growth	**456.13**	**2,351**	**2.24**

Source: NBS (2023) and CBN (2023)
*B means Billion

Appendix VI – Computation of 2-BDR Flat

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Y	X1	X2	X3	2*3	3*4	2*4	2*2	3*3	4*4	1*2	1*3	1*4	1*1
69.44	8.45	3	520.12	25.35	1560.36	4395.014	71.4025	9	270524.8	586.768	208.32	36117.13	4821.914
105.5	8.06	4	574.18	32.24	2296.72	4627.891	64.9636	16	329682.7	850.33	422	60575.99	11130.25
46.89	9.01	10	493.03	90.1	4930.3	4442.2	81.1801	100	243078.6	422.4789	468.9	23118.18	2198.672
23.14	15.68	11	404.65	172.48	4451.15	6344.912	245.8624	121	163741.6	362.8352	254.54	9363.601	535.4596
70.5	16.52	11	375.75	181.72	4133.25	6207.39	272.9104	121	141188.1	1164.66	775.5	26490.38	4970.25
69.44	12.09	12	421.74	145.08	5060.88	5098.837	146.1681	144	177864.6	839.5296	833.28	29285.63	4821.914
105.5	11.4	13	448.12	148.2	5825.56	5108.568	129.96	169	200811.5	1202.7	1371.5	47276.66	11130.25
32.2	13.25	14	432.2	185.5	6050.8	5726.65	175.5625	196	186796.8	426.65	450.8	13916.84	1036.84
43.66	16.95	15	440.83	254.25	6612.45	7472.069	287.3025	225	194331.1	740.037	654.9	19246.64	1906.196
40.37	17.78	17	450.72	302.26	7662.24	8013.802	316.1284	289	203148.5	717.7786	686.29	18195.57	1629.737
38.63	8.45	3	520.12	25.35	1560.36	4395.014	71.4025	9	270524.8	326.4235	115.89	20092.24	1492.277
64.4	8.06	4	574.18	32.24	2296.72	4627.891	64.9636	16	329682.7	519.064	257.6	36977.19	4147.36
46.88	9.01	10	493.03	90.1	4930.3	4442.2	81.1801	100	243078.6	422.3888	468.8	23113.25	2197.734
16	15.68	11	404.65	172.48	4451.15	6344.912	245.8624	121	163741.6	250.88	176	6474.4	256
52.87	16.52	11	375.75	181.72	4133.25	6207.39	272.9104	121	141188.1	873.4124	581.57	19865.9	2795.237
27.68	12.09	12	421.74	145.08	5060.88	5098.837	146.1681	144	177864.6	334.6512	332.16	11673.76	766.1824
105.5	11.4	13	448.12	148.2	5825.56	5108.568	129.96	169	200811.5	1202.7	1371.5	47276.66	11130.25
20.18	13.25	14	432.2	185.5	6050.8	5726.65	175.5625	196	186796.8	267.385	282.52	8721.796	407.2324
43.66	16.95	15	440.83	254.25	6612.45	7472.069	287.3025	225	194331.1	740.037	654.9	19246.64	1906.196
24.78	17.78	17	450.72	302.26	7662.24	8013.802	316.1284	289	203148.5	440.5884	421.26	11168.84	614.0484
27.08	8.45	3	520.12	25.35	1560.36	4395.014	71.4025	9	270524.8	228.826	81.24	14084.85	733.3264
64.4	8.06	4	574.18	32.24	2296.72	4627.891	64.9636	16	329682.7	519.064	257.6	36977.19	4147.36
20.45	9.01	10	493.03	90.1	4930.3	4442.2	81.1801	100	243078.6	184.2545	204.5	10082.46	418.2025
35.17	15.68	11	404.65	172.48	4451.15	6344.912	245.8624	121	163741.6	551.4656	386.87	14231.54	1236.929
52.75	16.52	11	375.75	181.72	4133.25	6207.39	272.9104	121	141188.1	871.43	580.25	19820.81	2782.563
27	12.09	12	421.74	145.08	5060.88	5098.837	146.1681	144	177864.6	326.43	324	11386.98	729
64.6	11.4	13	448.12	148.2	5825.56	5108.568	129.96	169	200811.5	736.44	839.8	28948.55	4173.16
47.22	13.25	14	432.2	185.5	6050.8	5726.65	175.5625	196	186796.8	625.665	661.08	20408.48	2229.728
42.2	16.95	15	440.83	254.25	6612.45	7472.069	287.3025	225	194331.1	715.29	633	18603.03	1780.84
155.5	17.78	17	450.72	302.26	7662.24	8013.802	316.1284	289	203148.5	2764.79	2643.5	70086.96	24180.25
1583.59	**387.57**	**330**	**13684.02**	**4611.54**	**145751.1**	**172312**	**5374.322**	**4170**	**6333505**	**20214.95**	**17400.07**	**732828.1**	**112305.4**
Y	**X1**	**X2**	**X3**	**2*3**	**3*4**	**2*4**	**2*2**	**3*3**	**4*4**	**1*2**	**1*3**	**1*4**	**1*1**

Source: Researcher's Computation (2023)

2-BDR Flat

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	VAR00004, VAR00003, VAR00002[b]	.	Enter

a. Dependent Variable: VAR00001

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.276[a]	.076	-.030	31.94169

a. Predictors: (Constant), VAR00004, VAR00003, VAR00002

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2186.382	3	728.794	.714	.552[b]
	Residual	26527.066	26	1020.272		
	Total	28713.447	29			

a. Dependent Variable: VAR00001

b. Predictors: (Constant), VAR00004, VAR00003, VAR00002

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-74.376	105.219		-.707	.486
	VAR00002	.574	3.139	.065	.183	.856
	VAR00003	1.578	2.246	.216	.702	.489
	VAR00004	.224	.168	.401	1.333	.194

a. Dependent Variable: VAR00001

Computation of 3-BDR

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Y	X1	X2	X3	2*3	3*4	2*4	2*2	3*3	4*4	1*2	1*3	1*4	1*1
56.15	8.45	3	520.12	25.35	1560.36	4395.014	71.4025	9	270524.8	474.4675	168.45	29204.74	3152.823
58.33	8.06	4	574.18	32.24	2296.72	4627.891	64.9636	16	329682.7	470.1398	233.32	33491.92	3402.389
44	9.01	10	493.03	90.1	4930.3	4442.2	81.1801	100	243078.6	396.44	440	21693.32	1936
16.14	15.68	11	404.65	172.48	4451.15	6344.912	245.8624	121	163741.6	253.0752	177.54	6531.051	260.4996
58.77	16.52	11	375.75	181.72	4133.25	6207.39	272.9104	121	141188.1	970.8804	646.47	22082.83	3453.913
52.5	12.09	12	421.74	145.08	5060.88	5098.837	146.1681	144	177864.6	634.725	630	22141.35	2756.25
47.22	11.4	13	448.12	148.2	5825.56	5108.568	129.96	169	200811.5	538.308	613.86	21160.23	2229.728
37.71	13.25	14	432.2	185.5	6050.8	5726.65	175.5625	196	186796.8	499.6575	527.94	16298.26	1422.044
35.5	16.95	15	440.83	254.25	6612.45	7472.069	287.3025	225	194331.1	601.725	532.5	15649.47	1260.25
39	17.78	17	450.72	302.26	7662.24	8013.802	316.1284	289	203148.5	693.42	663	17578.08	1521
69.1	8.45	3	520.12	25.35	1560.36	4395.014	71.4025	9	270524.8	583.895	207.3	35940.29	4774.81
78.12	8.06	4	574.18	32.24	2296.72	4627.891	64.9636	16	329682.7	629.6472	312.48	44854.94	6102.734
48	9.01	10	493.03	90.1	4930.3	4442.2	81.1801	100	243078.6	432.48	480	23665.44	2304
25.07	15.68	11	404.65	172.48	4451.15	6344.912	245.8624	121	163741.6	393.0976	275.77	10144.58	628.5049
42.9	16.52	11	375.75	181.72	4133.25	6207.39	272.9104	121	141188.1	708.708	471.9	16119.68	1840.41
19.41	12.09	12	421.74	145.08	5060.88	5098.837	146.1681	144	177864.6	234.6669	232.92	8185.973	376.7481
29.54	11.4	13	448.12	148.2	5825.56	5108.568	129.96	169	200811.5	336.756	384.02	13237.46	872.6116
38.9	13.25	14	432.2	185.5	6050.8	5726.65	175.5625	196	186796.8	515.425	544.6	16812.58	1513.21
35.5	16.95	15	440.83	254.25	6612.45	7472.069	287.3025	225	194331.1	601.725	532.5	15649.47	1260.25
58.77	17.78	17	450.72	302.26	7662.24	8013.802	316.1284	289	203148.5	1044.931	999.09	26488.81	3453.913
45	8.45	3	520.12	25.35	1560.36	4395.014	71.4025	9	270524.8	380.25	135	23405.4	2025
58.88	8.06	4	574.18	32.24	2296.72	4627.891	64.9636	16	329682.7	474.5728	235.52	33807.72	3466.854
48.07	9.01	10	493.03	90.1	4930.3	4442.2	81.1801	100	243078.6	433.1107	480.7	23699.95	2310.725
29.81	15.68	11	404.65	172.48	4451.15	6344.912	245.8624	121	163741.6	467.4208	327.91	12062.62	888.6361
14.12	16.52	11	375.75	181.72	4133.25	6207.39	272.9104	121	141188.1	233.2624	155.32	5305.59	199.3744
35.75	12.09	12	421.74	145.08	5060.88	5098.837	146.1681	144	177864.6	432.2175	429	15077.21	1278.063
43	11.4	13	448.12	148.2	5825.56	5108.568	129.96	169	200811.5	490.2	559	19269.16	1849
55.76	13.25	14	432.2	185.5	6050.8	5726.65	175.5625	196	186796.8	738.82	780.64	24099.47	3109.178
29.81	16.95	15	440.83	254.25	6612.45	7472.069	287.3025	225	194331.1	505.2795	447.15	13141.14	888.6361
43.83	17.78	17	450.72	302.26	7662.24	8013.802	316.1284	289	203148.5	779.2974	745.11	19755.06	1921.069
1294.66	**387.57**	**330**	**13684.02**	**4611.54**	**145751.1**	**172312**	**5374.322**	**4170**	**6333505**	**15948.6**	**13369.01**	**606553.8**	**62458.62**

Source: Researcher's Computation (2023)

3-BDR Flat

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	VAR00004, VAR00003, VAR00002[b]	.	Enter

a. Dependent Variable: VAR00001

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.466[a]	.217	.127	20.23275

a. Predictors: (Constant), VAR00004, VAR00003, VAR00002

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2954.632	3	984.877	2.406	.090[b]
	Residual	10643.466	26	409.364		
	Total	13598.098	29			

a. Dependent Variable: VAR00001

b. Predictors: (Constant), VAR00004, VAR00003, VAR00002

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.065	71.776		.154	.879
	VAR00002	-.329	2.057	-.054	-.160	.874
	VAR00003	-.673	1.398	-.137	-.481	.634
	VAR00004	.109	.112	.308	.977	.338

a. Dependent Variable: VAR00001

APPLICATION OF GAME THEORY IN SOLVING URBAN WATER CHALLENGES IN IBADAN-NORTH LOCAL GOVERNMENT AREA, OYO STATE, NIGERIA

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Abstract
Globally, water management as an essential facility for human survival has been faced with divers challenges, particularly in developing nation where the demand outstripped supply. Despite various strategies evolved in solving its challenges, the problem still persists. This study therefore, is design to examine the application of game theory in solving urban water challenges in Ibadan north local government area of Oyo state, Nigeria. Survey research design was utilized and a convenience sample of 156 residents who were 18 years and above were purposively selected on the basis of the severity of water supply challenges. Also, the officials of the water agency were interviewed on the challenges of water supply in the area. Data were analyzed using descriptive and inferential statistics, while qualitative data were content analysed. Majority of the respondents were male while 90.0% earned between N60,000 to N80, 000. Majority (68.0%) of the respondents do not have access to water supplied from the State Water Corporation. Majority (81%) attributed water scarcity to seasonal factor, majority (82.0%) attributed water challenges to unreliability of water supply, not good for consumption; and too expensive to connect and maintain. The outcome of the game (2) indicates that the equilibrium value for the two players (the water agency and the residents) is ₦2,000 for 1,000 liters of water supply monthly. Game theory has been able to proffer solution to water challenges with reference to its outcome. Therefore, priority should be given customers (the residents) to willing-fully pay their water bills.
Keywords; *Game Theory, Water challenges in Ibadan, Oyo State water management authority*

Introduction

Water is an essential resource for the existence of human and all other species, while food supply and adequate nutrition also depend on water. An adequate supply of "clean" and "portable" water is one of the most basic human needs, and one that is not met for more than half of the world's population (WHO/UNICEF, 2010). Oyebode *et al* (2015) stated that half to two-third of the world's population does not have access to adequate quantities of safe drinkable water, yet two-third of the earth's surface is covered with water.

Many developing nations not only have urbanization and pollution issues, but also serious water related problems. Therefore, water quality degradation and water scarcity are two serious problems in developing countries (Shouke Wei, 2008; WHO/UNICEF, 2010). This was observed to be hinged on certain factors , such as, temporally and spatially uneven distributed precipitation; exponentially increasing water consumption with increased population growth rate (UN-CSD, 1994; WASH, 2012; United Nations, 2018); the loss of potential sources of freshwater resulting from unsustainable water resources management practices (Wang, 2005), as well as increasing temperature (Westmacott and Burn, 1997).

Nigeria, African's most populated country, with, about 200 million people, has limited water supply not only in the arid to semiarid north, but also in the southern region along the Atlantic Ocean. The main problem confronting water development in Nigeria is lack of absolute planning and its implementation (World Bank/Federal Republic of Nigeria, 2012). Statistical evidence of acute water shortages stagnated at 47% from 1990 to 2006, but increased to 54% in 2010. In urban areas, access actually decreased from 80% to 65% in 2006, but, it then recovered to 74% in 2010 (Oyebode *et al*, 2015). However, the statistics on access to public water is conflicting due to divergent definitions, indicators and methodologies applied by different water corporations and agencies. Moreover, water production facilities in Nigeria are "rarely operated up to its full capacity due to broken down of equipment, or lack of power or fuel for pumping". The operating cost of water agencies is pushed up by the need to rely on diesel generators to pump and/or supply water for the general public. It is a common sight nowadays to see the population in urban and rural areas searching endlessly for water because of one problem or the other (Gbadegesin, 2021). In the light of inaccessibility to safe water supply, the people then have to turn to other sources and they have to go through a third party who

delivers in small quantities and charge a lot more money for it. In fact, the poorest pays the highest prices for water and often polluted and contaminated water (Oyebode *et al*, 2015).

In Nigeria, water management facilities are fast deteriorating, rivers are in deplorable conditions and the ever-increasing population is all making water challenges bigger every day, to the extent that millions of people in urban and rural areas still lack access to safe portable/drinkable water (African Development Bank Group, ADBG, 2009). Meanwhile, the challenges of urban water supply in Nigeria are categorized into financial, commercial, operational and institutional challenges (Oyebode *et al*., 2015). In Ibadan, like most major cities in Nigeria, urban water supply is confronted with these challenges, as residents do not have access to urban water supply; either the system does not reach them; or the municipality does not extend water to their areas (Gbadegesin, 2021). These observed cleavages in the distribution and management of water for accessibility call for different strategies. While various theoretical modelling as well as empirical methods have been adopted in managing water overtime, the challenges still persist. This is because, the management of water requires a multi actors in the interactive and interdependent approach that remain a gap in holistically solving the percived water challenges in Ibadan North LGA. This study, therefore was designed to examine the challenges of urban water supply using a game theoretical models. Game theory is one of the useful and powerful approach that can be used to model such challenge, since it studies the strategies and equilibrium of multi-actors in interactive and interdependent situations (Pethig, 1992; Myerson, 1997; Petrosjan and Zenkevich, 1996; Shouke Wei, 2008). This is done with the view to ameliorating the perennial water challenges that have pervaded the strata of the LGA, through developing theoretical model and practical result-oriented approach. The specific objectives of the study were to:

1. the socioeconomic variables of the respondents,
2. Investigate the existing status of water supply,
3. Analyse water scarcity and survival strategies, cost of connecting/accessing, sourcing and maintaining water supply,
4. investigate the challenges in accessing/connecting Oyo State Water Corporation (OYSWC) water supply.
5. Construct cooperative and non-cooperative game theoretical model for adequate water supply in the area.

Study Area

The study was carried-out in Ibadan-North Local Government Area of Oyo State, Nigeria; located on latitude 7° 24' 33" N and longitude 3° 53' 24" E. It is one of the largest LGA in Oyo State. Local Government Secretariat is situated at Agodi-Gate Ibadan, opposite the Oyo State Government House, Ibadan. There are twelve wards and forty –one localities in Ibadan North Local Government. Population as at 1991 (NPC) stood at 302,271 and as at the 2006 (NPC Census) we have 306,795. The area extent as at 1991 is 163km^2 and by 2006 it has extended to about 420km$^{2.}$ (Oyo state.gov.ng). This clearly shows that the metropolitan area as a whole is experiencing urban sprawl. It is a multi-ethnic and heterogeneous society, largely dominated by the indigene, the Yoruba, the Igbo who are mainly involve in commerce, The Fulani and Hausa, are found mainly in Sabo Area. This area is characterized by limited access to adequate water supply and basic sanitation services, inadequate housing plan, prevailing high population densities and difficult environmental conditions.

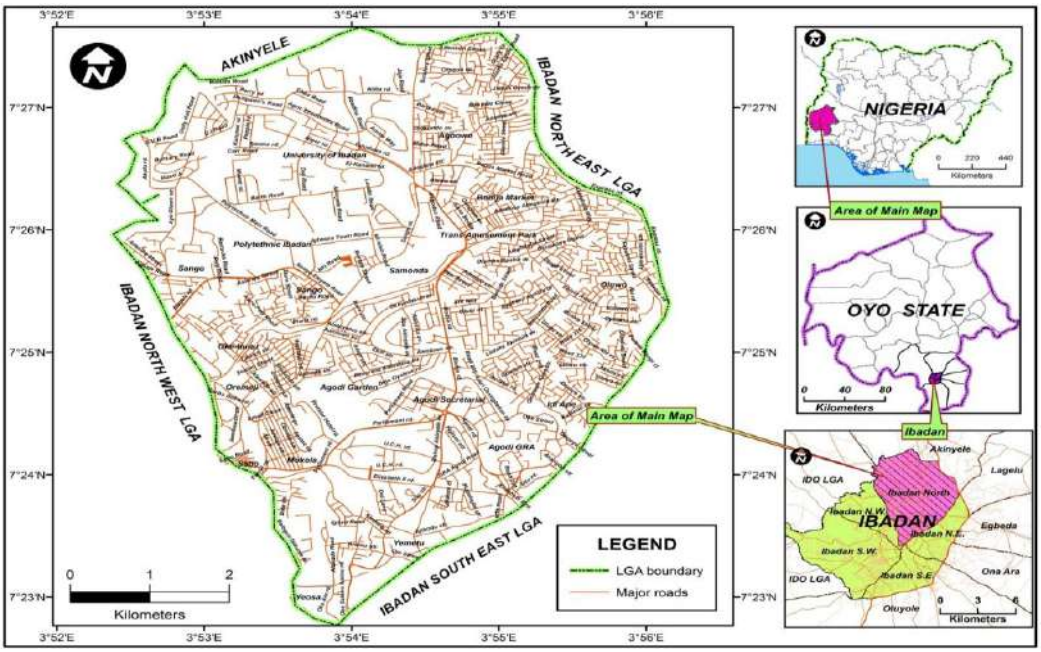

Fig1.1: Map Showing Ibadan North Local Government Area

Theoretical Framework/ Review of Literature

This study is based on the theoretical framework of Game Model, which was first launched by John von Neumann, a great mathematician, and Oskar Morgenstern in 1944 (Neumann, 1991). Game theoretical modelling concepts and reasoning have been widely applied in economic, commercial, social, political, biological, and many other social sciences to help people analyze and understand social and behavioural phenomena. However, a game is a metaphor of the rational behaviours of multi-actors in an interacting or interdependent situation, such as cooperating or coalition, conflicting, competing, coexisting, etc. (Wei and Gnauck, 2007). Whereas, an actor may be a country, a region, a state, a group, an agent, an organization, an individual, organism, abiotic and biotic constituents or even nature proper (Shouke Wei, 2008). The essence of this theory is to analyze the interaction of one with others, to study the strategies and equilibrium of the actors as well as how they can do better.

A game is defined as follows:

G_T = (N, A, P, I, O, E)

Where: **Gr** is the game: **N** - Players, **A** - Action (Moves), **P** - Payoff (or Utility), **I** - Information, **O** - Outcome and **E** - Equilibrium (i.e., NAPI-OE). **NAPI** are collectively known as the rules of a game and **OE** are the game results. The main task of constructing a game model is to define the rules (**NAPI**) in mathematic language and get the solution from **OE**.

In the general perspective, every player has different strategies. However, the optimal strategy for an individual player is to maximize his benefits by using the game rules (Kreps, 1993); and the optimal strategy for the player of a society as a whole is to maximize the common welfare of the society through the rules. Game theory models involve the following conditions and assumptions:

1) Players in the game models are regarded as "intelligent and rational". Rational player means that each player will choose an action or strategy which can maximize his expected utility given, he thinks what action other players will choose. Intelligent player means that each player understands the situation, and he knows the fact that others are intelligent and rational;

2) Each player considers not only his own knowledge and behaviour but also others' during pursuing exogenous aims;
3) Each player has more than one choice or sequence ("plays");
4) All possible combinations of choices or plays result in a well-defined outcome: win or lose, or mutual gains and losses;
5) The players know the rules of the game and the options of other players, but they do not know the real decisions of other players in advance. Therefore, every player has to choose options based on his assumption of what other player will choose;
6) Each player knows that his actions can affect the others, and the actions of others affect him;
7) Each player makes the best possible move, and he knows that his opponent is also making the best possible move.

Moreover, for the purpose of this study, binding agreements: non-cooperative and cooperative games (strategic games) was used. In this game theoretical model, it does not mean that the two branches (non-cooperative and cooperative games) are applied to analyze different kinds of games, but they are just two ways to view the same game (Gibbons, 1992; Zhang, 1996).

Non-cooperative game can be distinct from the following aspects in the contest of solving urban water challenges. The variables are distilled thus:

(a) modelling the situation of lacking binding agreements between the players (the water agency and the residents);
(b) what actions (moves) the players (the water agency and the residents) can take;
(c) how the water agency and the residents (the players) interact with each other to maximize individual welfares;
(d) solutions concepts: Nash equilibrium, sub-game perfect Nash Equilibrium, Bayesian Nash Equilibrium and perfect Bayesian (sequential) Equilibrium;
(e) mainly stressing individual rationality, individual optimal strategies and payoff;
(f) the results may be efficient and maybe not.

While Cooperative game model can also be expressed by:

(a) modelling the situation of binding agreements between the water agency and the residents;
(b) what coalition forms or means the players (the water agency and the residents) can use to maximize the collective welfare of all the players;
(c) how the available total value split in a satisfactory way;
(d) most popular solution concepts: the stable set, equity-based rule, the core Shapley value as well as Nash bargaining solution;
(e) Stressing mainly collective rationality, efficiency and fairness;
(f) the results are usually social optimum.

In summary, the non-cooperative and cooperative game theories are like the positive and normative approaches. With reference to non-cooperative and cooperative game theories, non-cooperative game theory is strategy oriented and it studies what players expect to do and how they do it. Cooperative game theory studies what the players can achieve and how they can achieve it. Theoretically, human societies and nature are full of games. For instances, the game can be between: human and rain, rivers, lakes and animals; human and human; animals and animals; plants and plants; animals and plants; or their habitats, and so on (Shouke Wei, 2008), the study adopt the interaction between human and human i.e. the OYSWC and the water consumer.

Methodology

Survey research design was utilized while both primary and secondary data were sourced. A reconnaissance survey was undertaken within the study area to elicit information on the severity of challenges of water in the study area. Based on the result, a convenience sample of 156 residents who were 18 years and above were purposively selected on the basis of the severity of water supply challenges. Also, the officials of the water agency were interviewed on the challenges of water supply in the area. Questionnaire containing the socioeconomic variables, status of water supply, water

scarcity and survival strategies, cost of connecting/accessing, sourcing and maintaining water supply, challenges in accessing/connecting Oyo State Water Corporation (OYSWC) water supply and developing a game model for the study were administered to the respondents. In addition, an In-Depth-Interview (IDI) was conducted on the officials of the water agency regarding the challenges of water supply in the area. Data were analyzed using descriptive (frequencies, tables and percentages. Mean, median, mode and standard deviation) statistics, while game theoretical model was constructed for adequate water supply in the area. Qualitative data were content analyzed.

Result and Discussions

Socio-economic distribution of Respondents

Investigation on the socioeconomic characteristics revealed that, 67.0% were male. The average age of the respondents was 35 ± 10 years, while majority (57.0%) of the respondents were married. About 78.0% had tertiary education and 63.0% being public/civil servant Their average monthly income was ₦47,500 ± ₦15,200. The general implication of the distribution show that they are predominantly low income earners whose demand for water both quantitative and qualitative can be very significant. All other variables regarding the socioeconomic characteristics and the specific mean distribution of age and income are contained in table 1and 2.

Table 2: Socio-economic distribution of Respondents

Gender of Respondents			
	Frequency	**Percentage**	**Cumulative %**
Male	105	67%	67%
Female	51	33%	100%
Total	**156**	**100**	
Age of Respondents			
	Frequency	**Percentage**	**Cumulative %**
18-30years	56	36%	36%
31-43years	75	48%	84%
44-56years	14	9%	93%
57-69years	11	7%	100%
Total	**156**	**100**	
Marital Status of Respondents			
	Frequency	**Percentage**	**Cumulative %**
Single	34	22%	22%
Married	89	57%	79%
Separated/Divorced	25	16%	95%
Widow(er)	8	5%	100%
Total	**156**	**100**	
Educational Level of Respondents			
	Frequency	**Percentage**	**Cumulative %**
No-formal Education	--	--	0%
Primary Education	--	--	0%
Secondary Education	34	22%	22%
Tertiary Education	122	78%	100%
Total	**156**	**100**	
Occupation of Respondents			
	Frequency	**Percentage**	**Cumulative %**
Student	9	6%	6%
Unemployed	11	7%	13%

Self-employed	35	22%	35%
Public/Civil Servant	98	63%	98%
Retired	3	2%	100%
Total	**156**	**100**	
Monthly Income of Respondents			
	Frequency	**Percentage**	**Cumulative %**
₦40,000 and below	41	26%	26%
₦40,001 – ₦60,000	67	43%	69%
₦60,001 – ₦80,000	33	21%	90%
₦80,001 – ₦100,000	11	7%	97%
Above ₦100,000	4	3%	100%
Total	**156**	**100**	

Source: Authors' Field Survey, 2022.

Table 2: Socio-economic distribution of Respondents

Domain	Minimum	Maximum	Mean	Std. Deviation
Age of Respondents	27	69	34.67	10.35
Monthly Income (NGN '000)	20	105	47.50	15.20

Source: Authors' Field Survey, 2022.

Status of Water Supply

The study revealed that majority (68.0%) of the respondents do not have access (not connected) to water supplied from the State Water Corporation (water agency), Out of the 32.0% that were connected,13.4% got connected through the State Water Corporation (OYSWC) officials; while 18.6% of the respondents got connected through a technician without consulting the State Water Corporation. Also, the consistency of water supply from the OYSWC was revealed. Respondents whose supply of water by OYSWC was seasonal accounted for 18.2%, while 13.8% of them were weekly. This an indication of inconsistency in water supply from the OYSWC.

However, out of the 68% (not connected), 20.0% and 48.0% were connected to borehole/well and private arrangement (sourcing and/or buying water) respectively. This implies that on a general average, respondents sourced and/or bought water for domestic and other usages. It means that majority of the residents would have to turn to other sources for water, who invariably deliver in small quantities with an exorbitant price. In addition, majority of the respondents might be exposed to unpleasant, unsanitary and unhealthy living, which is contrary to the expectations of WASH (Water supply, Sanitation and Hygiene) (WASH, 2012; United Nations, 2018). The study corroborates the work of Oyebode *et al* (2015), where it was asserted that, the poorest pays the highest prices for water and often polluted and contaminated water (table 3).

Table 3: Status of Public Water Supply

Connection to Public Water Supply (PuWS)			
	Frequency	**Percentage**	Cumulative %
Yes, connected to PuWS	50	32%	32%
No, not connected to PuWS	106	68%	100%
Total	156	100	
Procedure of connection to Public Water Supply			
	Frequency	Percentage	Cumulative %
Through OYSWC	21	13.4%	13.4%
Through private technician	29	18.6%	32.0%
Total	50	32.0%	
Consistency of water supply from the OYSWC			

	Frequency	Percentage	Cumulative %
Seasonal	28	17.9%	17.9%
Weekly	22	14.1%	32.0%
Total	50	32.0%	

Source: Authors' Field Survey, 2022

Water Scarcity and Survival Strategies

In other to investigate the scarcity and survival strategies of water supply in the area, the study was conducted. Regarding the perceived nature of water scarcity, majority (81%) of the respondents attributed water scarcity to seasonal factor (48%), high population pressure accounted for 33.0%, while 76.0% of the respondents indicated usual dryness of water sources. The proportion of the respondents whose duration of the dryness was as short as less than two months accounted for 46%, while two months and four months accounted for 38.0% and 16.0% respectively. Alternatives were sought after in order to ascertain the residents' survival strategies during dryness from water sources. The study revealed that during dryness, majority (58%) of the respondents used to buy water from private sources. While 24% trekked long distances to get water freely from any available source. About 12.0% got water freely from a nearby compound. Only 6% of the respondents had water irrespective of the dryness of the season. Regarding the portability of the water, the water that majority (74%) of the respondents had access to were not suitable for drinking. In-depth interview conducted with one of the participants revealed that they rely solely on buying sachet water. While 22.0% rely on buying borehole water for drinking, only 4.0% have direct access to portable/drinkable water. This indicates that majority of the residents lack access to portable/drinkable water, which could lead to outbreak of sickness and diseases resulting to untimely death (table 4).

Table 4: Water Scarcity and Survival Strategies

Reasons for water scarcity in the study area			
	Frequency	Percentage	Cumulative %
Seasonal factor	75	48%	48%
High population pressure	51	33%	81%
Poor funding of OYSWC	17	11%	92%
Mismanagement of OYSWC	13	8%	100%
Total	**156**	**100**	
Dryness of water sources			
	Frequency	Percentage	Cumulative %
Yes, regularly	30	19%	19%
Yes, only in dry season	90	57%	76%
No, not at all	36	24%	100%
Total	**156**	**100**	
Duration of dryness			
	Frequency	Percentage	Cumulative %
< 2 months	78	46%	46%
2 months	59	38%	84%
4 months	19	16%	100%
Total	156	100	
Survival strategies during dryness of water sources			
	Frequency	Percentage	Cumulative %
Buy water from private sources	90	58%	58%
Trekked distances to get water freely from any available source	37	24%	82%
Free water from a nearby compound or neighbour	19	12%	94%
Always have water	10	6%	100%
Total	156	100	

Source of Portable/Drinkable Water			
Source of drinkable water	Frequency	Percentage	Cumulative %
Buying of sachet water	115	74%	74%
Buying borehole water for drinking	34	22%	96%
Direct access to portable water	7	4%	100%
Total	**156**	**100**	

Source: Authors' Field Survey, 2022.

Cost of Connecting/Accessing, Sourcing and Maintaining Water Supply

Moreover, the cost of connecting/accessing, sourcing and maintaining water supply were investigated. The study revealed that, out of the 32.0% that were connected to OYSWC water supplied, 22.0% paid ₦2,000 monthly (but not frequent) for the water supplied, while 10.0% had stopped paying. The reason for a stop in the sudden payment was revealed in the in-depth interview with one of the respondents where he said, '*we do not have access to the water supply anymore, how can we be paying for what we one is not given'.* With respect to OYSWC connecting charges, it was revealed that 16.0% of the respondents spent ₦50,000 which includes: digging, piping and connecting, while 9.0% and 7.0% spent < ₦50,000 and > ₦50,000 on connection charges respectively. Meanwhile, the cost estimates of connection/access to OYSWC water supply were carried-out using the contemporary prevailing exchange rate.

In terms of water consumption rate, majority (54.0%) of the respondents consumed 3,000 liters (3 kiloliter) of water monthly, 24.0% consumed < 3,000 liters, while 22.0% consumed > 3,000 liters monthly. Similarly, on the amount that the respondents spend on water monthly, the study revealed that majority (73%) spent ₦4,000, while 17.0% and 20.0% spent < ₦4,000 and > ₦4,000 respectively. However, for the purpose of comparison, the OYSWC officials were also interviewed to know the estimate of their water bills. Estimated water bills were revealed to vary, depending on the household size and building size. Thus, ₦2,000 monthly per kiloliter was estimated for a household size of four persons/a single family unit. With this monthly amount per kiloliter, it implies that majority of the respondents will be able to pay their bill provided the supply of water is reliable and efficient. In addition, the satisfaction of the respondents regarding the supply of water was investigated. The study revealed that majority (71%) of the respondents were not satisfied considering their comfort and affordability in relation to the cost of connecting/accessing and sourcing water supply (table 5).

Table 5: Cost of Connecting/Accessing, Sourcing and Maintaining Water Supply

Monthly Payment for Public Water Supply			
	Frequency	Percentage	Cumulative %
Yes, payment is made	34	22%	22%
No, payment was stopped	16	10%	32%
No payment at all			
Total	50	32.0%	
Connection charges for Public Water Supply (PuWS)			
	Frequency	Percentage	Cumulative %
< N50,000:00	14	9.0%	9.0%
N50,000:00	25	16.0%	25.0%
> N50,000:00	11	7.0%	32.0%
Total	50	32.0%	

Source: Authors' Field Survey, 2022.

Challenges in accessing/connecting OYSWC water supply

Furthermore, study was conducted on the major challenges involve in accessing or connecting OYSWC in the study area. The study shown that majority (82%) of the respondents had a combination of factors contributing to their challenges, such as unreliability, not good for consumption; too expensive to connect and maintain. About 18.0% had distance as a challenging

factor which was believed to have contributed to their inability to connect state that inability to connect to OYSWC sources. The result was buttressed by the assertion of the one of the participant on the interview, where it said,

> '*there is no need for it, because their water supply is not reliable; we do not have functional pump station; although disconnection as a result of road construction might have contributed to this'.*

Regarding the adequacy of water in terms of meeting their monthly demand. The result shown that, majority (86.0%) do not enjoy monthly water adequacy. Generally, the result implies that water demand by the respondents through OYSWC have not been met. When OYSWC officials were interviewed to know their challenges in carrying out their mandates. Their response was mainly cut across financial, operational; commercial; and institutional challenges. The result validates the work of Oyebode *et al* (2015).

Developing a Game Model for the Study

Base on the result from the respondents earlier mentioned, a model of game theory is to be developed for this study. In this case, the game involved is classified as human and human game (HH-G). That is, the game between the water agency (OYSWC) and the residents. HH game is a society's game and games of strategy. Hence, strategic games were adopted. This is because a wide range of situations on conflicts and challenges have been modeled as strategic games (Bogardi and Szidarovszky, 1976; Friedman, 1991; Gibbons, 1992; Straffin, 1993; Gardner, 1995; Fundenberg and Tirole, 1996; Stahl, 1999; Osborne, 2000; Gintis, 2000; Shouke Wei, 2008).

The strategic game (or normal game) was defined as follows:

$$\mathbf{G = (N, (S_i), (U_i))}$$

Where: $\mathbf{N} = \{1, 2, ... n\}$ set of players; $\mathbf{S_i} = \{S_1, S_2, ... S_n\}$, is the strategies profile of player *I*; and $\mathbf{U_i} = \{U_1, U_2, ... U_n\}$, is the payoff function of player *i*.

Strategic (or normal) games are usually applied to model the static (or simultaneous-move) games in which every player chooses a strategy simultaneously. The strategy profile of all the players determines the payoff of every player. Static games can be either with complete information or with incomplete information. Simultaneous choice does not mean that one player chooses the strategy with other players at the same time, but it just means that a player does not know the choice of the others. The simple model of a strategic game is a two-person game, which can be constructed as a bi-matrix:

$$G = \begin{array}{cc} & \begin{array}{cc} 2 & \\ P_1 & P_2 \end{array} \\ \begin{array}{c} 1 \\ \\ \end{array} & \begin{array}{c} S_1 \\ S_2 \end{array} \left\{ \begin{array}{cc} (a, a) & (b, c) \\ (c, b) & (d,*d) \end{array} \right\} \end{array}$$

In this study, the matrix describes the two players as: the water agency - OYSWC - (Player 1) and the residents (Player 2). Player 1 has two strategies S_1 (₦2,000 per month) and S_2 (for 1,000 liters), and Player 2 has two strategies P_1 (₦4,000 per month) and P_2 (for 3,000 liters). There are four cells which represent four outcomes, and in each cell, there are pairs of letters. The first one in each cell of the matrices refers to the payoff or the values that Player 1 (the water agency) could get through the possible interacting actions at the end of game (₦4,000), and the second numbers are what Player 2 (the residents) could get at the end of game (3,000 liters of water). The outcome with * in the cells is the equilibrium outcome, since there is no further explanation. The rows of the matrix usually represent strategies of Player 1 (the row player), while the columns of the matrix represent strategies of Player 2 (the column player). The game matrix for this study is simply expressed as:

$$G = \begin{array}{c} \\ 1 \end{array} \begin{array}{c} \begin{array}{cc} 2 & \\ P_1 & P_2 \end{array} \\ \begin{array}{c} S_1 \\ S_2 \end{array} \left\{ \begin{array}{cc} (2) & (1) \\ (4) & (3) \end{array} \right. \end{array} (*d)$$

$$G = (2*3) - (4*1)$$

$$G = (6) - (4)$$

Outcome of the game is: 2

The outcome of the game (2) indicates that the equilibrium value for the two players (the water agency and the residents) is ₦2,000 for 1,000 liters of water supply monthly at a prevailing market value). However, each of the players can maximize his payoff (monetary values for the water agency and satisfactory water consumption for the residents). Relatively, the application of this model provides an illustration of the critical need to finance the required investment on water supply facilities for economic development and social rehabilitation in the study area. This result also revealed the importance of the ability to pay which a number of the respondents may not be able to take, given their income status. Although, on the part of OYSWC there is still problem of accurate customer's data that are needed (customers' database), accompany with competent staff, which will enhance their commercial operations to billing and water charges collection.

Conclusion

The application of game theory has been able to reveal the challenges of water supply such as adequate staff and accurate customer's data that could enhance the operations of water supply in Ibadan, particularly Oyo state. Therefore, priority should be given to collecting the data of customers (the residents) who are willing-fully to pay their water bills. In addition, OYSWC should give care diligence in employing competent staff who will be able to handle the operations in their delivery of service. On the part of Government, utility bills should be reviewed to accommodate the affordability level of charges imposed on the people.

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OIL SPILLS AND CHANGING COMMUNITY LIVELIHOOD PATTERNS IN IBENO LOCAL GOVERNMENT AREA, AKWA IBOM STATE, NIGERIA

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Abstract
Oil spills and changing community livelihood patterns in Ibeno Local Government Area, Akwa Ibom State, Nigeria was examined with particular interest in the occurrence of oil spill and livelihood pattern of residents as a response strategy to its effect on their socio - economic life. Data on occurrence and livelihood patterns were gathered using structured questionnaire, field observations and available statistics. Simple random sampling was employed to select Eighteen (18) communities for study. Systematic sampling technique was employed to select the households in the study area. Data generated were analysed using descriptive statistical analysis techniques. From the analysis, result shows that 74.1% of change from farming to trading was as a result of the occurrence of oil spills in the study area. It was established that various strategies were employed by residents to enhance their wellbeing in the event of oil spills and other disturbances that affected their livelihood assets. Based on the findings it is recommended that oil operators should be more proactive in monitoring their operations to stem down the frequency of spills. Oil operators and Non-Governmental Organizations (NGOs) should train residents in new livelihood skills to help them cope with the realities of their environment as a mark of Corporate Social Responsibility (CSR).
Keywords: *Oil Spill, Livelihood, Patterns, Coastal Communities,*

1.0 Introduction

The oil industry largely has negative impacts on coastal communities' livelihoods. These effects and their mechanisms vary across locations, ecosystems, species, and specific activities and groups. Oil being a keystone in the current energy system the world over; regardless of climate change, high price volatility and a long history of social and environmental concerns, still accounted for about 32% of the global energy mix before the COVID-19 pandemic and is expected to be relevant for a couple of decades (Andrews *et al.,* 2021). These concerns are in the forms of social unrest and oil spills that degrade the environment leading to the disruption of normal life in the oil producing areas.

Oil spill is the unintentional release of liquid petroleum hydrocarbon into the environment as a result of human activities and it is a form of pollution (Ndeh *et al.,* 2017). It is one of the most challenging environmental consequences of oil exploration, production and transportation. Aside from the anthropogenic causes of oil spills, they might sometimes be caused by natural disasters. Oil spill hazards have resulted in loss of property, impacts on livelihoods and displacement of individuals in the affected communities. The collective impacts of oil spill on the environment and local inhabitants are worsened by seasonal flood which transfers the oil pollution to farmlands (Nriagu *et al.*, 2016).

There is a paradox of resource endowment on economic development with expectation that oil wealth can translate into broad-based development and expectation is generally high among communities situated near oil development infrastructure as they hope to benefit from revenues, jobs, compensation payments, or other 'trickle down' effects to improve their economic well-being. However, numerous scholarly researches show that coastal communities remain on the sidelines of these developmental prospects, bearing many costs without receiving commensurate benefits due to lack of skills which limit job access, environmental impacts negatively affecting local livelihoods, and unresolved governance dilemmas across different scales and actors (Andrews *et al.,* 2021).

The negative effects of oil prospecting and production activities in Ibeno Local Government Area (LGA) result from oil spill incidences are common features. This requires prompt response to avoid fatalities and destruction of the ecosystem, vast installations of equipment and livelihood assets. Oil spill response is aimed at minimizing damage and reducing the time for environmental recovery, this however is impossible without active participation by all relevant stakeholders one of which the host community plays a vital role (Chang *et al.,* 2019).

Coastal inhabitants worldwide face a constant dilemma between economic development and pressures towards resource conservation. The Niger Delta region of Nigeria is home to valuable natural resources providing livelihoods in farming and fishing. Ibeno LGA is rich in crude oil with numerous oil mining companies speckled across its territory; this has contributed immensely to the economy of the area. The aboriginals of Ibeno LGA are predominantly farmers and fishermen, the activities of oil prospecting and exploitation is perceived to have negatively affected their livelihoods.

Livelihood has different meanings which include the capabilities, assets; natural, physical, human, financial, and social capital, diverse activities and access to these assets as facilitated by institutions and social relations that collectively determine the living gained by individual homes (Oduro *et al.,* 2015). In line with this thinking, livelihood has been defined as "a means of earning money to live" or simply as "a means of living" (Jack, 2018 and Kassa, 2019). Livelihood is considered environmentally sustainable when it can manage and recover from stresses and shocks while maintaining and enhancing its capabilities and available assets both in the present and in future and not undermining the natural resource base (Ellis, 2000; Fikru, 2008). This is further justifiable when it enhances the local and global assets on which community's livelihood depends, and has net beneficial effects on the source of revenue of others.

In view of this, households often respond to changes in the quality and quantity of livelihood assets available to them by adopting new livelihood strategies or adapting old ones in ways that allow them to take advantage of new opportunities and/or mitigate the effects of development. For example, they may shift from subsistence to commercial agriculture, invest in non-agricultural income-generating activities, find non-farm waged employment or diversify their income sources (Armah *et al.,* 2010).

Livelihood strategies are the actions taken by individuals and households to improve upon or maintain their current well-being. The strategies help in coping with impoverishment using a stock of livelihood assets at the family's disposal. For example, a household may choose to produce its own food because it has access to land or some household members may participate in wage employment because they possess some employable skills (Oduro *et al.,* 2015). In the light of the foregoing, the aim of this study is to assess the changing patterns of the inhabitants as response to oil spills in Ibeno LGA of Akwa Ibom State, Nigeria.

2.0 Research Problem

According to Orimoogunje (2013) oil spills have posed a major threat in Ibeno LGA and its environment, in the form of destruction of the ecosystem, mangrove swamps and farmlands. This has caused serious economic losses to local inhabitants, who depend mostly on fishing and subsistence farming for their livelihoods. Currently, communities within Ibeno LGA are allegedly lacking sustainable livelihood assets although several strategies have been employed to adapt to the effects of prevalent changes in the environment. As a result, the economy of the region has changed due to population influx for oil and gas exploration and production by oil companies and the incessant effect of oil spills on their way of life. Communities in Ibeno LGA where spills occur experience crop lose, land degradation and lose of aquatic life as a result of deposits of spilt oil retained in the environment especially in the case of non-moving water (Tonbra, 2021). Oils spills effects are seen on surface of water and land, affecting fishing, cultivation and tourism which are key livelihood activities of many coastal communities (Andrews *et al.,* 2021).

Where the current situation is not addressed, it has perhaps led to shortage in food production, increase in cost of food items and youth restiveness as a result of loss of jobs. Many studies carried out in the study area have been on the effect of oil spills on the physical environment, the land, air and water but not on the strategies employed by inhabitants to cope with the prevailing economic challenges. Research in the area of livelihood change as a result of oil spills in Ibeno LGA is scanty. It is against this background that this research was embarked upon to assess oil spills and changing community livelihood patterns in Ibeno LGA.

3.0 Study Area

The study area, Ibeno LGA lies between latitudes 4^{o} 30' and 4^{o} 36' north of the Equator and longitudes 7^{o} 48' and8^{o} 18' east of the Greenwich Meridian. It is located in the southern part of Akwa Ibom State in the Niger Delta region of Nigeria. Ibeno LGA consists of 23 villages. It stretches for

about 40km from Eastern Obolo on the west through Okposo I to the estuary of the Cross River on the east. It is bordered by Oron on the east and Eket, Esit Eket and Mbo on the north. It is bordered by the Atlantic Ocean on the south and shares borders with Onna and Eastern Obolo LGAs on the west as shown in Figure 1. The total population of Ibeno LGA according to the National Population Commission (1996) was 93,277 persons. Hence the projected population of Ibeno LGA to 2023 was 228,152 persons.

Figure 1: Map of Ibeno LGA

Oil spills have led to severe socio-economic breakdown, mangrove ecosystem destruction and the adverse effects of environmental degradation leaving those who are earning a living from the environment jobless. Aquatic lives have also been destroyed with the pollution of traditional fishing grounds, exacerbating hunger and poverty in the fishing communities (Odjuvwuederhie, *et al.*, 2006).

The effects of frequent oil spills on these economic activities are encroachment in farmlands, displacement of community members from their ancestral homes, livelihoods and properties worth millions of naira. According to Olusiyi (2009), when oil spills occur, the economic activities of the people tend to be paralysed. Oyebamiji and Mba (2014) affirmed that oil spills on land destroy crops and damage the quality and productivity of soil that communities use for farming. However, water pollution caused by oil spills is a serious threat to the marine ecosystem (Alvernia *et al.*, 2021).

4.0 Review of Related Literature

Globally, the amount of oil spilt into water bodies and land raises concern as it affects the sustainability of coastal and marine life as well as the livelihoods of the inhabitants of the communities it occurs. In Nigeria, records indicate that the first oil spill took place in Bomu on the 19th July 1970 during which 150 barrels of oil were spilled (Mobil Producing Nigeria 1998 and 2010). Other notable incidents are presented in Table 1.

Table 1: Volume of Oil Spills in Nigeria

S/N	Date	Incident Site	Cause	Estimated Spill volume (Barrels)
1	1978	Shell Petroleum Development Corporation (SPDC) Forcados Terminal Tank		580,000
2	1979	Forcados		600,000
4	1980	Texaco Funiwa 5 well blowout	Fire outbreak	400,000
5	1980	Oyakama		30,000
6	1981	Forcados Ogulagha and Neighbouring villages	Blow out in tank5	
7	1982	Abudu pipeline	Sabotage	18,818
8	1983	Oshika		10,000
9	1992	Bikorogha	Pipe Leakage near a valve,	
10	1994	Odimodi Laboseigha Barki Creek and surrounding forest, Okorobientuaye Creek,	Leakage of pipeline	
11	1995	Yeye, Sekebolou Obotobo I		
12	1996	Tuomo	Leakage from trans Ramos trunk line	
13	1998	Idougbene Creeks Funiwa		
14	1998	Idoho–QIT	Pipeline Leakage	40,000
15	2001	Bomu		150
16		Ibaba		
17	2012	NNPC pipe line at Arepo, and Egba villages	Fire out break as a result of vandalization	
18	2018	24" Nkpoku-Bomu Pipeline at Bera.	Sabotage	19
19	2018	Imo River 2 Well 31L Flowline at Odagwa-Umuadeo kwara Land	Sabotage	0.1
20	2018	14” Okordia-Rumuekpe Pipeline at Akaramini	Sabotage	81
21	2018	20” Otumara - Escravos Pipeline at Ugboegungun	Sabotage	172
22	2018	36” Nkpoku - Bomu Pipeline at Rumuesara Eneka	Sabotage	622
23	2018	Imo River Well 59T Flowline at Igiriukwu_Owaza	Sabotage	0.2
24	2018	6’’ Obigbo North - Ogale Pipeline at Ogale	Sabotage	72
25	2018	16’’ Egbema - Assa Rumuekpe Pipeline at Assa	Sabotage	34

Sources: National Mirror (2012); Shell Nigeria (2018)

Spilled oil generally has negative effect on sources of livelihood in communities where they occur, be it on land or in water bodies thereby affecting their livelihood activities. UNDP (2006) reported that over 60% of those dwelling in the Niger Delta region rely on their physical surroundings for survival. Hence, oil spills on their environment means impact on their livelihoods. According to Agbodi *et al.* (2015) spilled oil in the aquatic environment may cause damage to aquatic lives in a number of ways. It may form slick either buried in the sediments or stranded on the river banks, thereby preventing oxygen diffusion into the water affecting activities of aquatic life forms. Water pollution is a threat to water quality, the marine ecosystem and sea resources. Oil spills tend to destroy plants and animal life giving rise to a change in the ecology of the coastal zone if not properly cleaned. Aquatic life forms including phytoplankton, aquatic macro-phytes, mangroves, larvae, amphibians, crustaceans, bivalves, oysters, lobsters, crabs and other fauna are usually destroyed in the event of oil spill pollution.

Further research by John (2018) on the petroleum hydrocarbon pollution in Qua Iboe River estuary revealed that oil spills from petroleum exploitation and exploration have significant effect on the aquatic resources and the water quality in Ibeno LGA. He added that water pollution in Ibeno is thus a serious concern as location of major oil companies and oil servicing establishments are found within Ibeno LGA, thereby making oil spillage a major issue of concern. Quite often, the quantity of oil spill at a time is so great that even fishes find it difficult to adjust to the polluted state of the marine environment. Environmental pollution arising from oil spills is capable of degrading, altering or forming part of a process of degrading the quality of many parts of the environment (Ekpenyong and

Udofia 2015). Similarly, oil spill affects the sources of livelihood of the residents and influences their kind of occupation. The deforestation and degradation of the forests affect practitioners of the above-indicated livelihoods negatively. The destruction of mangrove forests has led to the near depletion of periwinkles and crabs (Tonbra, 2021).

Wildlife, forestry and biodiversity are major natural resources and capital assets of the coastal zone. The natural resource base, land, water bodies and biodiversity provide rural households in lower income countries with food, shelter, and medicines, which are variously gathered and hunted in common lands and waters. These resources are natural capital and sources of livelihood for the rural community dwellers (Ellis, 2000). Where they are mismanaged it deals serious blow on the livelihood and economy of these persons that wholly depend on these resources to survive (Bhandari, and Grant, 2007). With the available sources of livelihood, agriculture is the mainstay of livelihood for majority of households in the study area while salary jobs, skills and non-farm jobs make up alternative sources of livelihood.

Jack (2019) asserted that owing to oil pollution, several households who were engaged in Traditional livelihoods in the Niger Delta region such as fishing and farming abandoned same as a result of poor returns on investments triggered by oil pollution. In a way of offering solution to the situation, he stressed that diversification of livelihood by farmers and fishermen significantly promote income. Hence, other forms of livelihood activities include lumbering, palm wine tapping, canoe carving, hunting and palm oil production, periwinkles and crabs harvesting. All of these livelihood activities are also affected by oil pollution.

There is no doubt that the disastrous effects of oil spills in the Niger Delta region of Nigeria impact the environment negatively and influences the socio-culture, occupation of residents and living conditions of the inhabitants of this region. (UNEP, 2011 and Paul, 2015)

Literature on the operations of the international Oil Companies (IOCs) in the Niger Delta region and the numerous causes of oil spills show that their activities have more adverse effects than good on the communities. Ejiba *et al.* (2016) described the effects of IOCs on the rural areas as source of displacement and distortion of the rural society. The negative effect of IOCs activities and oil spills promotes stagnated agriculture and rural - urban migration. In line with Ejiba *et al.* (2016), Chijioke *et al.* (2018) supported that IOCs are rather instrumental to underdevelopment in the rural areas. Agriculture, which is the major source of income of the natives, is destroyed and the rural economy of the rural communities experiences a serious decline. The IOCs operating in the Niger Delta communities at intervals initiates socio-economic development programmes in the region, but research shows that some of these projects implemented are based on the wrong perception of the host communities' needs (Amadi and Tamuno, 2001).

In line with above, Ebegbulem *et al.* (2013) critically assessed the effect of oil exploration on poverty in the Niger Delta region of Nigeria. The author's extensive review of the literature and drawing conclusion from the empirical findings restated the neglect of the region and the consequences of pollution as a drawback to economic progress. It was concluded in the study that the greatest negative tendency associated with oil exploration and exploitation in the Niger Delta region is environmental degradation.

The effect of oil spills in the Niger Delta region is enormous that Lawal and Ese (2012) reported that oil spills in the region is under-reported. Conversely, Lawal and Ese (2012) had it that independent estimates showed that at least 115,000 barrels (15,000) tons of oil are spilled into the delta every year, making the Niger Delta one of the most oil impacted ecosystems in the world and this leads to productivity losses as reported by UNDP Report (2006). Similarly, in the UNDP report, Opukri and Ibaba (2008) stated that oil production worsened environmental disaster and has affected fishing and other agricultural activities in the region. Complementing the above statement, Anee (2014) researched on the challenges of communities' development; stated that development starts only when a man is able to take control of his environment, to manipulate and manage progressively everything in that environment to increase his production and productivity of all those things he needs to live a qualitatively better life. Anee (2014) saw communities' development as including physical transformation of downtrodden and degraded habitats to the presence of modern infrastructures, buildings, town-halls/ civic centres, standard school buildings, Airports, Model hospitals, access to internet, mobile networks, good and standard roads, good road network, bridges, standard shopping malls, electricity and pipe borne water. Yet findings from available studies particularly Nwabuenyi

(2012) and Omorogbe (2013) indicated that farms, houses and the socio-economy of oil producing communities are experiencing negative effects through thermal pollution and oil spillage.
A correlation of the poor living conditions of the locals and underdevelopment in the Niger Delta shows a positive relationship between the effect of oil exploration activities and the degree of underdevelopment in the area (Amadi and Tamuno, 2001). Duru (2010) precisely emphasised that complete neglect by successive governments and massive degradation in the region, caused by oil production, export activities and crude oil spillage over the years contributed immensely to the bane of the region.

As earlier stated, farming and fishing are major means of livelihood within the Niger Delta communities and surpluses are sold to raise income. Economic impacts of pollution are really felt in farming and fishing, forest and biodiversity, household items and occupational tools. While the impact on farming leads to low crop yield, low income, high cost of food, shortage of food items and general food insecurity, reduction in spending and loss of livelihood. The impact on fishing comes in the form of shortage of fish, low income, high cost of fish, loss of livelihood and reduction in spending. Economic impact on forest and biodiversity leads to depletion of animals and economic trees, reduction in hunting, loss of livelihood and low income. As a result of declining resources due to threat to livelihoods, persons in the affected communities re-strategize and device means to diversify their livelihood activities, while deliberate attempts are made to cut-down consumption in the mist of increasing live expectancies.

Affirming these, Jack (2018) averred that due to oil pollution, several households who are engaged in traditional livelihoods in the Niger Delta region such as fishing and farming are abandoning same to other livelihood activities because of poor economic returns caused by oil pollution. These diversifications involve non-agricultural livelihoods in a bid to raise their standard of living to cushion the limitations associated with the reliance on a single mainstream economic activity. It is a non-stop coping process that involves embarking on supplementary livelihoods in addition to the traditional livelihood activities or completely moving away from traditional ones for new livelihood activities to increase sources of livelihood (Ellis, 2000). Fikru (2008) adduced that complementary livelihood activities increase productivity and reduce poverty as these terns to create more employment and reduce rural-urban drift in search of work and increase economic growth. Considering the impact of oil pollution, Awoniyi and Salman (2012) insisted that agricultural households that do not combine non-agricultural activities are more prone to poverty. Diversification infers operating varieties. Diversification of livelihood by farmers and fishers significantly promote income. The more diversification by households, the more income they attract to themselves as well as increase in growth and standard of living.

5.0 Research Methodology

Survey design was used to derive data for analysis. The approach employed the use of questionnaire, oral interview and field observation. To ensure a dependable and reliable result, Ibeno LGA was split into five strata for data gathering. For the questionnaire administration, a simple random sampling was adopted to select the number of communities and systematic sampling technique was used to select households. The sample size was determined using Taro Yamane statistical distribution techniques; descriptive statistical technique was employed to analyse the data gathered.

The population of the study comprised the settlements within Ibeno LGA. According to the National Population Commission (1996), the population of Ibeno LGA was 93,277 and the population of the sampled communities was 44,531. With a population growth rate of 3.5%, the projected population of Ibeno LGA to 2023 was approximately228,152 people and the projected population of the sampled communities was108,921 persons.

For the purpose of this study, simple random sampling technique was used to select eighteen communities out of the 23 communities in the study area. The sampled communities are listed in Table 2. The study area was stratified into five strata (Ibeno East, Ibeno West, Ibeno South, Ibeno North and Ibeno Central) and the questionnaire was systematically distributed to the households in the individual communities. The population size was projected from the National Population Census figure. Similarly, with the 1998 National Population Policy, the total number of households in a

settlement was derived by dividing the projected population figure by estimated household size of six. For the sample size, the number of households for each settlement was divided by the sum of the households in the study area and multiplied by the total number of sample size of 398.

Descriptive analysis was used to summarize and describe numerical data in the form of tables, percentages and graphs. The contents of the questionnaire used included strategic information reflecting the various proposed variables as stated above.

Table 2: Sampling Framework of the Study

S/N	Name	Population 1996	2023 Projection	No of Household	Sampled Size
1	Atabrikang	969	2,290	382	7
2	Ntafre	141	333	56	2
3	Iwuokpom	1,785	4,218	703	16
4	Okorotip	1,394	3,294	549	13
5	Ikot Iwang,	2,102	4,968	828	19
6	Opolom,	3,887	9,186	1,531	35
7	Iwuochang,	5,682	1,3428	2,238	51
8	Ukpenekang,	7,856	1,8566	3,094	70
9	Mkpanak,	7,690	1,8173	3,029	69
10	Itak Abasi,	1,081	2,555	426	7
11	Inua eyet Ikot,	381	900	150	4
12	Ndito Eka Iba	3,990	9,429	1,572	36
13	Itak Afaha	1,163	2,748	458	10
14	Itak Idim Ukpa	327	773	129	3
15	Itak Idim Ekpe	586	1,385	231	6
16	Okposo	2,908	6,872	1,145	26
17	Okposo 2	1,293	3,056	509	12
18	Okom Ita	1,296	3,063	511	12
	Total	44,531	108,921	17,541	398

Source: Researchers' compilation (2023)

The sample size for the study was determined using the Taro Yamane formula:

n= N/1 +[1 N (e) ^2].....Eq (i)

Where: n= sample population, N= finite population, e = the level of significance (0.05), and 1 = Unit (or Constant),

Substituting values into the equation, n = N/1+ [1 N (e) ^2]

N = 44,531/ [1+44,531. (0.05)^2]

N = 44,531/ [1 + 44,531. (0.0025)]

N = 44,531/ 112

N = 398

Table 3: Independent Variables

Variables	Definition	Unit of Measurement
Oil spill Occurrence	Frequency of oil spills	Number
Spill quantity	Volume of spill/sqm of the study area	Bbl

Note: Bbl - Barrels

Table 4. : Dependent Variables

Variables	**Definition**	**Units Of Measurement**
Change from fishing to Civil services	Persons that have changed from fishing to government employment	Number
Change from farming to trading	Persons that have change from farming to buying and selling	Number
Change from hunting to other activities.	Persons that have changed from hunting to other activities like carpentry, petty trading and hairdressing	Number
Dominant livelihood (occupational) activities.	Major occupational activities	Percentage
Poor condition of living	Poor condition of living of the people	Number
Vulnerability	Health Risks as a result of oil spills	Number
Food security	Rate of crop yield as a result of oil spills	Number
Rate of development	Development influenced by oil spill	Number
Household dependency	Ability to meet family needs when oils spill has impacted the natural source of livelihood of family members.	Number
Sickness outbreak	Potential outbreak of sickness as a result of oils spills	Number
Acquisition of skills	Acquisition of new skills as a coping strategy after oil spills	Number
Loss of livelihood	Loss of sources of livelihood as a result of oil spills.	Number

6. Data Presentation, Analysis and Discussion

This section presents the data gathered from the field in line with the aim of the research; and interpretation of the result.

6.1 Volume of Oil Spills in Ibeno LGA

Table 5: Volume of oil spills in Ibeno LGA

S/N	Year	Incident site	Terrain	Cause	Estimated spill volume (bbl)
	2012	Qua Iboe oil field	Water	EQF	400,000 barrels
	2012	Qua Iboe oil field	Water	EQF	200 barrels
	2013	Idoho PP	Water	EQF	14.26 barrels
	2014	Edopp PP	Water	EQF	5.19 barrels
	2014	South west of Okoro terminal	Water	EQF	2.76 barrels
	2014	QIT Processed area	Land	PL	30,260 barrels
	2014	Ibeno Water		EQ F	15000 barrels
	2014	Ubit Wellhead platform	Water	EQF	
	2015	QIT	Water	FM	6.97 barrels
	2016		Offshore	FM	600,000 barrels
	2016	Eneh Awa	Land and Water	COR	580,000 barrels
	2020	Usari FP	Water	EQF	
	2021	Ibeno QIT	Land		1.29 barrels 12,400 barrels

Note: EQF(Equipment Failure), COR (Corrosion), PL (Pipeline Leakage), FM (Force Majeure)
Sources: NESREA (2012), Sahara Reporters Newspaper (2014), Daily Post (2016), Business and Human Right Resource Centre (BHRRC) (2016)

Table 5 presents volumes of oil spilled in various locations in Ibeno LGA. Data gathered, showed that in 2012, two oil spill incidents occurred at Qua Iboe Oil field and a total of 400,200 barrels of oil was discharged into the environment. The terrain of impact was the water bodies and the possible cause of the incident was equipment failure. In 2013, oil spill incident occurred at Idoho platform releasing a total of 14.26 barrels of oil into water bodies as a result of equipment failure. A total of four oil spill incidences occurred in Ibeno LGA in 2014 releasing a total of 15,038.21 barrels of oil into both land and water environments, caused by equipment failure, pipeline leakage and force majeure respectively. In 2015, a total of 6.97 barrels of oil was spilled into the environment as a result of corrosion at the QIT. In 2016, two oil spill incidents occurred in Ibeno LGA, at Eneh Awah and Usari platforms as a result of corrosion and equipment failure discharging a total of 1,180,000 barrels of crude oil into both water and land environments. In 2020, a spill incident was recorded in Ibeno LGA which led to a loss of 1.29 barrels of crude oil into water bodies as a result of equipment failure. In

2021, oil spill incident occurred at the QIT releasing 12,400 barrels of oil into the land environment as a result of equipment failure.

According to the data gathered, the highest incident of oil spill in Ibeno LGA from 2012 to 2021 was recorded in 2016 with two incidents resulting to the loss of 1,180,000 barrels of crude oil. The second highest during this period was in 2012 discharging a total of 400,200 barrel of oil and the third highest oil spill incident was recorded in 2014 leading to a loss of 15,038.21 barrels of oil.

Table 6: Summary of Mean Scores for Changes in Livelihood Pattern

Communities	Fishing to civil service	Farming to trading	Hunting to other activities	Other activities to farming
Atabrikang	4.6	3.1	3.7	3.1
Ntafre	3.5	4.5	4.0	3.5
Iwuokpon	4.0	3.5	4.0	4.5
Okorotip	4.0	4.5	4.0	4.0
Ikot Iwang,	4.5	5.0	4.5	3.0
Opolom 4.5	4.2	4.6	3.0	3.0
Iwuochang,	4.2	4.3	4.7	2.5
Ukpenekang,	4.5	4.6	4.6	2.5
Mkpanak,	4.5	5.0	5.0	4.0
Itak Abasi,	5.0	5.0	4.1	3.1
Inua eyet Ikot,	3.5	3.8	4.0	3.5
Ndito Eka Iba,	4.0	3.7	3.5	3.5
Itak Afaha,	4.5	5.0	3.5	3.5
Itak Idim Ukpa,	3.7	4.7	4.0	3.7
Itak Idim Ekpe,	4.7	4.5	4.0	4.0
Okposo 4.7	4.5	4.5	4.5	4.7
Okposo 2	3.2	4.0	4.5	3.2
Okom Ita	3.2	4.0	4.5	3.2
Total	77.0	83.7	77.8	80.9

Source: Researchers' compilation of data from field (2023)

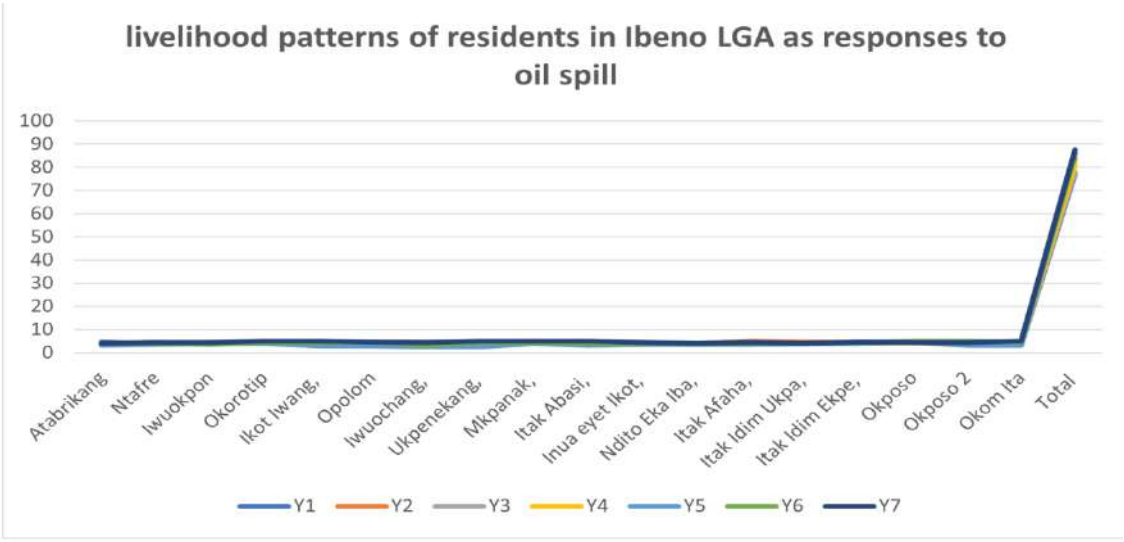

Figure 2: Graphical representation showing the Summary of Mean Scores for changes in Livelihood pattern

Source: Researchers' compilation of data from field (2023)

Table 6 shows the summary of mean scores for livelihood patterns in the various communities in Ibeno LGA and illustrated graphically in Figure. For Atabrikang community, change from fishing

to civil service recorded 4.6; change from farming to trading recorded 3.1, the response for change from hunting to other activities stood at 3.7: change from other activities to farming recorded 3.1. For Ntafre, gradual change from fishing to civil service recorded 3.5, while a shift by the residents from farming to trading recorded 4.5. Change from hunting to other activities was slightly above average and stood at 3.0. Change from other activities to farming recorded a mean score of 3.5. For Iwuokpom, gradual change from fishing to civil service recorded 4.0, while a shift by the residents from farming to trading recorded 3.5. Change from hunting to other activities was slightly above average and stood at 4.0. Change from other activities to farming recorded a mean score of 3.5. In Okorotip, change from fishing to civil service recorded 4.5, Change from farming to trading recorded 5.0, the responses for change from hunting to other activities and change from other activities to farming were 4.0 apiece. In the case of Ikot Iwang, the mean score of persons that have changed from fishing to civil service stood at 4.5. In the same vein, mean score of those that changed from farming to trading was 5.0. Respondents' responses for change from hunting to other activities stood at 4.5. Change from other activities to farming response indicated a mean score of 3.0, For Opolom, gradual change from fishing to civil service recorded 5.0, while a shift by the residents from farming to trading recorded 5.0. Change from other activities to farming was slightly above average and stood at 4.6. The survey in Iwuochang shows that the mean score of persons that changed from fishing to civil service stood at 4.2. In the same vein, mean score of those that changed from farming to trading was 4.3. Respondents' responses for change from hunting to other activities revealed a mean score of 4.7. Change from other activities to farming recorded a mean score of 2.5. For Ukpenekang, change from fishing to civil service recorded 4.5, change from farming to trading recorded 4.6, the responses for change from hunting to other activities stood at 4.6, change from other activities to farming recorded 2.5. For Mkpanak, gradual change from fishing to civil service recorded 4.5, while a shift by the residents from farming to trading and change from hunting to other activities recorded a mean score of 5.0. Change from other activities to farming recorded 4.0. Itak Abasi, was not really different as mean scores of persons that changed from fishing to civil service was 5.0, the swap from farming to trading stood at 5.0. Mean score for change from hunting to other activities was 4.1. Change from other activities to farming recorded a mean score of 3.1. Inua Eyet Ikot recorded 3.5 as mean score for change from fishing to civil service, 3.8 for change from farming to trading, 4.0 for changed from other activities to farming, 3.5 for both change from other activities to farming. For Ndito Eka Iba, change from fishing to civil service recorded 4.0; change from farming to trading recorded 3.7.The responses for change from hunting to other activities recorded 3.5, change from other activities to farming. In the case of Itak Afaha, the mean score of persons that have changed from fishing to civil service stood at 4.5. Similarly, mean score of those that changed from farming to trading stood at 5.0. Responses for change from hunting to other activities change from other activities to farming. For Itak Idim Ukpa, gradual change from fishing to civil service recorded 3.7, while a shift by the residents from farming to trading recorded 4.7. Change from hunting to other activities stood at 4.0. Change from other activities to farming. Itak Idim Ekpe recorded, 4.7 as mean score for change from fishing to civil service, 4.5 for change from farming to trading. A mean score of 4.0 for both change from hunting to other activities and change from other activities to farming. In Okposo the survey reveal that the mean score of persons who changed from fishing to civil service was 4.7. The swap from farming to trading, from hunting to other activities and from other activities to farming, all recorded a mean score of 4.5. With a slight variation from the former, Okposo 2 recorded a mean score of 3.2 for change from fishing to civil service and 4.0 changed from farming to trading. Change from hunting to other activities stood at a mean score of 4.5. While change from other activities to farming stood at 3.2. Lastly, Okom Ita recorded a mean score of 3.2 for change from fishing to civil service. While a shift by the residents from farming to trading recorded 4.0. The change from hunting to other activities recorded 4.5 and change from other activities to farming was 3.2.

The result of the survey reveals a shift from fishing to civil service in communities like Atabrikang, Opolom, Iwuochang, and Itak Abasi with a mean score of 5.0. Communities like Ikot Iwang, Ukpenekang, Mkpanak, Itak Afaha, Itak Idim Ekpe and Okposo recorded between 2.5 and 4.7 as mean scores. The rest of the communities have mean scores of between 3.2 and 3.5. For change from farming to trading, not fewer than seven (7) communities out of the 18 sampled for study recorded 5.0 as mean score while the rest recorded within the range of 3.1 and 4.7. Consequently, for change from hunting to other activities as a result of crude oil spill impact on the environment, only

Mkpanak recorded the highest mean score of 5.0. Iwuochang recorded 4.7, while Opolom recorded 4.6. Other communities like Ikot Iwang, Okposo, Okposo 2 and Okom Ita recorded 4.5 as mean scores. Other communities like Ndito Eka Iba, Itak Afaha, Atabrikang, Ntafre and Itak Abasi recorded mean scores within the ranges of 3.5 and 4.1. For change from other activities to farming the mean scores of between 2.5 and 4.5 were recorded for the entire communities. No community recorded a mean score as high as 5.0.

7.0 Discussion of Findings

This section presents the discussion of findings on the livelihood patterns of residents in Ibeno LGA as response to oil spills on their socio-economic lives.

It is established that livelihood activities of residents are greatly influenced by the occurrence of oil spills. This result agrees with Alvernia (2021) whose study affirmed that the effect of oil spill incidences on people is the loss of livelihood, which generates a significant case of unemployment. The result of the various variables analysed, showed a significant change from farming to trading with a percentage of 74.1%.

The assertion that change from farming to trading is as a result of oil spills is in line with Ndeh *et al.* (2015) whose study assessed the effect of oil spillage on agricultural soil in Ukpenekang, he discovered that crude oil contaminated soils affects crop yield and toxic heavy metals are ingested by plants. Chijioke, Ebong, and Ufomba (2018) affirmed that oil spills do not only affects the chemical properties of the soil, but also result in poor soil fertility leading to poor crop productivity in the study area as well as polluting of rivers and streams where fishing activities were carried out for subsistence up keep of the family, hence the reason some residents diversify into trading. Information gathered during the study have it that there is a low fish catch as a result of oil spill pollution and fishermen go as far as deep off-shores for fishing.

8.0 Conclusion

To cope with negative events, adverse factors and shocks that affects households' livelihoods during oil spill disasters, residents adopt strategies that help cushion the effects of these challenges on their economic lives by choosing other livelihood options like trading, skill acquisition training with respect to the various asset endowments to reduce poverty and curb health challenges.

9.0 Recommendations

The following recommendations were made based on the findings of the research in order to mitigate the current and impending risk associated with the effect of oil spills on the resident in the study area.

i. Oil operators should be more proactive in monitoring and servicing their pipelines and operations to stem down the frequency of oil spills.

ii. Government should establish effective policy enforcement strategies and programmes to ensure that polluters carryout effective remediation of the impacted sites to mitigate the adverse effect of oil spills on the environment.

iii. Oil operators and Non- Governmental Organizations (NGOs) should train residents on new and sustainable skills for them cope with present economic realities of their environment as marks of corporate social responsibility. This will help to achieve poverty reduction and community empowerment for sustainable development.

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RISK IDENTIFICATION OF RAILWAY REHABILITATION PROJECTS IN NIGERIA

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Abstract
Railway projects are complex and are characterized by variety of risks. Risks are events that impact projects objectives, hence, the need to effectively and efficiently manage them. The research focuses on risk identification being the first step of risk management process. Because risks are different for same projects at different locations, the study thus aimed at establishing risks inherent in railway rehabilitation projects typical to Nigeria. It identified risks inherent in railway projects in Nigeria and assessed their severity. To achieve these objectives, Delphi technique was adopted through the administration of a two-rounds questionnaire leading to the development of risk profile for railway projects rehabilitation works. The data collected was analyzed using relative importance index while confirmatory factor analysis was used to ascertain the variables in the construct. The results show 71 railway risks typical to rehabilitation works in Nigeria grouped into nine categories, with technical risks classification having the highest number of 20 risks while material and equipment risks classification have the lowest risk number of two. Based on the RII the most severe risks include variation of construction material prices, theft and vandalism on site, civil work delays and continuity and bad weather each having RII value of 1.00. It is recommended that organizations should imbibe the culture of keeping risk register to help future projects risk identification. Risks abound for rehabilitation railway projects, as such, organizations should ensure their identification at the inception of every project to guarantee successful project delivery.
Keywords: *Nigeria, Railway Rehabilitation Projects, Risk identification, Risk Management.*

1.0 **INTRODUCTION**

Construction projects generally involve risks due to its nature. Risk in construction project can affect its budget, quality, performance and productivity. Risks are events that impact projects objectives which can be either positive or negative. It is very important to manage projects risks by mitigating the negative risks and exploring the positive risks. In the framework of project management theory and methodology is project risk management (PRM). The importance of PRM in project management functioning cannot be overemphasized as its efficiency significantly influences project performance (Kinyua, Ogallah, & Mburu, 2015). Rehabilitation construction projects are performed under a series of communication, coordination, and cooperation to integrate many works and arrange complicated interfaces in a limited working area. As a result, they are faced with so many expected and unexpected challenges. Consequently, negligence during construction works or inadequate plan could lead to occurrences of accidents and cause great damage of lives, assets, environment, and the society (Railway Reconstruction Bureau, 2009).

Risks are inherent in every project including the railways. Railway rehabilitation works usually face challenges such as: limited available working areas, particularly when it comes to the management of machineries, materials, personnel, and dynamic access; remaining the normal operations of original railway system and maintaining safety at work areas; managing fluent traffic flow nearby construction sites; remaining the functions of the pipelines in or nearby construction sites through the temporary works of hoist, reroute, or transfer; protecting nearby residential buildings and facilitating as well as managing safety of residents and pedestrians near job sites; using customized equipment to perform works on the job areas with restricted spaces such as height limitations under existed bridges; corresponding to current regulations of environment protection, noise, vibration, and air and water pollutions (Nieto-Morote & Ruz-Vila, 2011). According to Datta and Mukherjee (2001) railway rehabilitation project is highly complex and has many potential risks which commonly result in huge losses, it is therefore necessary to implement risk management on such rehabilitation railway projects in order to salvage the losses. Consequently, the risk associated with the railway rehabilitation project can be reduced or even eliminated by the implementation of systematic risk management process comprising risk identification, risk assessment, analysis, and selection of appropriate risk response strategy - risks might be positive or negative (PMI, 2019).

Several previous studies in developed and developing countries have identified and classified railway risks. For example; Suh (2000) identified 30 risks classified into three (social and political, engineering/construction and financial). Andric, Wang and Zhang (2019) identified 24 railway risks, Yang (2018) identified 13 railway risks, Inac and Vayvay (2018) identified 31 railway risks, and Fang, Marle, Zio and Bocquet (2012) identified 56 railway risks all classified into six while Vishwas and Gidwani (2017) identified 20 risks classified into seven. Although studies exist on risks identification of railway projects, however, little was found on risks specific to Nigerian railway projects, with emphasis to risk identification, this represents a gap in literature to be covered. Hence, this paper focuses on the first step of risk management process which is risk identification of railway projects. It deals with negative risks as the impact of negative risks will unpleasantly affect the project success. Since very limited research is conducted in the past on this topic risk identification in Nigerian railway projects, this paper gives detail understanding of the topic by determining risks inherent in Nigerian railway rehabilitation works and their severity.

2.0 LITERATURE REVIEW

2.1 Project Risk and Project Risk Management

Study on risk has increasingly become a point of shared interest between many entities representing different sectors. This gave rise to different but converging definitions of risk. Risk has been defined both qualitatively and quantitatively. Risk can be defined qualitatively as the potential of loss or injury resulting from exposure to hazards, (hazard is being considered as source of danger that is not associated to the likelihood with which that danger will actually lead to negative consequences) while quantitative definitions of risk associate hazards with their probability of nuisance to the people and the environment (Berrado *et al*., 2011; Chou *et al*., 2012). This quantitative definition of risk aims to estimate the degree or probability of loss related directly to the occurrence of hazards or potential failures of a system. The Project Management Institute defined project risk as an uncertain event or condition that if it occurs, has an effect on at least one of the project objectives such as scope, schedule, cost and quality (PMI, 2019).

The concept of risk management has grown within the field of Project Management (PM) since the inception of PM, though there are still a lot of theoretical problems and implementation lacks. Modern risk management has evolved from this issue of physical harm that may occur as a result of improper equipment or operator performance. According to the PMBOK® Guide, Project Management (PM) is "the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements" (PMI, 2010). Many risk management methodologies and associated tools have been developed now in the context of PM, with qualitative and/or quantitative approaches, often based on the two concepts of probability and impact (or severity) of the risky events. Project management is accomplished through the appropriate application and integration of a number of grouped PM processes comprising of five process groups: initiating, planning, executing, monitoring and controlling and closing. Project risk management (PRM) is a crucial and an indispensable aspect of the PM because it is among the thirteen knowledge areas that determines project success.

The objectives of PRM are to increase the probability and impact of positive events, and decrease the probability and impact of negative events in the project (PMI, 2019). Because of the uncertainty nature and the potential for change, the project risk management process is iterative and goes through progressive elaboration throughout the project's life cycle. Classical PRM process is comprised of four major phases: risk identification, risk analysis, risk response planning, and risk monitoring and control (Li et al., 2021).

2.2 The Railways

Railways are safe land transport systems when compared to other forms of transportation. It plays a significant role in the sectoral development and overall growth of any economy; It opens up regions, hinterlands and rural areas by facilitating agricultural development as well as facilitates the growth of cottage/large scale industries (Prastowo, & Purba, 2020). It also attracts residential, commercial educational and recreational settlements and developments around its corridor (Apanisile & Akinlo, 2013; Muktar, 2011; Okobi & Ugo, 2014). Furthermore, it is part of the logistics chain, which facilitates the international trading and economic growth in most countries. Railway transport is

capable of high levels of passenger and cargo utilisation and energy efficiency in contrast to road transport, where vehicles run on prepared flat surface. Due to the role it performs in growth and development process, railway transport system is seen as the mainframe around which an integrated national transport system is built. It capacity, which is further accentuated by its safety and security factors, coupled with its ability to travel longer distance with ease and lower unit costs, places it in good stead to serve as the hub of a transport system of a nation (Muktar, 2011; Okobi & Ugo, 2014; Rodrigue & Slack, 2013).

2.3 Risks in Railway Projects

Studies have been conducted in recent years on risks in railway projects for effective and efficient delivery. Such studies accept the fact that railway projects are complex and challenging, as such, are exposed to variety of risks. Thus, an understanding of the risks inherent in railway projects construction is critical for construction practitioners to identify and analyze these risks as well as develop responding strategies proactively. Railway-related risks are those risks that have arisen specifically on railway projects execution. An extensive list of risks related to railway projects was compiled from a variety of literature sources including Chou *et al*. (2012); Zou, Zhang, and Wang (2007); Couwenberg (2015), Fang *et al*. (2012) and Sangsomboon and Yan (2014). These studies group the risks into nine categories, this is to aid in risk identification as well as enabling strategic approach to comprehensive management of risks on railway projects. The categories include: commercial and procurement; financial; contractual; force majeure; human resource; material and equipment; legal, social, political and economic; project management, physical and construction site; and technical risks classification. It should be noted that this categorization does not cover all the risk groups, but rather is design to facilitate risk identification for the construction experts and researchers.

2.4 Risk Identification, Tools and Techniques

Risk identification involves identifying all threats (risks) that could affect the achievement of project's objectives. Risk identification purpose is to assess possible risks and their consequences on the project's ability to achieve project targets. Risk identification might be from within or from external sources. Various risk identification tools and techniques abound and they include: questionnaire surveys, literature review, checklist, documentation review, brainstorming, Delphi technique, case studies of past projects (PMI, 2017).

As an integral part of risk identification, risk categorization structures the diverse risks that affect a project (Zou et al., 2007). Sharma and Gupta (2019) conducted research on risk identification and management in construction projects where they reviewed fifteen papers published from 1995-2019. The authors identified various methods of risk classification and discovered the most commonly used risk classification method is based on the nature of the risk (such as management, technical, financial to mention a few). Several previous studies by Andric, Wang and Zhang (2019); Yang (2018); Inac and Vayvay (2018); Patil, Shinde and Hailkar (2017); Vishwas and Gidwani (2017); Ellis (2016); Sangsomboon and Yan (2014); Fang Marle, Zio and Bocquet (2012); Zou and Li (2010) and Suh (2000) have classified railway risks in this way.

3.0 METHODOLOGY

Research Design: This study adopted the deductive approach as it considered theories, developed research questions, collected data, analysed the data collected and makes findings. Survey strategy is commonly associated to the deductive approach in research, hence, the study used the survey research strategy. According to Yang and Zou (2014), Fang *et al*. (2012) and Fang (2011), the survey design is the best design that can sample the opinion of experts in identifying risks and their sources as well as the collection of quantitative and qualitative data which can be analyzed using descriptive and inferential statistics. In surveys, data are collected through questionnaires, interviews and focus group discussions. This study employed the quantitative research method (using the questionnaire) because they are most suitable to achieve the objective of the study.

The population for this study include all registered contractors, architects, quantity surveyors, engineers, clients and all construction practitioners directly involved in railway projects. This is because they have rich experience in railway projects. The sample frame for this study was then chosen to be those professionals and other individuals who had been involved in more than one

railway projects in Nigeria (since information on risks specific to Nigeria is required). Although there is no official document stipulating the number of professionals that have been involved in railway projects in Nigeria, professionals who were involved in railway projects – staff of NRC were contacted directly, and were of great assistance because they also directed the researcher to others with whom they had worked with on railway projects in the past such as professionals in government organization (Federal Capital Development Authority (FCDA), Federal Ministry of Transport), contractor organization include (China Civil Engineering Construction Corporation - CCECC, Duluidas Nigeria Limited, Costain West Africa, Ansaldo Limited, and Lingo Limited); and consultant organization - Technics Engineering Architecture Marketing - TEAM) Nigeria Limited. The identification of risks typical to Nigerian railway projects rehabilitation works was done by surveying railway practitioners which include: five staff of the NRC from Lagos and Zaria in Kaduna state, five staff of CCECC from different locations of the country (Ogun, Lagos, and Kaduna), two staff of Duluidas Nigeria Limited, two staff of Costain West Africa and one staff of Roughton International Limited.

3.1 Questionnaire Survey

Literature focusing on risk in railway projects in other countries (developed and developing) was mainly investigated. The identified list of risks was organized based on synthesis of criteria in literature: Chou *et al*. (2012); Zou, Zhang, and Wang (2007); Couwenberg (2015), Fang *et al*. (2012) and Sangsomboon and Yan (2014)**.**

Data for the identification of railway risks in Nigeria was collected using the Delphi technique leading to the development of risk profile for rehabilitation works. In developing the list of railway project risks specific to Nigeria, two rounds of questionnaire survey were conducted. A list of railway risks developed from literature was given to experts who were chosen according to two criteria – they have more than 5 years' experience on railway projects and secondly, were most familiar with railway projects - those directly involved in the execution of railway projects and have handled more than one railway project. The respondents were to indicate whether or not the risk occurred on projects they participate and the severity of the risk on a 5-point Lekert scale ranging from 5 (extremely severe) -1 (insignificant). Relative Importance Index (RII) used for the analysis was computed based on the responses of the questionnaire, items with RII value less than 0.5 indicate that the respondents do not agree that the said item is a risk belonging to that particular risk category and were discarded.

Delphi technique according to Rikkonen *et al*. (2006) is a method for the structuring of a group communication process so that the process is effective in allowing a group of individuals, as a whole to deal with a complex problem. This technique has been used in the literature as a reliable empirical method for consensus reaching and has gained substantial acceptance across disciplines - project management inclusive (Bril *et al*., 2006**;** Czinkota & Ronkainen, 2005). This study chose to consult experts and practitioners due to the fact that no literature identified the complete list of railway project risks for rehabilitation works specific to Nigeria, whereas it is possible to get a good number of practitioners and experts who are versed in the specialized subject. This study consulted core railway project participants (construction professionals of different field) located across the country through e-mails who were involved in railway projects. A similar approach was adopted by Rostami (2016) in which core project participants were contacted via Survey Monkey and e-mails. The panelist for this study worked independently while responding to the two rounds of questionnaires. According to Chan *et al*. (2001) the iterative process produces new information for panelists in each round and affords them the chance to amend their assessments so that biases or personal, subjective opinions are minimized.

In the selection of the expert panel, to have a reliable result, purposive sampling technique was used to select the panel of experts who have extensive working experience in railway projects in Nigeria for both rehabilitation and new construction works, as well as experts that have been carrying out risk management in their projects and also have great understanding of risks in railway projects. The credibility of this study is guaranteed because responses were obtained from respondents with vast experience in railway projects rehabilitation and new construction works. The first round of the questionnaire was sent to 20 target respondents (comprising of the project manager, the civil engineer, quantity surveyor, architects among others in the contractor, consultant and client organisation). A total of 15 experts responded to the invitation and participated in the first-round survey for railway

project rehabilitation works, this gives a 75% response rate. All the 15 respondents also completed the second-round questionnaire.

4.0 RESULTS

4.1 Demographic information of respondents

The respondents' demographic information is presented in this subsection. The role regarding the railway project shows 40.0% of the respondents are subcontractors, 20.0% each are civil engineers and project managers respectively, and 13.3% are clients, while the least proportion 6.7% constituted others specify. Also, 6.7% of the respondents have 0-5years work experience on railway project, 20.0% of the respondents have 6-10years work experience, 33.3% of the respondents have 11-20years work experience, 26.7% constituted of respondents with 21-30years of work experience, while 13.3% consisted of respondents with over 30years of work experience respectively. Correspondingly 6.7% of the respondents have 6-10years of work experience on construction works, 11-20years indicated 13.3% work experience, 46.7% consisted of respondent with 21-30years of work experience, while 33.3% of the distribution consist of those with over 30years of work experience and no respondent fall within 0-5 years work experience on construction projects.

Meanwhile 66.7% of the respondent indicate that their organization undertake 1-10 railway project in the past 10 years, 20% indicated over 11-20 projects, while 21-30 project consisted of the least proportion of 13.3%. Moreover 46.7% of the respondents often implement risk management in their railway projects, while 26.7% of the respondents always implements and same proportion (26.7%) rarely implement risk management with not sure respectively.

4.2 Risk Profile of Railway Project Rehabilitation works

Table 1 shows the results of the risk profile of railway projects for rehabilitation works. The findings show that 71 risks were identified by the respondents for rehabilitation works. Based on the risk categories, 20 (28.17%) of the identified risks belong to Technical risks classification; 11 (15.49%) risks are Contractual risks classification; 9 (12.68%) risks are Socio-|Economic risks classification; 8 (11.27%) risks each are Procurement risks classification and also financial risks classification; 5 (7.04%) risks each are Human Resource risks classification and Project Management risks classification; 3 (4.23%) risks are Force Majeure risks classification and 2 (2.82%) risks are Material and Equipment risks classification.

Accordingly, the result of the severity of risk based on the relative importance index (RII) (see Appendix Table 2) showed the most severe risks overall include variation of construction material prices belonging to financial risks, theft and vandalism on site (contractual risk category), civil work delays and continuity (contractual risk category) and bad weather (force majeure risk category) all having RII value of 1.00.

The result for procurement risk category in descending order based on severity are: disputes which ranked first with RII value of 0.933, followed by breach of contract (0.867), Terminations and reduced revenue/profit (0.800 each), political instability and poor relationship (0.600 each) and litigation (0.533). For financial risk category, variation of construction material prices ranked first with RII value of 1.000, fluctuation of currency exchange rate (0.933), owner deferred payment (0.867), financial crisis and delay cost (0.800 each), funding source 90.733) finally inflation and cost overrun (0.533 each). For contractual risk category, theft and vandalism on site and civil work delay ranked first with RII value of 1.000, liquidated damages on intermediate milestone and delay of progress payment (0.933 each), delays due to client late decision and banks stop financing the work.

Table 1: Risk Profile for Railway Project Rehabilitation Works

S/N	Risk Description	Risk Category	S/N	Risk Description	Risk Category
1	Breach of contract	Procurement	37	Project condition difference	Project Management
2	Claims	Procurement	38	Veracity (accuracy) of soil survey and construction	Project Management
3	Terminations	Procurement	39	Owner offer construction information error	Project Management
4	Disputes	Procurement	40	Construction delivery delay	Project Management
5	Litigation	Procurement	41	Delays in material and equipment delivery	Material & Equipment
6	Poor relationship	Procurement	42	Unavailable material and equipment	Material & Equipment
7	Instability	Procurement	43	Taxation	Socio-economic
8	Reduced revenue/profit	Procurement	44	Energy use statement	Socio-economic
9	Financial crisis	Financial	45	Technology Transfer	Socio-economic
10	Owner deferred payment	Financial	46	Political situation	Socio-economic
11	Inflation	Financial	47	Decision making process	Socio-economic
12	Funding source	Financial	48	Technical Constraints	Socio-economic
13	Cost overrun	Financial	49	Complexity of project	Socio-economic
14	Delay cost	Financial	50	Changes in policy and regulation	Socio-economic
15	Variation of construction material prices	Financial	51	Changes in salary	Socio-economic
16	Fluctuation of currency exchange rates	Financial	52	Reliability and availability targets	Technical
17	Vandalism on site	Contractual	53	Noncompliance contractual rolling stock	Technical
18	New local laws and regulations	Contractual	54	Overcost due to security requirements for trains	Technical
19	Delays due to client late decision	Contractual	55	Train performance	Technical
20	Operating certificate delay	Contractual	56	Deport delay	Technical
21	Discrepancies client/operator/concessionaire	Contractual	57	Error in the survey (topography)	Technical
22	Civil work delay and continuity	Contractual	58	Track installation delay	Technical
23	Potential risks of claim from civil work subcontractor	Contractual	59	Reengineering/redesign	Technical
24	Fare collection requirements	Contractual	60	Rolling stock delivery delay	Technical
25	Banks stop financing the project	Contractual	61	Design errors and omissions	Technical
26	Risk of partial rejection of request for extension of time (EOT)	Contractual	62	Completeness of design (plan and specifications incomplete or in conflict)	Technical
27	Cost of modifications not covered by EOT agreement	Contractual	63	Construction/operational, e.g. use of unproven/outdated technology	Technical
28	Bad weather	Force Majeure	64	Delays in design and design change	Technical
29	Natural environment	Force Majeure	65	Quality control	Technical
30	Personnel crisis (strikes of workers)	Force Majeure	66	Type of contract	Technical
31	Contractor management and experience	Human Resource	67	Specification	Technical
32	Contractor financial problem	Human Resource	68	Inappropriate construction planning	Technical
33	Subcontractor breach of contract	Human Resource	69	Safety in construction	Technical
34	Subcontractor management ability	Human Resource	70	Construction affect natural environment	Technical
35	Subcontractor financial problem	Human Resource	71	Procedure of procurement	Technical
36	Project condition unable forecast	Project Management			

project (0.867 each), conflicting information between client/operator/concessionaire and risk of partial rejection of request for extension of time and cost of modification not covered by extension of time agreement (0.733 each) operating certificate delay and potential risk of claim from civil works subcontractor (0.600) finally new local laws and regulations and fare collection requirement (0.533). For project management risk category, owner offer construction information error ranked first with RII value of 0.857, construction delivery delay (0.800), veracity/accuracy of soil survey and construction (0.786), project condition unable to forecast (0.714), finally project condition difference (0.643). For force majeure risk category, bad weather ranked first with RII value of 1.000, personnel crisis (0.733), and finally, natural environment (0.643). For human resource risk category, subcontractor breach of contract ranked first with RII value of 0.800, followed by contractor management and experience and also subcontractor financial problem (0.667), contractor financial problem (0.600) and finally subcontractor management ability (0.533). For material and equipment risk category, delays in material and equipment delivery ranked first with RII value of 0.867, followed by unavailable material and equipment (0.667). For socio-economic risk category, taxation, technical constraints and complexity of project ranked first with RII value of 0.800 each, followed by technology transfer and changes in salary (0.800), changes in policy and regulations and political situation (0.733) and finally energy use assessment (0.667). For Technical risk category, inappropriate construction planning, delays in design and design change ranked first with RII value of 0.933, followed by specifications and design errors and omission (0.867 each), rolling stock delivery delay (0.857), deport delay, error in the survey, track installation delay, reengineering/redesign and

procedure of procurement (0.800 each), construction affect natural environment and scope of procurement (0.733 each), train performance, quality control and completeness of design (0.667 each), type of contract, over-cost due to security requirement and noncompliance contractual rolling stock (0.600 each), lastly, reliability and availability target (0.533).

5.0 Discussion

The study from the review of the literature identified 153 railway risks (see Appendix Table 2), each of these 153 risks is assigned to one of the nine main classifications identified from the literature reviewed in the study. Risks according to Marle and Vidal (2011) are classified for the purpose of easy identification and treatment which could be in any of the following format: (1) either they are grouped according to their nature (financial risks, technical risks and the like), or (2) grouped according to their numerical attributes (probability, impact or criticality) or (3) according to their risk owner (client, contractor and the like). The 153 identified risks were classified into: commercial and procurement risks classification, financial risks classification; contractual risks classification; force majeure risks classification; human resource risks classification; material and equipment risks classification; legal, social, political and economic risks classification; project management, physical and construction site risks classification; and technical risks classification.

Since there is no existing list of railway project risks specific to rehabilitation works in Nigeria, the study used a generic list of risks and their classifications from previous studies. The identified risk classifications are global classifications and the 153 risks are generic in which not all of the classifications and risks fits into every society, country or railway projects. Furthermore, a two-round Delphi questionnaire survey was conducted with railway project experts who identified risks with their classifications specific to Nigerian railway projects from inception to operation and maintenance. The study established 71 railway project risks for rehabilitation works classified into nine for easy identification and treatment. As stated above based on the study of Marle and Vidal (2011) on the different method of risks classification, some authors combined both risk classification by nature and by risk owner. However, in the cause of the study it was discovered that these classifications may not necessarily be sacrosanct, there could be a merger or a combination of one or two or all, what is most important in the classification is to ensure that all the risks are taken care of and are appropriately accounted for. It was also observed that maintaining a particular method is important that is why this study adopted the Marle and Vidal (2011) first classification, based on the nature of the risks. Additionally Sharma and Gupta (2019) in their study conclude that risk classification based on the nature of the risk is the commonly used. Actually, the nature shows how the risks evolved and what is most important is to understand the logic behind the risks which is best explained by the nature of the risk.

The result of the analysis shows little adjustment in the risk classification to the generic risk classifications. For example, commercial and procurement risks classification was adjusted to "procurement risks classification", the reason as stated by the respondents is because procurement has some aspect of commercial. Also legal, social, economic and political risks classification was adjusted to "socio-economic risk classification" because social factors can include political, cultural and legal. Finally, project management, physical and construction site risk classification was adjusted to project management risk classification because project management include physical and construction site works. The risks identified in this study for rehabilitation works are classified into nine based on the findings, they are: procurement risks, financial risks, contractual risks, force majeure risks, human resource risks, project management risks, material and equipment risks, socio-economic risks and technical risks. Several previous studies by Andric, Wang and Zhang (2019); Yang (2018); Inac and Vayvay (2018); Patil, Shinde and Hailkar (2017a); Patil, Shinde and Hailkar (2017b); Vishwas and Gidwani (2017); Ellis (2016) Sangsomboon and Yan (2014); Fang Marle, Zio and Bocquet (2012); Zou and Li (2010) and Suh (2000) have classified railway risks in this way.

But the dynamic nature of risks according to Al-Harthi (2015) have increased the number and sources of risks that are now experienced in the construction industry and many processes have become cyclical and interdependent, furthermore, there is need for effective management of risk classifications in order to avoid uncertainties that could have serious effect on other classifications which will ultimately impact on the entire project negatively. The findings in this study are similar with the findings of Sangsomboon and Yan (2014) having nine risk classifications. The established

risks specific to Nigeria, their classifications as well as their distribution for railway projects rehabilitation works is shown in Table 1.

6.0 Conclusion

This paper has accomplished its aim which is to establish risks inherent in railway projects for rehabilitation works and their criticality. Identification of risks inherent in railway projects is critical in the risk management process leading to the overall project success. This paper has reported on the determination of risks inherent in railway rehabilitation works, and ranked the risks in order of their severity, to enable proper planning of the project as perceived by the respondents contributing to the development of risk management strategies for railway rehabilitation works in Nigeria. The paper established 71 risks classified into nine.

It is found that a number of risks are related to the technical risk classification. Technical risks include risks that are associated with the construction process, design and technology. The risks include technology and system integration of design and construction which is synonymous with the nature of railway and infrastructure construction projects. From design view point, technical risk is defined as the inability to build a product that satisfies the requirement, and it usually transpires from the consultant or project team.

The established risks and their criticality are intended to help industry professionals in managing a project proactively at a more cost effective. Conclusively, this paper is hoped to give guiding principle to professionals that are involved in construction, particularly in railway rehabilitation projects.

7.0 Recommendations

The following recommendations are made as a result of the findings of this research.

i. Organizations should imbibe the culture of keeping a risk register to help future projects risk identification.
ii. Risks abound for rehabilitation railway projects, as such, construction practitioners should ensure their identification at the inception of every project to guarantee effective project risk management leading to successful project delivery.
iii. When embarking on any railway rehabilitation project, project managers should ensure that the most severe risks are mitigated with high priority for successful project delivery

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APPENDIX

Table 2 presents a confirmatory factor analysis for the variables in the construct (the various risk categories) items that have a factor loading more 0.6 are accepted as measure of the construct (the various risk categories as applicable), while items with factor loadings less than 0.6 are not good measures of the said construct and are suggested to be removed from the construct (the various risk categories as applicable). Relative Importance Index (RII) is also computed based on the responses of the questionnaire, items with RII value less than 0.5 indicate that the respondents do not agree that the said item is a risk belonging to that particular risk category.

Table 2: GENERIC RAILWAY PROJECT RISK

S/N	Risks Description	Factor Loading	RII	Remark
A.	**COMMERCIAL AND PROCUREMENT RISK (C & P RISK)**			
1	Breach of contract issue	0.940	0.867	Is a C & P risk
2	Claims	0.801	0.867	Is a C & P risk
3	Warranty problems	0.564	0.333	Is not a C & P risk
4	Terminations	0.840	0.800	Is a C & P risk
5	Intellectual property infringement charges	0.579	0.286	Is not a C & P risk
6	Alleged confidentiality disclosure	0.595	0.154	Is not a C & P risk
7	Disputes	0.648	0.933	Is a C & P risk
8	Litigation	0.828	0.533	Is a C & P risk
9	Poor relationship	0.997	0.600	Is a C & P risk
10	Failure to obtain objectives	0.545	0.333	Is not a C & P risk
11	Bad public relations	0.998	0.400	Is not a C & P risk
12	Declining morale	0.753	0.233	Is not a C & P risk
13	Political Instability	0.886	0.600	Is a C & P risk
14	Weaknesses of brand integrity	0.821	0.333	Is not a C & P risk
15	Loss of goodwill	0.684	0.400	Is not a C & P risk
16	Reduced revenue/profit	0.818	0.800	Is a C & P risk
17	Size of the project, links to other procurement	0.877	0.467	Is not a C & P risk
18	Budget constraints and immovable timescale	0.742	0.333	Is not a C & P risk
19	Type of contract	0.679	0.167	Is not a C & P risk
20	Dispute resolution	0.553	0.333	Is not a C & P risk
B	**FINANCIAL RISK**			
21	Insurance deductibles	0.536	0.400	Is not a financial risk
22	Exchange risks on suppliers	0.925	0.200	Is not a financial risk
23	Tax risk on onshore	0.624	0.467	Is not a financial risk
24	Exchange risks	0.529	0.467	Is not a financial risk
25	Risk of kidnapping/banditry and youth restiveness	0.528	0.333	Is not a financial risk
26	Available cash flow decrease	0.715	0.233	Is not a financial risk
27	Capital tension supply	0.721	0.333	Is not a financial risk
28	Project cost control	0.886	0.200	Is not a financial risk
29	Financial crisis	0.507	0.800	Is a financial risk
30	Owner deferred payment	0.598	0.867	Is a financial risk
31	Expenses of overspend	0.631	0.400	Is not a financial risk
32	Funding and budget constraints	0.976	0.333	Is not a financial risk
33	Inflation	0.650	0.533	Is a financial risk
34	Funding source	0.862	0.733	Is a financial risk
35	Accuracy of cost estimate	0.575	0.333	Is not a financial risk
36	Joint venture	0.937	0.400	Is not a financial risk
37	Cost overrun	0.987	0.533	Is a financial risk
38	Delay cost	0.856	0.800	Is a financial risk
39	Variation of construction material prices	0.582	1.000	Is a financial risk
40	Fluctuation of currency exchange rates	0.618	0.933	Is a financial risk
C	**CONTRACTUAL RISK**			
41	Liquidated damages on intermediate milestone and delay of progress payment threshold	0.867	0.933	Is a contractual risk
42	Vehicle storage in another city	0.975	0.200	Is not a contractual risk
43	Theft and vandalism on site	0.655	1.000	Is a contractual risk
44	New local laws and regulations	0.925	0.533	Is a contractual risk
45	Traffic signaling, priority at intersection	0.944	0.400	Is not a contractual risk
46	Unclear interface with the client, for infrastructure equipment	0.545	0.467	Is not a contractual risk
47	Delays due to client late decision	0.947	0.867	Is a contractual risk
48	Limited force majeure definition	0.934	0.267	Is not a contractual risk
49	Operating certificate delay	0.907	0.600	Is a contractual risk
50	Permits and authorizations	0.659	0.333	Is not a contractual risk
51	Archaeological findings	0.502	0.467	Is not a contractual risk

52	Conflicting information/discrepancies between client/operation/concessionaire	0.697	0.733	Is a contractual risk
53	Civil work delay and continuity	0.801	1.000	Is a contractual risk
54	Responsibility of client on civil work delay	0.526	0.400	Is not a contractual risk
55	Potential risks of claim from civil work subcontractor	0.844	0.600	Is a contractual risk
56	Non-compliance with technical specifications rolling stock	0.562	0.400	Is not a contractual risk
57	Shifting of utilities and contingency works	0.599	0.467	Is not a contractual risk
58	Fare collection requirements	0.546	0.533	Is a contractual risk
59	Risks of partial rejection of request for extension of time (EOT)	0.602	0.733	Is a contractual risk
60	Banks stop financing the project	0.836	0.867	Is a contractual risk
61	Cost of modifications not covered by extension of time agreement	0.777	0.733	Is a contractual risk
62	Extra trains	0.991	0.133	Is not a contractual risk
63	Waiting time at stations	0.591	0.467	Is not a contractual risk
64	Ticketing design delays	0.867	0.133	Is not a contractual risk
D	**FORCE MAJEURE RISK**			
65	Bad weather	0.729	1.000	Is a force majeure risk
66	Natural environment	0.767	0.643	Is a force majeure risk
67	Personnel crisis (strikes of workers)	0.813	0.733	Is a force majeure risk
68	Failure to complete projects within scope of owner's budget	0.921	0.467	Is not a force majeure risk
E	**HUMAN RESOURCES RISK**			
69	Contractor management and experience	0.855	0.667	Is a human resource risk
70	Contractor financial problem	0.574	0.600	Is a human resource risk
71	Sub-contractor breach of contract	0.630	0.800	Is a human resource risk
72	Sub-contractor management ability	0.698	0.533	Is a human resource risk
73	Sub-contractor financial problem	0.561	0.667	Is a human resource risk
74	Staff quality problem	0.967	0.133	Is not a human resource risk
75	Brain drain	0.584	0.333	Is not a human resource risk
F	**PROJECT MANAGEMENT, PHYSICAL AND CONSTRUCTION SITE (PMPC) RISK**			
76	Delay of energizing	0.973	0.333	Is not a PMPC risk
77	Risk on certification of equipment	0.588	0.367	Is not a PMPC risk
78	OCS installation	0.803	0.143	Is not a PMPC risk
79	Project condition unable forecast	0.869	0.714	Is a PMPC risk
80	Project condition difference	0.697	0.643	Is a PMPC risk
81	Veracity of soil survey and construction	0.661	0.786	Is a PMPC risk
82	Owner offer construction information error	0.629	0.857	Is a PMPC risk
83	Construction delivery delay	0.658	0.800	Is a PMPC risk
84	Public utility transportation	0.639	0.467	Is not a PMPC risk
85	Construction problems	0.988	0.133	Is not a PMPC risk
86	Land supply arrangement and requisition of land	0.790	0.200	Is not a PMPC risk
G	**MATERIAL AND EQUIPMENT RISK. (M & E)**			
87	Material Scarcity/delay	0.996	0.200	Is not an M & E risk
88	Delays in material and equipment delivery	0.600	0.867	Is an M & E risk
89	Unavailable material and equipment	0.691	0.667	Is an M & E risk
90	Material fluctuation	0.762	0.333	Is not an M & E risk
H	**LEGAL, SOCIAL, ECONOMIC AND POLITICAL RISK. (LSEP)**			
91	Government policy, uncertain regulatory environment	0.967	0.467	Is not an LSEP risk
92	Taxation	0.818	0.867	Is an LSEP risk
93	Public perception	0.774	0.200	Is not an LSEP risk
94	Technology transfer	0.949	0.800	Is an LSEP risk
95	Public perception on safety	0.646	0.200	Is not an LSEP risk
96	Decision making process	0.795	0.533	Is an LSEP risk
97	Changes in policy and regulation	0.756	0.733	Is an LSEP risk
98	Changes in salary	0.727	0.800	Is an LSEP risk
99	Environmental impact statement	0.856	0.200	Is not an LSEP risk
100	Transportation impact statement	0.581	0.133	Is not an LSEP risk
101	Energy use assessment	0.730	0.667	Is an LSEP risk
102	Long term viability	0.807	0.467	Is not an LSEP risk
103	Political situation	0.828	0.733	Is an LSEP risk
104	Reasonableness of projects	0.834	0.333	Is not an LSEP risk
105	Technical constraints	0.941	0.867	Is an LSEP risk
106	Complexity of project	0.525	0.867	Is an LSEP risk
J	**TECHNICAL RISK**			
107	Safety studies	0.574	0.133	Is not a technical risk
108	Traction/breaking function	0.653	0.333	Is not a technical risk
109	Travel time performance	0.591	0.467	Is not a technical risk
110	Reliability and availability targets	0.547	0.533	Is a technical risk
111	On board CCTV scope	0.878	0.200	Is not a technical risk
112	Noise and vibration attenuation	0.654	0.467	Is not a technical risk
113	Harmonics level	0.817	0.333	Is not a technical risk
114	Noncompliance contractual rolling stock	0.864	0.600	Is a technical risk
115	Over cost due to security requirements for trains	0.972	0.600	Is a technical risk

116	Track insulation	0.637	0.200	Is not a technical risk
117	Construction safety interfaces	0.707	0.200	Is not a technical risk
118	Electromagnetic interferences	0.925	0.333	Is not a technical risk
119	Interface rail/wheel	0.594	0.400	Is not a technical risk
120	Pedestrian zones	0.601	0.200	Is not a technical risk
121	Train performance	0.901	0.667	Is a technical risk
122	Depot delay	0.876	0.800	Is a technical risk
123	Error in the survey (topography)	0.826	0.800	Is a technical risk
124	Track installation delay	0.562	0.800	Is a technical risk
125	Reengineering/redesign	0.559	0.800	Is a technical risk
126	Slabs pouring delay	0.959	0.467	Is not a technical risk
127	Initial specification of civil work	0.931	0.133	Is not a technical risk
128	Rolling stock delivery delay	0.892	0.857	Is a technical risk
129	Safety standard	0.522	0.333	Is not a technical risk
130	Use of unproven/outdated technology (construction/operation)	0.615	0.933	Is a technical risk
131	Adverse climatic or geological condition	0.829	0.100	Is not a technical risk
132	Inappropriate construction planning	0.912	0.933	Is a technical risk
133	Inappropriate construction method	0.617	0.200	Is not a technical risk
134	Site working accident	0.609	0.200	Is not a technical risk
135	Supervision of construction deficiency	0.816	0.333	Is not a technical risk
136	Safety in construction	0.572	0.533	Is a technical risk
137	Construction affect natural environment	0.660	0.733	Is a technical risk
138	Track installation machine performance	0.735	0.133	Is not a technical risk
139	Design errors and omissions	0.798	0.867	Is a technical risk
140	Operation technology poverty lead to structure of potential defect	0.958	0.400	Is not a technical risk
141	Completeness of design (plan and specification incomplete or in conflict)	0.918	0.667	Is a technical risk
142	Delays in design and design change	0.595	0.933	Is a technical risk
143	Standard codes	0.902	0.400	Is not a technical risk
144	Project complexity	0.799	0.400	Is not a technical risk
145	System Integration	0.890	0.467	Is not a technical risk
146	Intellectual property rights	0.993	0.333	Is not a technical risk
147	Quality control	0.855	0.667	Is a technical risk
148	Type of contract	0.733	0.600	Is a technical risk
149	Contracting arrangement	0.863	0.467	Is not a technical risk
150	Labour type	0.849	0.467	Is not a technical risk
151	Specification	0.927	0.867	Is a technical risk
152	Scope of procurement	0.909	0.733	Is not a technical risk
153	Procedure of procurement	0.965	0.800	Is a technical risk

DEMAND AND SUPPLY DYNAMICS OF PUBLIC ELECTRICITY IN UYO URBAN, AKWA IBOM STATE, NIGERIA

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Abstract
The aim of the study was to assess the demand and supply dynamics of public electricity in Uyo urban, Uyo, Akwa Ibom State, Nigeria. Data was collected through field surveys using structured questionnaire to elicit responses from the respondents in the study area. Physical enumeration was carried out to identify all electricity infrastructure available and their locations within the study area, and their relative demand on public electricity was determined using an ideally estimated daily electricity supply of 18 hours. Correlation analysis was used to determine the relationship between the variables measured in the study. Findings revealed that the demand for public electricity is high due to the rapid growth and development of the urban area, occasioned by demographic and physical changes, and the plethora of socio-economic activities within the area. Public electricity supply was also found to be erratic and not able to meet the ever-increasing demand to meet the socio-economic needs of the people. It is therefore recommended that infrastructure provision be systematically done with facts and figures, rather than using the present-day random approach so as to match the demand with supply requirements
Keywords: *Demand, Supply, Public electricity, Infrastructure, Urban*

1.0 Background of the Study

Electricity undoubtedly plays a crucial role in the physical, industrial, and socio-economic development of society. Industrialization increases the demand for public electricity, consequently, creating the need for adequate public electricity infrastructure (World Bank, 1994). A world without electricity amounts to non-mechanized production while erratic and unstable supply of electricity disrupts production and impacts negatively on the durability of machines (UNIDO, 2010).

Electricity is universally considered as a critical factor of production besides labour and capital (Nelson *et al.,* 2013). Stern (2010) had noted that electricity is a central component in driving growth and scarcity of public electricity has a negative effect on economic growth. According to Onakoya and Yakubu (2017) there exists positive and bi-directional relationship between public electricity and economic growth. Similarly, Ayres and Warr (2005) had argued that historical declines in public electricity prices have been a major driver of economic growth. UNIDO (2011) attributed lack of development to dearth of public electricity

In spite of the above assertions, Sambo (2008) and Akinwale (2010) stated that electricity demand in Nigeria far outstripped supply with characteristic frequent outages. Over the years, Sambo (2008) and Akinwale (2010) reported that there has not been any significant change in this direction. Nigeria is reckoned as the lowest in power generating capacity, but with the highest population (Akintoye *et al.,* 2015). Per capita yearly consumption of electricity in Nigeria, according to available statistics from WorldData.info (2016) was put at 126 Kilowatt-hours (Kwh). This figure, according to Uduak and Ekong (2018) was far too low compared to the average per capita usage of electricity of 4,270 Kwh in Libya, 616 Kwh in India, 2,944 Kwh in China, 4,803 Kwh in South Africa, 8,307 Kwh in Singapore, and 13,394 Kwh in the United States.

The epileptic nature and limited power supply witnessed in Uyo urban and the country in general has been attributed to many factors. These include: lack of maintenance and expansion of infrastructure, ageing infrastructure, inadequate transmission and distribution networks, weak and radial network configuration, overloaded transformers, high transmission losses, vandalization of power lines and poor voltage profile (OTA, 1991; Uduak *et al.*, 2018; Nigeria Vision 20: 2020). At the level of the states, statistics are replete with inaccurate and unreliable data, reflecting exactly what the national scenario portrays (Uduak *et al.*, 2018). With this background in mind, this study intends to look into the electricity demand and supply of Uyo urban.

2.0 Research Problem

Uyo urban has since developed from a divisional headquarters in the early 1960s to a Local Government Area (LGA) headquarters and to its current status of a state capital city at the creation of

Akwa Ibom State in 1987. The rapid growth and development of the urban area, occasioned by the influx of people into the city over time has brought about demographic and physical changes within the urban setting. Consequently, there is increased demand for public electricity, not only for domestic and industrial purposes, but also for commercial, social and administrative concerns. This development, in turn, places a high demand on available public electricity supply infrastructure.

Whereas the demand for electricity by households and other uses increases astronomically in Uyo urban, the daily supply continues to decrease sharply. As such, the amount of electricity supply on a daily basis continues to fall short of meeting the needs of the people (Uduak *et al*., 2018). This development has left a lot of people with no other option than to look for alternative and costlier means of power supply like generators, fossil fuel and solar panels to satisfy their electricity needs. This scenario is associated with its attendant hazards and vulnerabilities. It also creates difficulty in assessing the actual public electricity demand and supply gap, which also poses a great deal of problem in balancing the demand-supply variation, as accurate statistics are not known. Therefore, inquiry into the electricity demand and supply differential, owing to the spate of urbanization experienced in recent times within Uyo urban, the study area is deemed necessary. In view of the above, the following hypothesis is formulated for this study: There is no significant relationship between public electricity demand and supply in Uyo urban.

2.0 The Study Area

Uyo urban, the study area, constitutes the built-up area of Uyo capital city, the administrative centre of Akwa Ibom State and areas declared by government as planning areas within Uyo LGA and its environs, which sprawl into some neighbouring LGAs (Ofem, 2012). It lies between latitudes 4° 30′ and 5° 05′ North of the Equator and longitudes 7° 54′ and 8° 00′ East of the Greenwich Meridian as presented in Figure 1.

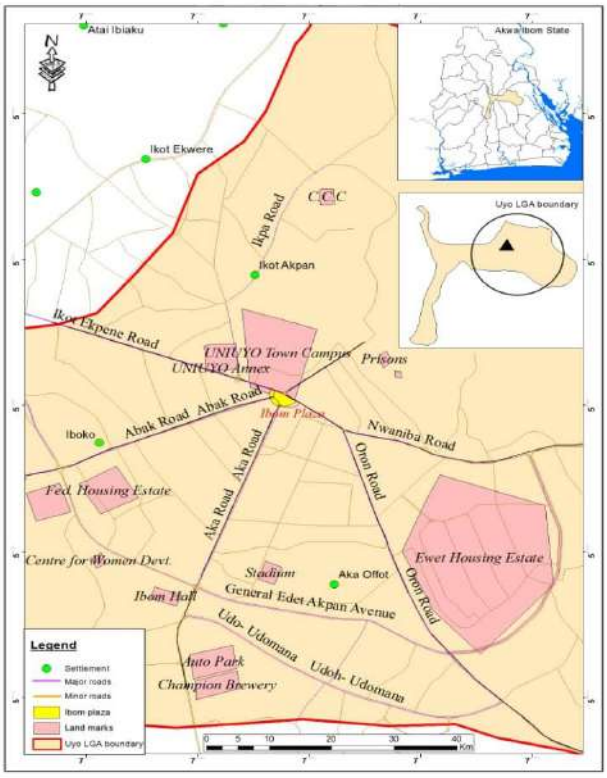

Figure 1: Map of Uyo Urban
Source: GIS Laboratory, Department of Geography and Natural Resources Management, University of Uyo, Uyo (2023)

The population of the neighbourhoods that make up Uyo urban from the 1991 census figures, stood at 288,688 persons. Projected to 2023, the population was 674,106 persons. This increase in population

due to urban dynamics over time places a huge demand for public electricity and adequate public electricity supply in the area.

4.0 Review of Related Literature

Public electricity demand is undeniably important in any society. It affects the economy which, in turn, affects the livelihood of the people (their income, health, and happiness). This, by extension, also affects their ability to meet basic needs, such as infrastructure, education and so on (Kayode *et al*., 2017). Access to electricity is particularly crucial to human development. This is because electricity, in practical terms, is indispensable for certain basic household activities, such as lighting, refrigeration and the running of household appliances. Narayan and Smyth (2005) analysed the residential demand for electricity in Australia using the Autoregressive Distributed Lag (ARDL) bounds testing co-integration approach. Annual data for 31 years from 1969 to 2000 for income, temperature, price of electricity and price of natural gas were included in the modelling. Findings revealed that income and price of electricity were the most important factors in the long-run. Temperature was found to be significant to a small degree, but the price of natural gas was not significant in the long-run. Amusa *et al*. (2009) also applied the ARDL approach on data for the period between 1960 and 2007 in South Africa. It was revealed that while the price of electricity had an insignificant effect on aggregate electricity demand, changes in income had an appreciable impact. They however advised on the need for pricing policies to ensure that electricity prices are cost reflective and that such policies should also enhance the efficiency of electricity supply and use.

A similar study was carried out on electricity demand and supply scenario analysis for Nigeria by Ibrahim and Kirkil (2018) using Long range Public Electricity Alternatives Planning (LEAP). They opined that electricity demand and supply forecasts are important tools for determining solutions to the problems in the electricity sector such as power outages. The LEAP modelling tool was used to project electricity demand and supply for a target year 2040. Three scenarios namely; Business As Usual (BAU), Public Electricity Conservation (PEC) and Renewable Public Electricity (RPE) were generated. The three scenarios were analyzed based on electricity demand and supply, environmental impacts and costs. The electricity demand in the target year of 2040 for the BAU and RPE scenarios increased to 283.6 billion KWh, while that of the PEC scenario increased to 233.8 billion Kwh from 35.9 billion Kwh in the base year, 2010. The PEC scenario had the least capital cost (44.2 billion USD less than the BAU scenario) and fixed costs (15 billion USD less than the BAU scenario); the PEC scenario also had the second largest quantity of Green House Gas (GHG) emissions - 1,004.8 million tons of Carbon (IV) Oxide equivalent (CO_2eq).

The RPE scenario had the least GHG emissions among the three scenarios (114.79 million tons of CO_2eq) but was to be the most expensive scenario to implement because of its high capital (56.3 billion USD more than the BAU) and fixed costs of 4.1 billion USD more than the BAU scenario). As a result of the economic challenges faced by Nigeria, the PEC scenario was found to be the most realistic path in providing uninterrupted power supply. The authors concluded that the growth in electricity demand in the BAU and RPE scenarios is attributed to the electricity access targets set by the Federal Government of Nigeria, which has increased the electricity demand. Electricity demand in the BAU and the REN scenarios will reach 283.6 billion KWh in 2040. This demand will be 233.8 billion KWh by 2040 in the PEC scenario which is 17.55% lower compared to the BAU and RPE scenarios. This reduction of electricity demand by the PEC scenario is because of the more efficient use of electricity and reduction in transmission and distribution losses. This reduction of electricity demand in the PEC scenario is advantageous over the BAU and RPE scenarios. This is because less electricity demand leads to a reduction in the amount of electricity to be supplied. Thus, for electricity generation to meet up with the demand, conscious capacity building efforts should be employed by both the government and relevant agencies. Adequate public electricity infrastructure that is commensurate with set targets of electricity generation should be consciously developed in line with policy directions. The business as usual syndrome should be eradicated to a great extent. Transmission losses should be avoided as much as possible through decentralization of transmission outlets. Public electricity conservation measures should be incorporated into the system as a matter of policy so as to take advantage of the benefits derivable from this exercise. This will not only improve upon the quantity of electricity generated, but also the quantity available for use by consumers (Amusa *et al*., 2009).

Aziz *et al*. (2013) conducted a study on factors affecting public electricity demand in developing countries using a dynamic panel analysis. They presented an empirical study of public electricity demand, in which demand is expressed as a function of various factors, such as income, price, economic structure, and CO_2 emission. Parameter values were estimated econometrically, using a panel data approach of 16 developing countries over a 30-year period. In general, the empirical results of this study confirmed the majority of the findings in public electricity demand analysis where income and price have shown to be important determinants in public electricity demand. Moreover, economic structure and also CO_2 emission appear to exert significant impact on public electricity demand. Short and long-run elasticity demands are estimated and some policy suggestions are given to improve public electricity saving and green public electricity consumption in developing countries.

Al-Azzam and Hawdon (1999) estimated the demand for public electricity in Jordan from 1968 to 1997. In addition to income and relative prices, they included a construction activity as an indicator of the development process. Controlling for changes in the political climate faced by Jordan, they incorporated dummy variables to represent the level of conflict in the region. Using a log-linear specification and the dynamic Ordinary Least Squares (OLS) method, they found out that income; construction activity and political instability have a positive statistically significant relationship with public electricity consumption. However, real price had only a neutral or weak effect. They concluded therefore that economic growth is likely to be accompanied by proportional increases in public electricity demand and hence environmental degradation. They also concluded that the lack of responsiveness of demand to price changes suggest that taxes on their own are unlikely to achieve governmental goals for public electricity conservation or environmental improvement, although they may well be efficient for revenue raising.

Narayan and Smyth (2005) found income to be very significant in the public electricity demand in the long run. The price of substitute and population were also very significant in the determination of the demand for electricity. Babatunde and Shaibu (2009) examined the residential electricity demand in Nigeria, using annual data from 1970 to 2006 for income, price of electricity, price of substitute and population. They found out that, contrary to Narayan and Smyth's findings, the price of electricity was significant. Whether the price of electricity is significant or not, as argued by the different schools of thought above, the authors opined that if public electricity substitutes are developed and the pricing kept well within the reach of the average Nigerian, then the sole demand for public electricity would be reduced to the barest minimum. This would not only reduce pressure on the limited quantity of electricity available, but would also buttress the quantity of electricity available for further distribution among the growing populace.

In the same vein, public electricity supply in urban areas an issue that researchers have considered over the years. For example, Chineke and Igwiro (2008) demonstrated that Nigeria receives abundant solar public electricity that can be usefully harnessed - an annual average solar radiation of about 5.25 KWh/m^2/day. This varies between 3.5 KWh/m^2/day at the coastal areas and 7 KWh/m^2/day at the northern boundary. The average amount of sunshine hours all over the country is estimated to be about 6.5 hours. This gives an average annual solar public electricity intensity of 1,934.5 KWh/m^2/year. Thus, over the course of a year, an average of 6,372,613 power joules/year (approximately 1,770 MWh/year) of solar public electricity falls on the entire land area of Nigeria. This is about 120,000 times the total annual average electrical public electricity generated by the Power Holding Company of Nigeria (PHCN). With a 10% conservative conversion efficiency, the available solar public electricity resource is about 23 times the Public Electricity Commission of Nigeria's (ECN) projection of the total final public electricity demand for Nigeria in the year 2030 (Oyedepo, 2014; ECN, 2022). To enhance the developmental trend in the country, there is every need to support the existing unreliable public electricity sector with a sustainable source of power supply through solar public electricity.

In terms of the consumption of electricity, a classification into three groups has been proposed (industrial, residential, and street light consumption). In 1970, the total electricity consumption stood at 145.3 MW/h; this increased to about 536.9 MW/h in 1980. However, in
2005, the total electricity consumption had increased to 1,873.1 MW/h (CBN, 2007). On the generation side, these values of 176.6 MW/h in 1970 increased to 815.1 MW/h in 1980. By the end of 2005, the achieved total electricity generation was 2,997.3 MW/h. Comparing the per capita power

generation to that of other countries, Nigeria has the lowest among the countries, while the USA has the highest per capita electricity generation (CBN, 2007).

In spite of the contribution of electricity to the total gross domestic product, it is evident that Nigeria is facing several problems. The failure of the electricity sub-sector to efficiently meet the demand for electricity in the country has been caused by a number of factors. This, in essence, has been detrimental to economic growth in the country. The Central Bank of Nigeria (CBN, 2000) identified numerous problems associated with the National Electric Power Authority (NEPA), (now PHCN). Among these are: Lack of preventive and routine maintenance of PHEDC's facilities. Frequent major breakdowns, arising from the use of out-dated and heavily overloaded equipment.

5.0 Research Method

The survey research approach was employed to gather data from the general population using survey instruments. The survey provided the data base required for the research analyses and outcomes through testing of the hypothesis.

The target population for the study was sampled by segmenting the study area into a number of squares using Spatial Sampling Framework. The population figures for these neighbourhoods were generated by projection from the 1991 census figures from the National Population Commission (NPC). This outcome formed the study population for the research. A total of 50 segments were obtained from the sub-division of the study area. As a result, 50 neighbourhoods, each with the highest population from the respective segments were selected. From the above figure, the number of households within the sampled 50 neighbourhoods for the study was determined by dividing the population figure by the mean household size of five persons (NPC, 1991), thus bringing the figure to 90,898 households. Sample population to be surveyed from the 90,898 households thus obtained for this study was derived by using the Taro Yamene formula for the estimation of sample population from a finite population size: $n = N/1+N(e)^2$, with 0.05 level of significance

Therefore, number of households for study: (n) $= \dfrac{90{,}898}{1 + 90{,}898\,(0.05)^2.} = 398.247$

The sample size for each settlement was obtained by dividing the number of households within the neighbourhood by the total number of households in the study area and multiplying the result by the total sample size of 398 households. Systematic Random Sampling technique was used to select households for the study. Structured questionnaire was administered on each of the respondents who were the heads of the households and the results compiled for data analysis. A detailed analysis of sample population for the study is presented in Table 1.

Table 1: Sample Population Projection (Sampled Communities)

S/N	Neighbourhood	1991 Popn.	2023 Projection	No. of Households	Sample size
1	Nkim Ibiono	490	1,222	244	2
2.	Ntak Inyang	311	775	155	2
3.	Ibiaku Uruan	3,922	9,778	1,956	9
4.	Iba Oku	899	2,241	448	3
5.	Nduetong Oku	899	2,241	448	3
6.	Afaha Oku	4,127	10,289	2,058	9
7.	Ekritam II	2,759	6,878	1,376	6
8.	Ikot Obio Enang	2,445	6,095	1,219	5
9.	Afaha Idoro	939	2,341	468	3
10.	Mbribit Itam	2,146	5,350	1,070	5
11.	Effiat Offot	4,179	10,418	2,084	9
12.	Ibiam	11,450	28,544	5,709	53
13.	Nsentip	10,727	26,742	5,348	49
14.	Udo Ekpo Inyang	12,277	30,606	6,121	57
15.	Atim Atakpo	11,174	27,857	5,571	51
16.	Udosen Uko	10,701	26,677	5,335	49
17.	Ekpo Obot	10,745	26,787	5,357	49
18.	Paul Bassey	9,965	24,842	4,968	46

19.	Asutan	8,987	22,405	4,481	41
20.	Anua Offot	6,521	16,257	3,251	14
21.	Ibiaku Offot	1,383	3,448	690	5
22.	Use Offot	3,674	9,159	1,832	9
24.	Ifiayong Usuk	2,778	6,926	1,385	6
25.	Obot Obom	695	1,733	347	3
26.	Nsukara Offot	1,706	4,253	851	6
27.	Ifa Ikot Okpon	616	1,536	307	2
28.	Itiam Ikot Ebia	1,226	3,056	611	5
29.	Atan Offot	3,387	8,444	1,687	7
30.	Anua Obio	813	2,027	405	3
31.	Obio Offot	2,006	5,001	1,000	6
32.	Use Ikot Ebio	640	1,596	319	2
33.	Ikot Asat	800	1,994	399	3
34.	Afia Nsit I	1,023	2,550	510	3
35.	Obio Etoi	908	2,264	453	3
36.	Mbierebe Obio	2,375	5,921	1,184	5
37.	Itiam Etoi	3,227	8,045	1,609	7
38.	Mbiabong Ikot Antem	1,232	3,071	614	5
39.	Mbak Akpan Ekpenyong	707	1,763	353	3
40.	Mbak Ikot Abasi	1,883	4,694	939	6
41.	Ikot Inyang Esuk	2,482	6,188	1,237	5
42.	Ifa Ikot Akpan	1,226	3,056	611	5
43.	Ikot Eeto	779	1,942	388	3
44.	Ikot Abasi Idem	440	1,097	21	2
45.	Afaha Atai	2,482	6,188	1, 238	5
46.	Ikot Iko	1,092	2,722	544	3
47.	Mbiokporo Nsit	3,423	8,534	1,707	7
48.	Oboyo Ikot Ita	3,056	7,619	1,524	7
49.	Mbiokot	707	1,763	353	3
50.	Afaha Ikot Osom	602	1,501	300	2
51.	Ikot Oku Obio	1,261	3,144	629	5
52.	Ikot Okure	1,751	4,365	873	6
53.	Mbikpong Atai	823	2,052	410	3
54.	Ibiaku Issiet	3,453	8,608	1,722	8
55.	Nung Udoe	5,037	12,557	2,511	11
56.	Nung Ukana	1,567	3,907	781	5
57.	Afaha Ikot Owop	2,189	5,457	1,091	5
	Total	183,083	456,304	90,898	648

Source: Computed by the researchers (2023)

Quantifiable measures in terms of numerical ratings and quantifications were used in the structured questionnaire to obtain data that were used in testing the relationship between the variables (dependent and independent) identified for the study. These variables are presented in Tables 2 and 3.

Table 2: Public electricity and public electricity infrastructure (Independent) variables needed for the study

Variable	Definition of Variable	Unit of Measurement
Electricity Demand	Quantity (Daily)	KWh
Electricity Supply	Quantity (Daily)	KWh
ELECTRIC INFRASTRUCTURE		
Power sub-stations		
Transformers		KWh
Electric Poles		Number
Meters		Number
ALTERNATIVE POWER SOURCES		
Generators		Number
Solar Power		Number
Cost of alternative sources		Naira

Source: Compiled by the researchers (2023) from literature review

The data collected on the basis of the variables were analysed using Factor Analysis to establish the strength of the relationship between them. An efficient model, customized to the studied environment was derived and simulated at 95% level of confidence. The statistical analysis software that was used to accomplish this task is The Statistical Package for the Social Sciences (SPSS), version 25. Multiple Regression Analysis was employed to investigate causal relationships between the variables. It was helpful in measuring the actual impact of each independent variable in predicting the outcome of the dependent variable. This technique could only be applied to make generalisation about a larger sample size. Udofia (2011) recommended 15 samples to arrive at a fairly accurate result. Hence, the adoption of this statistical technique was justified. The model is presented thus:

$$Y = a + b_1X_1 + b_2X_2 + \ldots\ldots\ldots\ldots\ldots + b_nX_n + e$$

Where: Y = dependent variable (contributions), Xes = independent variables (changes), a = the intercept, b = regression coefficient, and e = the residual or error term.

6.0 Data Presentation, Analysis and Discussion of Results

This section presents the data, analyses and discussion of the results of the research carried out in the study. The testing of hypothesis and the discussion of findings are also presented here.

6.1 Assessment of Public Electricity Demand in Uyo Urban

The study assessed the public electricity demand in Uyo urban using the data in Table 2.

Table 2: Electricity Use and Functionalities in Uyo Urban

Uses	Frequency	Percentage
Cooking	158	24.44
Washing	62	9.5
Ironing	55	8.52
Lighting	230	35.56
Entertainment	38	5.93
Business	86	13.21
Administration	14	2.10
Others	5	0.74
Total	**648**	**100.00**

Source: Field Data (2023)

Electricity use and functionalities as one of the indicators of public electricity demand in Uyo urban is presented in Table 2. The data indicate that the major use to which electricity is put into is lighting (35.56%). The other uses in order of priority are cooking (24.44%), business (13.21%), washing (9.5%), ironing (8.52%), entertainment (5.93%), administration (10%) and other uses such as heating and pumping of water. These reveal that lighting and cooking were the priorities of the users with respect to electricity demand.

Table 3: Electricity Demand Through Appliances Use

Appliance Use	Frequency	Percentage
Air-conditioners	24	3.70
Refrigerator	34	5.31
Deep Freezer(s)	17	2.59
Cooker(s),	75	11.61
Washing Machine(s)	23	3.58
Water heater(s)	41	6.3
Heating coil(s)	18	2.72
Electric kettle	15	2.35
Blender	16	2.45
Standing fan	61	9.38
Ceiling fan	55	8.52
Vacuum cleaner	10	1.48
Electric bulb	82	12.72
Clippers	37	5.68
Television	81	12.45

Radio	32	4.94
Hair dressing machine	13	1.98
Welding machine	6	0.99
Others	8	1.24
Total	**648**	**100.00**

Source: Field Data (2023)

The use of appliances was one of the indicators of public electricity demand in Uyo urban and the data as presented in Table 3 indicate that the major appliances used in the study area are electric bulbs (12.72%) and television sets (12.45%). The least appliance used is the welding machine (0.99%) which is an industrial machine. Judging from the information obtained, it can be said that the public electricity demand for industrial use in Uyo urban is low as most of the appliances with the highest use are household (domestic) appliances. This could be attributed to the fact that industrial activities depend, to a large extent, on alternative power supply rather than public electricity supply to meet their demands.

Table 4: Electricity Demand Based on Institutional Projections

Institution	Monthly Public Electricity Demand	Monthly Public Electricity Supply	Installed Capacity of Generating Plant
PHEDC	14,000MW	14,000MW	-
NIPP	-	-	191MW
NEMSA	-	-	-
TCN	100MW	57.1MW	144MW

Sources: Port Harcourt Electricity Distribution Company, National Integration Power Project and Transmission Company of Nigeria (2023)

The four institutions assessed gave varying information about the public electricity demand, supply and the installed capacities of their power generating sets as presented in Table 4. Both the public electricity demand and supply are low and the installed capacities of generating plants are equally small. Only the information from Transmission Company of Nigeria (TCN) indicates that the monthly public electricity supply (57.1MW) is lower than the demand for public electricity (100MW), indicating a shortfall in public electricity supplied. The data from TCN also show that the public electricity demand (100MW) is lower than the capacity of generating set (144MW). This could be attributed to the fact that the geographical area called Uyo urban is not an industrial area and therefore the power needs of the area may be low. Added to this is the fact that industries make their own power supply arrangements to suit their needs.

6.2 Public Electricity Supply in Uyo Urban

To determine the level of supply of public electricity in Uyo urban, data on the considered variables are presented here.

Table 5: Duration of Daily Power Supply

Duration of power supply	Frequency	Percentage
1 – 3 hours	163	25.14
3 – 6 hours	324	50
7 – 9 hours	61	9.42
10 -12 hours	50	7.72
Greater than 12 hours	50	7.72
Total	**648**	**100.00**

Source: Field Data (2023)

The data in Table 5 indicate that half of the study population (50%) received three to six hours of power supply daily. A quarter of the study population (25.14%) received less than three hours of power supply. The other quarter received daily power supply of above seven hours. Thus, it can be shown that the study area is in short supply of public electricity, that is, the power supplied does not meet the demands of the people in the study area.

Table 6: Duration of Daily Power Outages

Duration of power outage	Frequency	Percentage
1 – 3 hours	162	25
3 – 6 hours	203	31.33
7 – 9 hours	152	23.46
10 -12 hours	78	12.04
Greater than 12 hours	53	8.17
Total	**648**	**100.00**

Source: Field Data (2023)

To estimate power supply in Uyo urban, the level of power outages experienced by the people was considered. As presented in Table 6, about a quarter (25%) of the population of the respondents in the study area experienced a daily power outage of less than three (3) hours. A majority (31.33%) had a power outage of at least three (3) to six (6) hours daily. From the information gathered from the field survey, it can be said that the power supply in the study area is erratic not regular. This, to a great extent, could affect socio-economic activities in the study area. Also, the erratic power supply could lead to the damage of household electrical appliances as the exact time which the power outage would occur is not always known.

Table 7: Duration of Monthly Outages

Duration of power outage	Frequency	Percentage
1 hour - 1 day	30	4.63
2- 4 days	20	3.09
5-7 days	189	29.17
8-10 days	186	28.70
11-14 days	179	27.62
Above 14 days	44	6.79
Total	**648**	**100.00**

Source: Field Data (2023)

Table 7 presents the monthly level of power outages experienced in Uyo urban. Twenty seven percent (27%) of the respondents in the study area experienced a monthly power outage of 11 – 14 days. Majority (29.17%) experienced a monthly power outage of at least five to seven days. It revealed that the power supply in the study area is erratic and this affected socio-economic activities in the study area. Also, the erratic power supply could lead to the damage of electrical appliances of households as the exact time which the power outage takes place is not known. Daily power outages also increased the cost of doing business in the study area.

Table 8: Strength of Power Supply Received

Strength of power supply	Frequency	Percentage
Stable Voltage (206 – 220 Volts)	301	46.45
Low Voltage (120 –220 Volts)	248	38.27
Extremely Low Voltage (≤ 120 Volts)	99	15.28
Total	**648**	**100.00**

Source: Field Data (2023)

As a guide to determining the power supply in Uyo urban, the strength of power supply received by the people was studied. Table 8 shows that majority (46.45%) received relatively stable

voltage supply (206 – 220 Volts) – which is however less than the acceptable standard range (220 – 240Volts), 38.27% received low voltages (120 – 200 Volts) and 15.28% received very low voltage (below 120 Volts). Judging from the proportion of people who received low and extremely low voltages, it is revealed that the strength of the power supply received in the area is not enough to serve the inhabitants of the area.

Table 9: Alternative Sources of Electricity Supply

Alternative Sources	Frequency	Percentage
Generating sets	428	66.05
Solar power	28	4.32
Lantern	112	17.28
Candles	50	7.72
Fuel wood	10	1.54
Others	20	3.09
Total	**648**	**100.00**

Source: Field Data (2023)

Table 9 presents data on alternative sources of electricity supply. Due to the shortage in the supply of public electricity in the study area, alternative sources of electricity that the people use to augment public power supply were assessed. The data indicate that more than half (66.05%) of the respondents used generating sets as alternative sources of public electricity supply, while 17.28% used lanterns, 7.72% used candles, 4.32% added solar panels to their roof systems to generate power, 1.54% used fuel wood while 3.09% used other sources of electricity supply. The fact that more people used generating sets is an indication that the handling of petroleum products could pose risk to environmental safety in the study area.

Table 10: Monthly Cost of Alternative Sources of Power

Cost of Alternative Sources	Frequency	Percentage
₦1,000 - ₦3,000	59	9.11
₦3,100 - ₦6,000	198	30.56
₦6,100 - ₦9,000	209	32.25
₦9,100 - ₦12,000	106	16.36
Greater than ₦12,000	76	11.73
Total	**648**	**100.00**

Source: Field Data (2023)

The monthly cost of alternative sources of power supply by households in the study area is presented in Table 10. The data from the survey indicate that 32.25% (the majority) spent between ₦6,000 and ₦9,000 of their monthly income on alternative sources of electricity. This could be interpreted to mean that people in the study area spend more on alternative sources of power supply than on public electricity supply - which averages between ₦4,500 and ₦7,500 due to the shortage in public electric power supply. This is in addition to the statutory public electricity bills that must still be paid whether the public electricity is supplied or not.

Table 11: Institutional Public Electricity Supply Facilities

Institution	Facilities	Number	Installed capacity	Total Supply
PHEDC	Transformer sub-stations	4	14000MW	
NIPP	Generating plants	3	191MW	100MW
NEMSA	-	-	--	
TCN	Transformer sub-station	1	144MW	57.1MW

Source: Field Data (2023)

Table 11 presents data of four institutions, namely NIPP, NEMSA, PHEDC, and TCN on available power supply facilities in the study area. Findings reveal that the NIPP merely generates power and feeds onto the national grid as by the regulatory body, NERC while NEMSA is a monitoring agency. Thus, it can be seen from Table 11 that while the NIPP, has an installed capacity of 191MW, it could only transmit 100MW to the National grid due to restrictions by NERC. It does not also service Akwa Ibom State directly where it is located, nay, the study area for the same reason. The PHEDC has four transformer sub-stations. No information was available on their installed capacities, even though it claimed that the amount of electricity transmitted by the agency (14000MW) equals the demand of the study area.

Table 12: Public Electricity Supply Constraints

Institution	Constraints
TCN	Weak conductors, vandalism, overgrown vegetation around facilities, and natural conditions like heavy rainfall, windstorm, thunderstorm and floods
NIPP	Transmission to the National grid, cost of generating public electricity, inadequate subvention, and inadequate maintenance of facilities
NEMSA	Inadequate power transmitted, overloaded transformer sub-stations, dilapidated transmission and distribution network, ignorance on conservative use of public electricity by consumers, and public electricity theft
PHEDC	Breakdown of power infrastructure, vandalization of power infrastructure, inadequate generation of power, ageing infrastructure, transmission losses, and management issues

Sources: TCN (2023), NIPP (2023), NEMSA PHEDC (2023)

On the basis of information provided by the institutions interviewed as presented I n Table 12, it can be seen that most of the constraints confronting the four institutions are man-made and can be solved if those responsible are willing to. The only physical constraints are heavy rainfall, windstorm, thunderstorm and floods which destroy public electricity infrastructure and reduce the supply of public electricity, thereby causing shortages and interruptions in supply in the study area.

6.4: Testing of Hypotheses

The following hypothesis was formulated and tested in the study:

H_0 - There is no significant relationship between public electricity demand and supply in Uyo urban

Multiple correlation analysis technique was used to test this hypothesis with the following variables:

i. Supply Variables:X_1 = Number of hours of public electricity supply; X_2 = Number of hours of outages; X_3 = Number of days of public electricity supply; X_4 = Number of days of power outages; X_5 = Strength of power supply.
ii. Demand Variables:D_1 = Electricity Use; D_2 = Appliance use; D_3 = Frequency of appliance use.

The result of the analysis is presented in Table 13.

Table 13: Correlation between Demand and Supply variables.

Correlations

		X_1	X_2	X_3	X_4	X_5	D_1	D_2	D_3
X_1	Pearson Correlation	1	.365**	-.388**	.422**	-.352**	.218**	-.001	-.077*
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.980	.050
	N	646	646	646	646	646	646	646	646

X_2	Pearson Correlation	.365**	1	-.432**	.495**	-.400**	.113**	.023	-.052
	Sig. (2-tailed)	.000		.000	.000	.000	.004	.560	.186
	N	646	646	646	646	646	646	646	646
X_3	Pearson Correlation	-.388**	-.432**	1	-.664**	.543**	-.267**	-.062	.084*
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.116	.033
	N	646	646	646	646	646	646	646	646
X_4	Pearson Correlation	.422**	.495**	-.664**	1	-.646**	.310**	.026	-.116**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.511	.003
	N	646	646	646	646	646	646	646	646
X_5	Pearson Correlation	-.352**	-.400**	.543**	-.646**	1	-.231**	-.027	.040
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.485	.308
	N	646	646	646	646	646	646	646	646
D_1	Pearson Correlation	.218**	.113**	-.267**	.310**	-.231**	1	-.105**	-.115**
	Sig. (2-tailed)	.000	.004	.000	.000	.000		.008	.004
	N	646	646	646	646	646	646	646	646
D_2	Pearson Correlation	-.001	.023	-.062	.026	-.027	-.105**	1	.064
	Sig. (2-tailed)	.980	.560	.116	.511	.485	.008		.102
	N	646	646	646	646	646	646	646	646
D_3	Pearson Correlation	-.077*	-.052	.084*	-.116**	.040	-.115**	.064	1
	Sig. (2-tailed)	.050	.186	.033	.033	.308	.004	.102	
	N	646	646	646	646	646	646	646	646

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The correlation distribution indicates that out of the three demand variables, D_1, D_2, and D_3, only D_1 (Electricity use) correlated with all the supply variables, X_1, X_2, X_3, X_4, and X_5 at 0.05 level of significance (0.000, 0.004, 0.000, 0.000, and 0.000 respectively). The other demand variables, D_2 (.980, .560, .116, .511, and .485) and D_3(.050, .186, .033, .003, and .308) did not correlate with the supply variables. It is therefore concluded that there was no correlation between the public electricity demand and the public electricity supply in the study area. Therefore, the hypothesis that: There is no significant relationship between public electricity demand and supply in Uyo urban is accepted.

7.0 Discussion of Results

Electricity use and functionalities were used as indicators of public electricity demand in Uyo urban and the result of the study revealed that the major use to which electricity is put into is lighting (35.56%). The other uses in order of priority were cooking (24.44%), business (13.21%), washing (9.5%), ironing (8.52%), entertainment (5.93%), administration and others (10%). These results, in which lighting and cooking took priority, indicate the importance the users attached to electricity use. This agrees with the study of Omri and Kahouli (2014) which revealed that electricity, in practical terms, is indispensable for certain basic household activities, such as lighting, refrigeration and the running of household appliances.

Appliance use was also identified as one of the indicators of public electricity demand in Uyo urban and the result of the study revealed that the major appliances used in the study area are electric bulbs (12.72%) and television sets (12.45%). The least appliance used is welding machine (0.99%) which is an industrial machine. Based on the information obtained, it can be said that the public electricity demand in the study area is low as most of the appliances with the highest use are household appliances. This is in line with the findings of ECN (2022); and Babatunde and Shaibu (2009), that the patterns of public electricity consumption in Nigeria's economy is dominated by the residential sector, followed by industrial, transport, commercial and agricultural sectors.

In line with established guidelines, the study area can be said to be short of power supply, that is, the power supplied does not meet the demands of the people in Uyo urban in hourly, daily and monthly bases. This varies from the study of Chineke and Igwiro (2008) who demonstrated that Nigeria receives abundant solar energy that can be usefully harnessed - an annual average solar radiation of about 5.25 KWh/m^2/day.

Due to the shortage in the supply of public electricity in the study area, alternative sources of public electricity that the people use to augment public electricity shortage abound. It supports the

findings of Abiodun (2003) who opined that in Nigeria, among the urban dwellers, kerosene and gas are the major alternative cooking fuels. Majority of the people rely on generators for power supply and kerosene stoves for domestic cooking, while only a few use gas and electric cookers (Abiodun, 2003).

8.0 Conclusion

Based on the findings of the study, the following conclusion is drawn: The provision of public electricity power infrastructure in Uyo urban is inadequate and cannot meet the demands of the people. This scenario has become a perennial problem which could be termed man-made and, as such, can be surmountable if those responsible demonstrate the willingness to do so. For the situation to improve, there must be a conscious positive attempt by the government and relevant agencies towards the provision and regular maintenance of the requisite electricity infrastructure needed in the area to avoid system collapse.

9.0 Recommendations

Based on the findings of the study, the following recommendations are made:

i. The true level of public electricity demand must be ascertained as this will help planners and policy makers to know the quantity and quality of public electricity to be supplied to the study area.
ii. The supply of public electricity in the study area also has to be increased. The increase will help meet with the rising public electricity demands of Uyo urban which is a fast urbanizing area.

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EFFECT OF MORTAR CHARACTERISTICS ON UNIAXIAL COMPRESSIVE STRENGTH OF CONCRETE BLOCK MASONRY

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Abstract
This study assessed the effect of varying mortar characteristics on the uniaxial compressive strength of masonry made with low strength concrete block units, in a view to understanding the behaviour of low strength concrete block masonry used in construction. Uniaxial compressive strength tests were carried out on 60 concrete block prisms to the requirements of BS EN 1052-1 (1999). Variables assessed through tests were; varying mortar strength and varying mortar joint thickness. Findings from the experimental program showed that prisms with mortar strength higher than those of low strength concrete blocks provided higher uniaxial compressive strength, though failure in these prisms were sudden, they showed the least energy absorption through crack formation and propagation prior to failure. Prisms with mortar strength within the range of those of concrete blocks failed with several cracks developed and propagated through mortar joints. Masonry prism strengths increased significantly with decreasing mortar thicknesses. It is concluded that for optimum performance of low strength concrete block masonry; mortar strength adopted should be kept lower but within the range of those of concrete block units; and thicknesses of mortar joints adopted should be made as low as possible to allow for the dimensional tolerances of block units as well as those of adjoining building elements. The study recommends that codes such as the Nigerian Industrial Standard which specifics low strength concrete blocks, should provide specific basis for the safe design and application of such concrete blocks for both structural and non-structural uses.

1.0 INTRODUCTION

The compressive strength of concrete block masonry is an important property considered during their design and construction. Under normal loading conditions, concrete block masonry walls are subjected to compressive loads from their self-weight in non-load bearing walls and from other structural members in load bearing walls. The compressive strength of concrete block masonry is influenced by masonry unit and mortar characteristics, the interaction between unit and mortar characteristics as well as by the quality of workmanship employed in construction of the wall (Fortes *et al*., 2017). Concrete block units employed in practice differ significantly in their strength characteristics. They are classified based on strength as low strength units with gross average compressive strength of 3.48 MPa (Syiemiong & Marthong, 2019), medium strength units and high strength units with gross area compressive strengths over 25 MPa (Fortes *et al*., 2017; Fonseca *et al*., 2019; Caldeira *et al*., 2020). High and medium strength concrete blocks are used for construction of load bearing masonry structures and referred to in design codes for masonry design (The Masonry Society, TMS, 2011; European Committee for Standardisation CEN, 2005). Low strength concrete blocks units find significant usage in developing countries as infill-walls, parapet walls, boundary walls as well as for structural walls in low-cost single-story buildings. Studies covering the behaviour of medium and high strength concrete masonry is readily available in literature but for low strength concrete masonry, studies are limited (Syiemiong & Marthong, 2019). As such knowledge on the influence of mortar characteristics on uniaxial compressive strength of low strength concrete masonry is limited. In Nigeria, low-strength concrete block units are commonly used for infill walls in low to medium-rise buildings and structural walls in low-cost single and two storey buildings (Ulaeto et al., 2024). Several studies covering different regions in Nigeria (Onwuka, Osadebe and Okere, 2013; Odeyemi *et. al.*, 2018; Ewa and Ukpata, 2013; Ajagbe, Ganiyu and Adeniji, 2013; Aiyewalehinmi and Tanimola, 2013; Ambrose, Etim and Koffi, 2019) have shown that concrete block units used for construction purposes have compressive strengths ranging between 0.19 and 2.02 Nmm^{-2}. This falls below the range of block unit compressive strengths used for prediction of characteristic compressive

strength of block masonry, provided in the BS 5628-1 (1992). The BS 5628-1 (1992) is a code accepted for the design of masonry structures in the Nigeria.

Though mortar makes up less than 20% of the longitudinal area of walls, the influence of its characteristics and interaction with block units cannot be underestimated. Important characteristics of hardened mortar that influence uniaxial compressive strength of masonry include strength (in compression, tension and flexure), thickness of bedding and the particle size distribution of aggregates used in the mortar production. Limited knowledge on the influence of these mortar characteristics on low strength concrete block masonry gives relevance to studies seeking to bridge this gap.

Majority of the studies in literature have emphasized on masonry constructed with medium to high strength concrete units. The relevance of these findings to masonry constructed with low strength concrete units is not established.

This study aims to assess through experiments, the influence of mortar characteristics on the uniaxial compressive strength of masonry made with low strength concrete block units, in a view to optimising the performance of low strength concrete block masonry used in construction. The specific objectives of the study are as stated below;

i. To evaluate the effect of variation in mortar strength on the uniaxial compressive strength of masonry prisms built with low strength concrete block units.
ii. To evaluate the effect of variation in thickness of mortar on the uniaxial compressive strength of masonry units built with low strength concrete block units.

The following null hypotheses were developed and tested to realise the aim of the study;

H_{o1}: There is no significant difference among results of uniaxial compressive strength test on concrete block prisms with varying mortar cement content.

H_{o2}: There is no significant difference among results of uniaxial compressive strength test on concrete block prisms with varying mortar joint thicknesses.

The significance of the study is hinged on its ability to improve understanding of behaviour of masonry constructed with low strength concrete blocks with varying mortar characteristics. This will enhance safety of masonry buildings and multi-storey frame buildings where such elements are used as infills.

2.0 Literature review

The uniaxial compressive strength of unreinforced masonry walls is one of the prime properties of such walls under different loading conditions. Different block and mortar characteristics influence the response of unreinforced masonry walls. Mortar strength, mortar thickness and mortar type have been listed amongst mortar characteristics which influence uniaxial compressive strength of concrete block walls (Hendry *et al.*, 2004; Fortes, *et al*., 2017). The primary determinant of mortar strength is the cement (and lime) content adopted in the mix design. Masonry design codes specify mortar based on volume mix proportions (Thamboo *et al.*, 2019). The Eurocode 6 (CEN, 2005) designates mortar based on compressive strength in MPa. The Masonry Society (TMS, 2016) and American Standards for Testing Materials, ASTM C270 (ASTM, 2014) provide classifications for five mortar classes. Mix specifications for mortar classes in accordance to the requirements of the BS EN 1996-1-1 (2005) and the TMS (2016) are as shown in Table 1.

Table 1. Code mortar classifications and volume proportion

Standard	Mortar classification	Volume proportion		
		Cement	Lime	Sand
BS EN 1996-1-1 (2006)	M12	1	0 to 0.25	3
	M6	1	0 to 0.5	3 to 4.5
	M4	1	0 to 1	5 to 6
	M2	1	0 to 2	7 to 9
TMS (2011)	M	1	0	2.25 to 3
	S	1	0.25 to 0.5	2.25 to 3
	N	1	0.5 to 1.25	2.25 to 3
	O	1	1.25 to 2.5	2.25 to 3

Several studies have investigated the influence of mortar strength on behaviour of masonry prisms (Drovgka *et al*., 2015; Zahra and Dhanaselar, 2016; Alvarenga *et al*., 2017; Fortes *et al*., 2017, Mohammad *et al*., 2017; Caldeira, *et al*., 2020; Zahra *et al*., 2021). Generally, slight increases in ungrouted masonry compressive strength were reported, with increases in the compressive strength of mortar. Changes in failure modes of masonry are also reported in literature. Fortes *et al*. (2017), Caldeira *et al*. (2020) and Zahra *et al*. (2021) noted the influence of the ratio of mortar strength to block strength (based on net area) on the failure mode of concrete masonry walls. When mortar was much weaker than blocks, mortar crushing was the prevailing failure mode; while block splitting or block crushing were observed when mortar was much stronger than blocks. In the Brazilian Code ABNT NBR 15961-1 (2011), mortars for hollow concrete block masonry are recommended to have a maximum compressive strength of 70 % of the hollow block units' 28 days net area compressive strength.

It has been established that reduction in mortar thicknesses increases masonry compressive strength and elastic modulus (Francis *et al*., 1972; Cassinello, 2006; Lima *et al*; 2012; Thambo *et al*., 2013; Reddy *et al*., 2009). Caldeira *et al.* (2020) observed that the influence of joint thickness on the compressive strength of masonry was more significant in masonry with mortar strength much lower than block unit strength. This is believed to be due to the decrease in lateral confinement caused by the increase in mortar thickness. These poses serious implications on the strength of concrete masonry as Mojsilovic and Stewart (2015) observed high coefficients of variations in mortar joint thicknesses at construction sites visited in a study. Greater mortar thicknesses at the top of walls and smaller thicknesses at the lower ends of walls were some abnormalies also noted by Mojsilovic and Stewart (2015). They also expose problems faced in the practical application of code specified joint thicknesses. Standard mortar thicknesses of around 6 – 15 mm are recommended in major international codes (Australian Standard Association, 2001; NBR 15961 – 2, 2011; British Standard Institution, 2005; TMS, 2011; Canadian Standards Association, 2014).

Majority of the studies in literature have emphasized on masonry constructed with medium to high strength concrete units. The relevance of these findings to masonry constructed with low strength concrete units is not established. Extensive use of masonry with concrete block units possessing low compressive strength in developing countries (Marthong & Syiemiong, 2019), presents a need to understand the impact of mortar characteristics on their compressive strength.

3.1 Materials and Methods

An experimental research approach was adopted for the study. This consisted of preliminary tests, to determine particle size distribution of fine aggregates used for mortar, mortar compressive strength and block compressive strength; and uniaxial compressive strength tests carried out on low strength concrete block masonry prisms.

Fine aggregates (sand) used for the study was river sand. Particle size distribution for fine aggregate was carried out in accordance to the BS EN 933-1: 2012a. Cement used was bought from a reputable dealer and assessed to ensure that was in good condition. Cement was manufactured to the requirements of the NIS 444-1 (2014), with compressive strength of 42.5 Nmm^{-2}. Portable water from

the laboratory water supply system was used for hydration of block and mortar mixes. Water/cement ratios for mortar was 1.20.

Concrete block units used were moulded using steel moulds. Block units were 225 x 112.5 x 112.5 mm in dimensions, which were adopted as half scaled specimens of the 450 x 225 x 225 mm blocks used in most developing countries of Sub-Saharan region of Africa (Oyekan and Kamiyo, 2011). Concrete blocks units produced in the regions are of mixes ranging between 1:5 to 1:12 (Oyekan and Kamiyo, 2011). Block units were cured by covering them with polythene bags and daily spraying with water from 2 days after moulding. Mortar uniaxial compressive strength test and concrete block unit uniaxial compressive strength tests were carried out in accordance to, BS EN 1015-11:2019 and BS EN 772-1:2000, respectively.

Sixty concrete block masonry prisms were constructed in the University of Uyo Concrete Laboratory. Masonry prisms consisted of two blocks along their length and three courses along their height as shown in Figure 1. Variables considered during testing are as highlighted in Table 2. Concrete block masonry prisms were spray with water daily and covered with polythene bags up till a day before testing. Testing of concrete block masonry prisms was carried out to the requirements of BS EN 1052-1 (1999). Masonry prisms were constructed three courses high (Figure 1) since the scope of study was limited to assessment of the relationship between mortar characteristics and prisms uniaxial compressive strength.

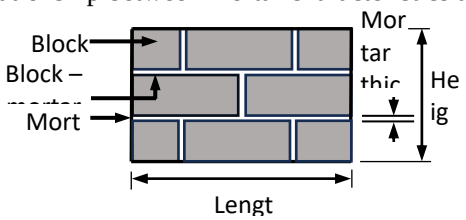

Figure 1. Masonry prism specimen

Table 2. Variables considered in testing

Variable	Method of determination	
Mortar strength	Mix ratio by volume:	1:0:6
		1:0:7
		1:0:8
		1:0:9
		1:0:10
Mortar joint thickness	Linear measurement of thickness:	6 mm
		9 mm
		13 mm
		19 mm
		25 mm

Masonry prisms were mounted on a Wincom digital display hydraulic universal testing machine, model WA-300B as shown in Figure 2. Uniform compressive forces were applied to the top face of each prism at a loading rate of 0.05 (N mm^{-2}) s^{-1}.

Figure 2. Test setup adopted for uniaxial compressive strength test of concrete block prisms.

3.0 Presentation of results

Preliminary tests

Preliminary tests on fine aggregate, mortar and block units yielded results which provided insight to understanding the behaviour of the concrete block masonry. Particle size distribution curve, obtained through sieve analyses of fine aggregates used for mortar is as shown in Figure 2. The particle size distribution of the fine aggregate obtained fell within the fine and coarse grading limits for mortar, specified in the BS EN 13139 (2002).

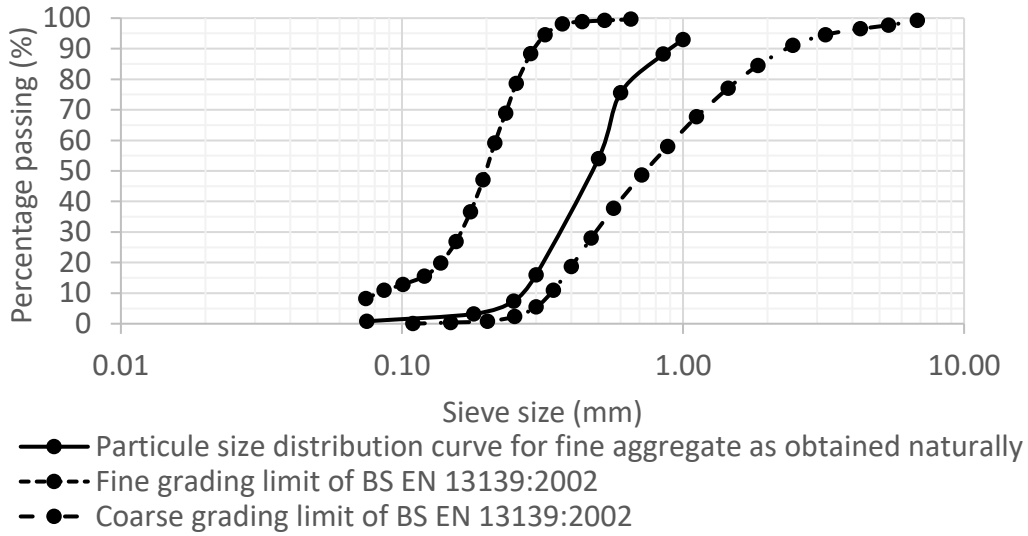

Figure 3. Particle size distribution curve of fine aggregates used for mortar

Table 3 shows mortar strength of for the five mixes used in the study. The 1:0:6 mortar mix ratio provided the mortar of highest mortar compressive strength (3.97 MPa) and the 1:0:10 provided the least mortar compressive strength (0.71 MPa). Uniaxial compressive strength of a solid 225 x 112.5 x 112.5 mm concrete block unit gave an average value of 1.88 Nmm^{-2}. This set of block units was used for the construction of all masonry prism specimens.

Table 3. Mortar compressive strength

Mortar mix ratio	Crushing force value (kN)			Compressive strength (MPa)			Mean compressive strength (MPa)
1:0:6	6.54	6.20	6.36	4.088	3.875	3.975	3.979
1:0:7	4.44	5.08	4.76	2.775	3.175	2.975	2.975
1:0:8	3.08	3.16	3.24	1.925	1.975	2.025	1.975
1:0:9	2.68	2.20	2.36	1.675	1.375	1.475	1.508
1:0:10	1.12	1.09	1.18	0.700	0.681	0.738	0.706

*Specimen loaded area: 40mm x 40 mm (1600 mm^2)

Effect of mortar average compressive strength on uniaxial compressive response of concrete block prisms

Increases in compressive strength of mortar led to increases in the uniaxial compressive strength of masonry prisms. Table 4 showed that mortar with the highest average compressive strength (3.979 MPa), gave an average prism uniaxial compressive strength of 1.212 MPa which is 25 % greater than the mortar with the least average compressive strength, 0.706 MPa. The difference among prisms with varying mortar strength was found to be significant at a 0.05 level of significance, using a One-way Analysis of Variances analysis as shown in Table 5. Therefore, the null hypothesis, H_1, was accepted. Prisms with 3.979 MPa average mortar compressive strength were observed to undergo crushing/splitting of blocks in the prisms, with less significant failure of the mortar joint. Fewer cracks were developed as shown in Figure 3. Prisms with the 1.975 MPa average mortar compressive strength showed clear and straight progression of cracks from one block course through the mortar joint to the adjoining block course. More failure cracks were also observed to developed on these prisms than on prisms with of other mortar mixes as shown in Figure 4.

Table 4. Concrete block prisms uniaxial compressive strength

Mortar strength	Crushing force value (N)			Compressive strength (MPa)			Average compressive strength (MPa)
	1	2	3	1	2	3	
3.979	63000	62700	63505	1.211	1.205	1.221	1.212
2.975	58250	57745	57585	1.120	1.110	1.107	1.112
1.975	51990	52100	52050	0.999	1.001	1.000	1.000
1.508	48455	48900	48610	0.931	0.940	0.934	0.935
0.706	47250	46915	47335	0.908	0.902	0.910	0.907

*Specimen loaded area: 462.5 mm x 112.5 mm (52031.25 mm^2)

Figure 4. Failure pattern of concrete block prism with 3.979 MPa average mortar compressive strength

Figure 5. Failure pattern of concrete block prism with 1.975 MPa average mortar compressive strength

Table 5. Analysis of Variance result for differences among compressive strength of prisms with varying mortar cement content

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.195	4	.049	1616.895	.000
Within Groups	.000	10	.000		
Total	.196	14			

Effect of mortar joint thickness on the uniaxial compressive response of concrete block masonry walls

Variations in mortar joint thickness influenced the uniaxial compressive strength of concrete block masonry prisms. Increases in mortar joint thickness led to decreases in the uniaxial compressive strength of masonry prisms. Table 6 showed that the thickest mortar joint, with 25 mm thickness, gave the least average prism uniaxial compressive strength, with a value of 0.580 MPa. This was 59 % lower than the uniaxial compressive strength gotten for the prism with 6 mm mortar joint thickness. The difference among prisms with varying mortar joint thicknesses was found to be significant at a 0.05 level of significance, using a One-Way Analysis of Variances analysis as shown in Table 7. Therefore, the null hypothesis, H_2, was accepted.

Table 6. Uniaxial compressive strength of concrete block prisms with varying mortar joint thickness

Mortar thickness (mm)	Prism loaded area (mm^2)	Crushing force value (N)			Compressive strength (MPa)			Average compressive strength (MPa)
		1	2	3	1	2	3	
6	51300	72070	71275	72915	1.385	1.405	1.389	1.421
9	51638	62330	62150	61959	1.198	1.207	1.204	1.200
13	52031	51520	52100	52050	0.990	0.990	1.001	1.000
19	52763	40725	41920	41105	0.783	0.772	0.795	0.779
25	53438	30100	31140	31005	0.578	0.563	0.583	0.580

*Specimen width: 112.5 mm

Table 7. Analysis of Variance result for differences among compressive strength of prisms with varying mortar joint thickness

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.299	4	.325	2896.815	.000
Within Groups	.001	10	.000		
Total	1.300	14			

4.0 Discussion of results

Tests on mortar compressive strength showed that increases in cement content in mortar mix increased uniaxial compressive strength of mortar. This was as expected. Increases in the quantity of cement generally leads to increases in the compressive strength of mortar or any cement-aggregate composite (Thamboo *et al.*, 2019). Physical properties and workability of the mortar prepared were good. This was as expected as the fine aggregate used satisfied the fines and coarse grading limits of the BS EN 13139 (2002).

Cement content of mortar was found to influence the uniaxial compressive strength of concrete block prisms due to its influence on mortar strength. This is in agreement with several prior studies including; Thamboo et al. (2019), Caldeira et al. (2020), and Zahra et al. (2021). The significance observed in these differences shows the importance of consideration of mortar compressive strength in masonry construction.

Consideration of failure modes is as important as consideration of the strength of the masonry prism. Masonry prisms constructed with mortar of average compressive strength 1.975 MPa, showed better energy absorption through the gradual development and propagation of cracks during failure. This was due to the little difference in strength between the mortar and the concrete blocks. The blocks were made using a 1:8 (cement: fine aggregate) mix which was the mix also adopted for the mortar.

Failure of prisms made of mortar with average compressive strength of 3.979 MPa were sudden, with fewer cracks. Damage in these prisms were concentrated around the blocks. This was due to the confinement provided by the stronger mortar to the blocks. This increased the strength of the prisms, reduced crack formation and promoted local failure of blocks by crushing.

Prisms with mortar of average compressive strength 0.706 MPa, failed by crushing and splitting of mortar joints since these were weaker than the blocks. The observed failure mode in prisms with mortar of average compressive strength of 1.975 MPa explains the Brazilian code ABNT NBR 15961-1 (2011) requirement, that mortar for hollow concrete block masonry should have a maximum compressive strength of 70 % of the hollow block unit's 28 days net area compressive strength. Compressive strength enhancement, due to lateral restraints, in mortar joint under loading conditions (especially in mortar bedding joints of low thicknesses) could subject mortar joints to a triaxial state of stress, significantly increasing their failure stress.

Mortar joint thicknesses significantly influenced the strength of concrete block prisms. This is in agreement with studies by (Francis *et al*., 1972; Cassinello, 2006; Lima *et al*; 2012; Thambo *et al*., 2013; Reddy *et al*., 2009). With lower thickness, lateral confinement increases, increasing the resistance of concrete block prisms. For this reason, design codes limit standard mortar joint thicknesses to between 6 – 15 mm. However, effective supervision during construction is needed to maintain such dimensional consistence, within acceptable limits of tolerance.

6.0 Conclusion and Recommendation

The study assessed the influence of mortar characteristics on the uniaxial compressive strength of masonry prisms made with low strength concrete block units, in a view to optimising the performance of low strength concrete block masonry used in construction. The effect of variation in mortar compressive strength on the uniaxial compressive strength of masonry prisms built with low strength concrete block units was evaluated. This was done in addition to the evaluation of the effect of variations in mortar joint thickness on the uniaxial compressive strength of masonry units built with low strength concrete block units. Findings from the experimental program showed that though prisms with mortar strength higher than those of concrete blocks provided higher uniaxial compressive strength, failure in these prisms were sudden with low energy absorption through gradual crack formation and propagation during failure. Prisms with mortar strength much lower than those of concrete blocks failed through sudden crushing of mortar joints. Prisms with mortar strength within the range of those of concrete blocks failed with several cracks developing and propagated through mortar joints. Therefore, the study concludes that for optimum performance of low strength concrete block masonry; mortar strength adopted should be kept lower but within the range of those of

concrete block units; and thicknesses of mortar joints adopted be made as low as possible to allow for the dimensional tolerances of block units as well as those of adjoining building elements.
The study recommends that international codes in addition to providing specifications on mortar grades provide recommendations on use of these mortar grades. The Nigerian Industrial Standard which specifics low strength concrete blocks (termed sandcrete blocks in the NIS 87, 2007) should provide basis for the design and application of such concrete blocks for both structural and non-structural applications.

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BATHYMETRY ESTIMATION FOR TURBID RIVER USING LANDSAT-8 OLI AND SENTINEL-2 MULTISPECTRAL IMAGES

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Abstract
Concern for obtaining bathymetry using alternative method to in-situ acquisition methods have led to increased use of optical satellite imagery of varying resolution for bathymetry mapping. Given the constraints of light transmission in turbid water with inherent sediment load, dissolved organic matters and chlorophyll-a, the applicability of Landsat-8 OLI and Sentinel-2 optical imageries in bathymetry estimation for a section of Imo River was tested. Lyzenga log linear and Stumpf et al log-ratio empirical models were adopted while Single Beam Echo Sounding depths were used for validation and calibration tests of estimated bathymetry. Statistical analyses of estimated bathymetry against sounding depths revealed that least RMSE (1.5) and largest RMSE (1.9) were obtained from Sentinel-2 based on Stumpf and Lyzenga models respectively. Coefficient of determination (R^2) showed that bathymetry from Sentinel-2 based on Stumpf's model represented 62% of reference depth while 55% of Landsat-8 derived bathymetry defined the reference depths. On the contrary, Lyzenga output from Landsat-8 had higher R2 (58%) than Sentinel (R^2 = 30%). Assessment on depth ranges indicated that least RMSE was obtained for 3 - 6 m region for the two images. Greater correlation with reference depth in the shallow region (0 – 6 m) than for deeper depths (6 – 12 m and above) was recorded for Sentinel-2 while Landsat recorded high correlation (56%) in the 6 – 12 m depth range. The study proved that satellite data can be utilized to derive reliable bathymetry for Imo River - an inland waterway with characteristic turbidity to the depth of 10 m.
Keywords: *Turbid River, Water Reflectance, Satellite Bathymetry, Stumpf Model, Lyzenga Model*

Introduction

Bathymetry depicts depths and shapes of underwater relief, including natural and man-made features in a manner similar to topographic map of land areas (Duman, 2018). Bathymetry has become a significant parameter useful for harnessing potentials of inland waterways beside the conventional use for production of nautical charts. It is useful in the sphere of marine sciences, marine navigation and safety, offshore and onshore developments, engineering design, construction, environmental studies and management, national economy and security, among others.

To date, optical remote sensing satellite data have increasingly been adopted for bathymetry mapping using imagery of varying resolution. Particularly, medium resolution satellite imageries are readily available and accessible with none or minimum fee (Jaelani *et al.,* 2019). It has large geographic coverage and is usually ideal for large study areas (Ahola *et al.*, 2020). However, capabilities for derivation of inland water bathymetry with reasonable accuracy depending on the nature of the water body, seabed characteristics and study context is fast expanding. Inland waters are defined as aquatic-influenced environments located within land boundaries as well as water bodies located in coastal areas and adjacent to marine region (Convention on Biological Diversity, 2008). Inland water bodies include rivers, streams, natural lakes (reservoirs), artificial lakes, canals and ponds. Inland waters are ecologically dynamic, usually impacted by turbidity and sediment through human related activities, floods, vegetation and wrecks, among other factors. Most often, inland waterways (rivers) are characteristically turbid and classified as case 2 complex water as they are affected by coloured dissolved organic matters and influenced by the presence of chlorophyll-a, load of sediments and suspended particulate matters (Ilori *et al*., 2019). Reliance on these inland turbid rivers for navigation, natural resource exploitation, trade and economic development raises the need to carefully select the parameters that will suit the peculiarity of this ecosystem for up-to-date bathymetry information. In this study, the attendant benefits of optical multispectral satellite data were harnessed in estimating bathymetry for part of Imo River using Landsat-8 OLI and Sentinel-2 MSI images.

Bathymetry estimation from optical satellite data is based on deriving relationship between recorded image radiance and light attenuation in water either through analytical or empirical method. The empirical method used expresses statistical relationship between optical image radiance and water depth using different reflectance of different wave bands in fitting equation to determine water depth. This can be achieved through log linear (Lyzenga linear transform) and log ratio (Stumpf ratio model) approach (Mohamed, 2019). Both techniques require a priori known depth and also provide for the use of several band combinations for optimum result.

I. Lyzenga Linear Transform Model: Lyzenga *et al.* (2006) model assumes that water surface reflectance is an exponential function of depth and that by taking a logarithmic transformation through linear regression; a linear relationship could be established between the surface reflectance and water depth (Zandbergen, 2020). Most often than not, the seabed is made up of different materials and each material has different absorption and reflectance property. Thus, multiple spectral bands or wavelengths are used to account for varying bottom reflectance (albedo variations) and spatial heterogeneity of seabed topography (Zandbergen, 2020; Saeed *et al*., 2021). The linear relation between water depth and log-transformed wavelengths in two bands (i and j) could be expressed in equation 1 (Said *et al*., 2017):

$$z = a_0 + a_i X_i + a_j X_j \quad \ldots \quad \text{Equation 1}$$

Equation 1 can be modified into equation 2 to account for more image bands.

$$Z = a_0 + \sum_i^n a_i \; X_{i=1} \quad \ldots \quad \text{Equation 2}$$

For optical satellite data devoid of atmospheric correction, X_i and X_j are obtained based on equation 3.

$$X_i = \ln [(R_w(\lambda_i) - R_\infty(\lambda_i)] \quad \ldots \quad \text{Equation 3}$$

$R_\infty(\lambda_i)$ is deep water radiance bottom reflectance, $R_w(\lambda_i)$ is reflectance of water, Z is water depth (satellite-derived bathymetry). X_i and X_j are radiance in blue and green bands respectively (independent variables), $L(\lambda_i)$ is observed reflectance in each band *i.e.* the remote sensing radiance after atmospheric and sun- glint corrections for spectral band λ_i, a_0 and a_i are regression coefficients (intercept and slopes) obtained from the relation between measured depths and band reflectance, a_i and a_j are slope for each band. n denote the number of spectral bands involved in the linear regression.

Usually, this method requires deep water radiance ($R_\infty(\lambda_i)$ bottom reflectance, multi-linear regression between image bands and known depth. Deep water radiance R_∞ usually account for surface reflection, including within-pixel sun glint, and atmospheric scattering (Casal *et al*., 2018). But in areas of turbid waters, where deep water values are not taken into consideration and where atmospherically processed and corrected data are available, X_i and X_j are derived from modified form of equation 3. Thus;

$$X_i = \ln (nR_w(\lambda_i)) \quad \ldots \quad \text{Equation 4}$$

Parameters of the equations are as earlier defined. For consistency between algorithms, n (constant used to keep log ratio positive) was not applied as there was no detectable significance of applying the constant.

II. Stumpf Ratio Model: The model is based on the ratio of two or more wavelengths. Ratio between high attenuation band (blue) and low attenuation band (green) will increase as depth increases. It also assumed that as depth increases, change in attenuation is greater than change attributable to bottom albedo so that ratio between two bands will remain similar over varying bottom reflectance at same depth. The ratio of bottom reflectance over substrate type is of less sensitivity and insignificant (Muzirafuti *et al.,* 2020). The reflectance of band with higher level of attenuation will continually

decrease when the depth increases while that of low attenuation band will increase. When depth increases, the ratio will increase (Hashim *et al.*, 2021). Natural logarithm transformation produces a linear relationship which is regressed against known depth to obtain estimated bathymetry. Stumpf ratio model is conceptually expressed by equation 5:

$$Z = m_1 * \left(\frac{\ln(n\,R_w\,(\lambda_b))}{\ln(nR_w\,(\lambda_r))}\right) - m_o \quad \ldots \quad \text{Equation 5}$$

Here, $\boldsymbol{\lambda}_g$ = green spectral band, $\boldsymbol{\lambda}_b$ = blue spectral band, n = fixed constant (say 1000) use to set algorithm positive for all areas, R_w = water reflectance associated with specific atmospherically corrected spectral band. Usually *n* is chosen to ensure positive log values and a linear response (Rossi *et al*., 2019; Zandbergen, 2020). m_0 is regression offset factor for depth at 0 m while m_1 is a constant use to scale the ratio (dimensionless) to depth (dimensional value) and is defined by the slope of regression graph (slope of the relationship between the band ratio and reference depth). Operationally, m_1 and m_0 linearly transforms the relative depth to actual depth in any datum of choice. The band ratios act to eliminate influence of substrate variability and accordingly enhance accurate bathymetry estimation for rivers of complex and varying bottom composition (Niroumand-Jadidi and Vitti, 2016). For study areas of varying substrate and albedo property, the analogous effect resulting from the ratio will help to check and effectively remove associated errors (Casal *et al.*, 2018).

The aim of the study was estimation of bathymetry for Imo River, a turbid river using Landsat-8 OLI and Sentinel-2 medium resolution multispectral images. Objectives of the study were:

i. To estimate bathymetry of Imo River using Stumpf *et al.* (2003) and Lyzenga *et al.* (2006) empirical models.
ii. To assess the functionality of the blue, green and red image bands as well as the combination of blue-green, blue-red, green-red, and blue-green-red bands in bathymetry estimation.
iii. To validate estimated bathymetry using in-situ sounding depths.
iv. To vertically calibrate and reference estimated bathymetry to chart datum.
v. To evaluate the performance of the estimation models.
vi. To assess the accuracy of estimated bathymetry based on the two estimation models and depth ranges as well as the reliability of estimated depths given the river turbidity.

Methodology

Study Area

The present study covers the section of Imo River lying within the geographical boundaries of Longitudes 07 º 30' 30" and 07 º 33' 00"E and between Latitudes 04º 35' 00" and 04 º 32' 00"N (figure 1). Imo River is a source of water both for domestic and industrial use. It provides a means of livelihood for many trades, commercial fishing and transportation activities. Traversing several towns, villages and farmland areas, the river is subjected to several ecological challenges arising from human activities and natural geomorphologic processes thus resulting in its turbidity.

Studies on physico-chemical characteristics of Imo River give the volume of dissolved oxygen for the upper parts traversing between Abia, Imo and Rivers States as varying from 2.50 to 8.50 mg/l (Okorie and Nwosu, 2014) while the lower course located within Akwa Ibom State (Ikot Abasi) has 13.3±0.4 mg/l of dissolved oxygen (Essien and Ofor, 2012). Investigation on the lower section indicates the river as being turbid due to high sediment load resulting from weathering while parts of the river congruence with other tributaries are less turbid (Oyo-Ita and Oyo-Ita, 2017). The river has an estuarine ecosystem with natural mangrove vegetation on the banks.

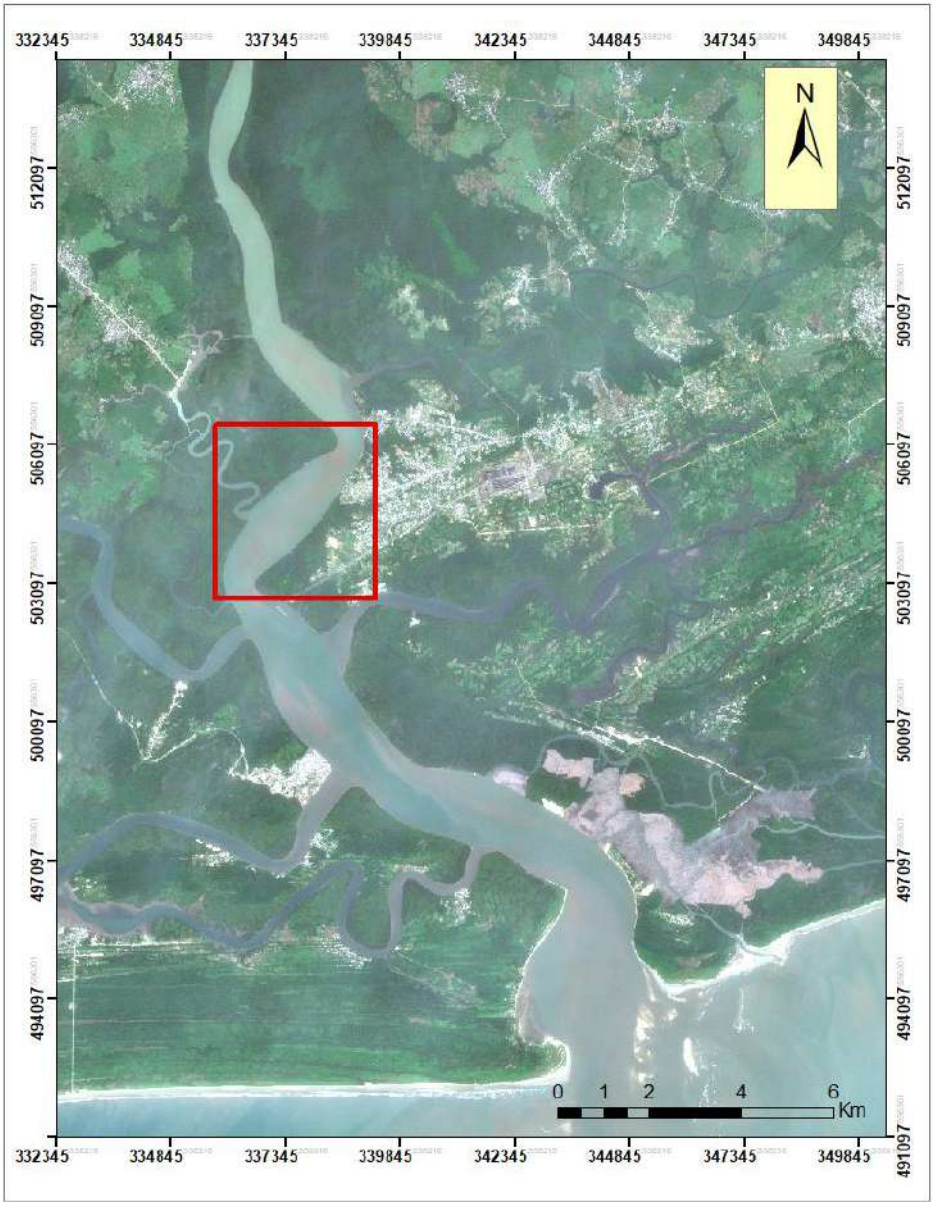


Figure 1: Image map showing Imo River

Data

Landsat-8 level-2 image of December 19, 2021 and Sentinel-2 level-2 acquired on December 20, 2021 were considered for estimation of bathymetry in this study. Echo sounding depths were used for model calibration and result validation. Predicted tide for date of image acquisition was obtained from previous studies (Udoh and Ekpa, 2022).

Methods

This involved image pre-processing, calculation of relative bathymetry, linear least squares regression, scaling of relative depth to actual depth and vertical referencing. The methodology flow chart is presented in figure 2.

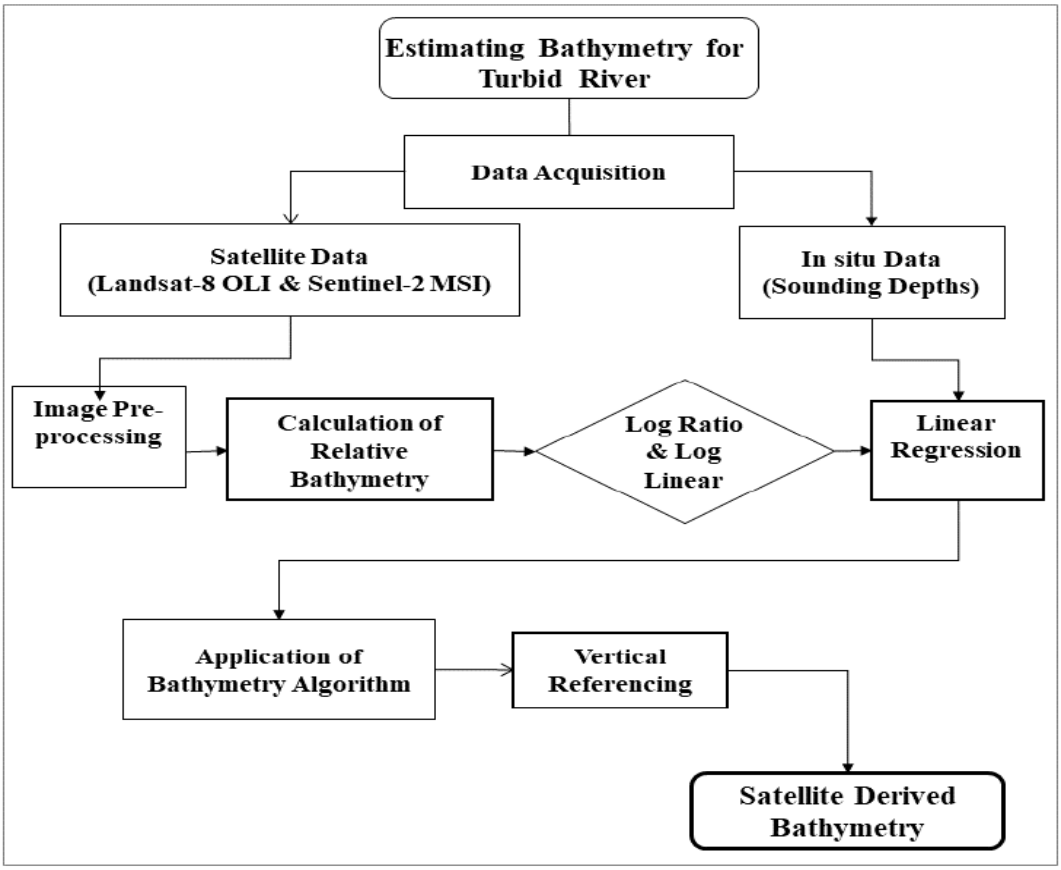


Figure 2: Flow chart for bathymetry estimation

Image pre-processing was applied to correct for distortion, unwanted environmental and atmospheric effects such as sun glint, cloud, speckle and distortions. Band operation of float and low pass filter processes were applied to each band to remove speckle noise. Spatial sub-setting of required image bands was done to reduce the satellite bands to area of interest. Further, Near Infrared (NIR) thresholding was used for separating water pixels from land and other features. Lyzenga *et al*. (2006) and Stumpf *et al*. (2003) models were applied in deriving the bathymetry. The procedure presented in GEBCO Cookbook (2019) was adopted.

Three image bands (blue, green and red) were used in the estimation process in order to find the model that gives the best result. For Lyzenga model, Satellite-Derived Bathymetry (SDB), were generated using blue, green and red bands as well as the combination of blue-green, blue-red, green-red, and blue-green-red bands. For Stumpf model, the blue/green, blue/red and green/red band ratios were used. This was to aid in selecting the best band model for each algorithm in furtherance to obtaining best SDB. Natural logarithm of the various bands ratios and band combination yielded relative bathymetric values (RB). The RB were subjected to least squares linear regression with sounded depths, which served as reference depths to obtained regression coefficients. Linear regression analysis gave the line that best fit the reference depths and RB depths. Performance of band ratios output were evaluated based on correlation coefficient (R^2). Next, actual satellite derived depths were obtained by applying the regression coefficients (m_1, m_0, a_0, and a_1, etc.) to relative depth values. SDB that best estimated the reference depth were adopted. These were $SDB_{Green/Red}$ and SDB_{Red} for Stumpf and Lyzenga model respectively. The SDB was vertically referenced and corrected for tide and also scaled to adopted chart datum.

Validation of SDB was performed by carrying out statistical analysis based on root mean squared error (RMSE), lowest and deepest depth values. Randomly selected 812 depths from Landsat-8 SDB were tested against corresponding reference depths. While Sentinel-2 SDB validation process involved the use of 909 depth data. Validation results are presented in section 3.0.

Estimated SDBs were also subjected to IHO Total Vertical Uncertainty (TVU) Survey Standards for "special order" check. According to IHO specification (IHO S-44, 2020), bathymetric uncertainty for special order survey at 95% confidence level is defined as:

$$TVU_{max}\ (D) = \sqrt{\sqrt{(a^2) + (b\ X\ d)^2)}} \quad \ldots \quad \text{Equation 6}$$

Where TVU is Total Vertical Uncertainty, 'a' is the portion of uncertainty that does not vary with depth, 'b' is a coefficient of the uncertainty that varies with depth, and d is the maximum depth. For 'Special Order', 'a' = 0.25 m and 'b' = 0.0075. The maximum depth (d) were based on outputs of the two satellite images and model. Analysis result is presented in Table 1 (Section 3.0).

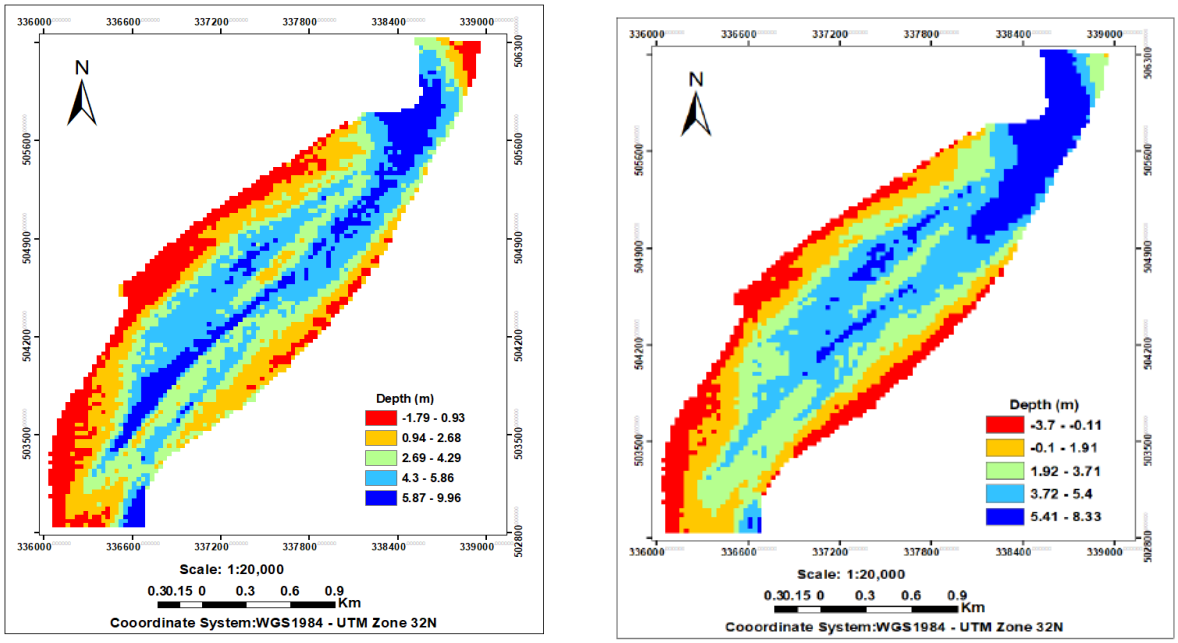
Accuracy assessment of estimated SDBs for Category of Zone (CATZOC) confidence was based on CATZOC B where controlled and systematic bathymetry mapping was executed using modern estimation algorithm. This is because reference data used were obtained without carrying out sonar and mechanical sweep of the river bed (Udoh *et al*., 2022), as noted in the survey characteristics of CATZOC B (IHO S-4, 2021). According to IHO S-4 (2021), depth accuracy for CATZOC B is expressed as:

$$Depth\ Accuracy = 1.00 + 2\%\ d \quad \ldots \quad \text{Equation 7}$$

Where, d is the depth. Based on the specification, an accuracy for 10m depth is 1.2m (IHO S-4, 2021). For this study, CATZOC computed results were compared against this standard accuracy (1.2m), since estimated depths were within the 10m range. Table 2 (Section 3.0) gives the result of the computation.

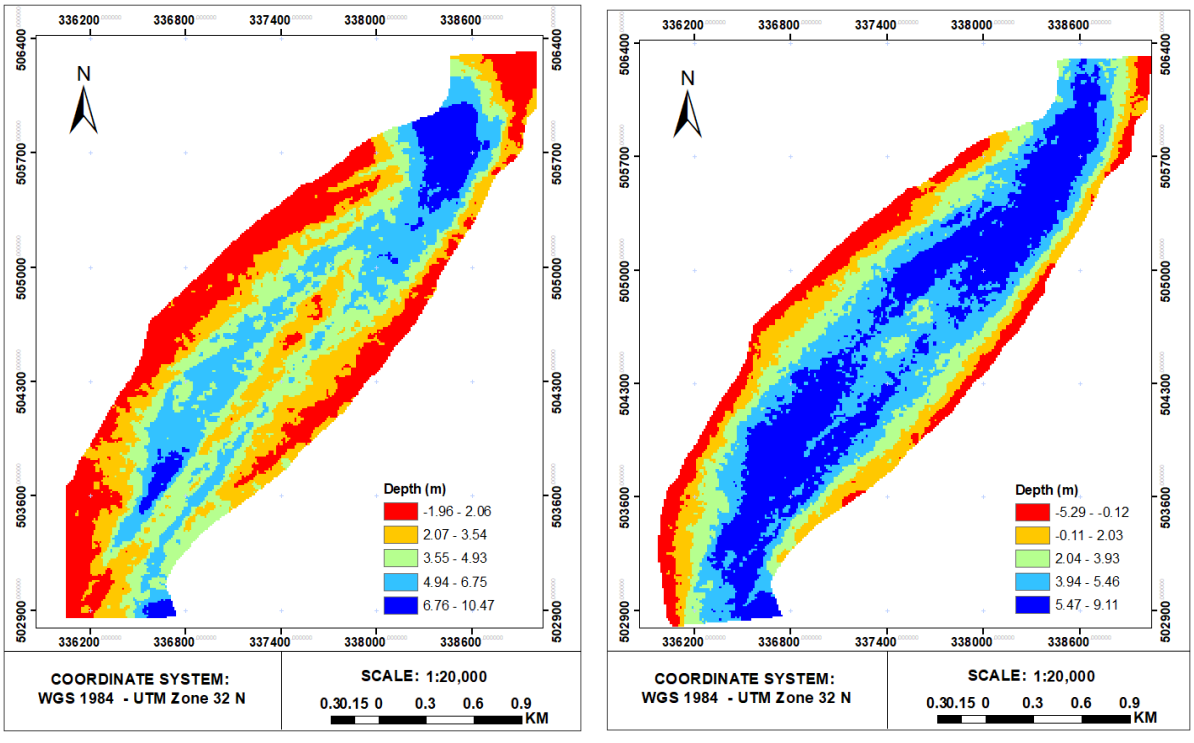
Results and Discussion

Figures 3 (a & b) and 4 (a & b) are the satellite derived bathymetry (SDB) obtained from Landsat-8 image and Sentinel-2 respectively. Results of SDB statistical evaluation are presented in table 1 while table 2 show the result of IHO TVU standard analysis for special order.



(a) (b)

Figure 3: Landsat-8 estimated bathymetry based on (a) Stumpf model & (b) Lyzenga model



(a) (b)

Figure 4: Sentinel-2 Estimated bathymetry based on (a) Stumpf model & (b) Lyzenga model

Figures 3 (a & b) and 4 (a & b) shows that the deepest part of the river section (deep blue) ranges between 5.47 m to 10.47 m, while shallowest depth region (red) were between -5.29 m above datum and -1.96 m.

Statistical analysis result presented in table 1 shows that bathymetry from Sentinel-2 image based on Lyzenga's model gave the shallowest depth (-5.29m) while Stump's model produced the deepest depth of 10.47m. Averagely, the deepest depth obtained from the study was 9.47m while average shallow depth was -3.19m. Still, $SDB_{Green/Red}$ bathymetry had the least RMSE of 1.5 while SDB_{red} had the largest RMSE (1.9). Coefficient of determination (R^2) showed that SDB from Sentinel-2 based on Stump's model represented 62% of reference depth while 55% of Landsat-8 derived bathymetry defined the reference depths. However, the reverse is the case with Lyzenga output as Landsat-8 produced higher percentage (58%) of depths than Sentinel (30%).

Table 1: Result of SDB statistical evaluation

Parameter	Reference Depth	Landsat-8		Sentinel-2	
		SDB_{GR}	SDB_{RED}	SDB_{GR}	SDB_{RED}
R^2		0.55	0.58	0.62	0.30
RMSE		1.8	1.7	1.5	1.9
Std. Dev.	2.1	1.7	1.7	1.9	1.6
Residual (L)		-2.54	-2.32	1.41	0.83
Residual (H)		6.63	5.56	3.34	5.44
Avg. Depth (m)	4.68	3.38	2.87	3.71	4.03
Min. Depth (m)	-0.66	-1.79	-3.70	1.96	-5.29
Max. Depth (m)	12.96	9.96	8.33	10.47	9.11

SDB_{GR} =SDB from green/red ratio, SDB_{Red} =SDB from red band, Avg. = average, Max. maximum, Min. = minimum,

R^2 = coefficient of determination, RMSE = root mean squared error, Std. Dev.= standard deviation. L= lowest, H = highest

The correlation of estimated depths with reference depths are visualized in figure 5 (a & b) for Landsat and figure 6 (a & b) for Sentinel.

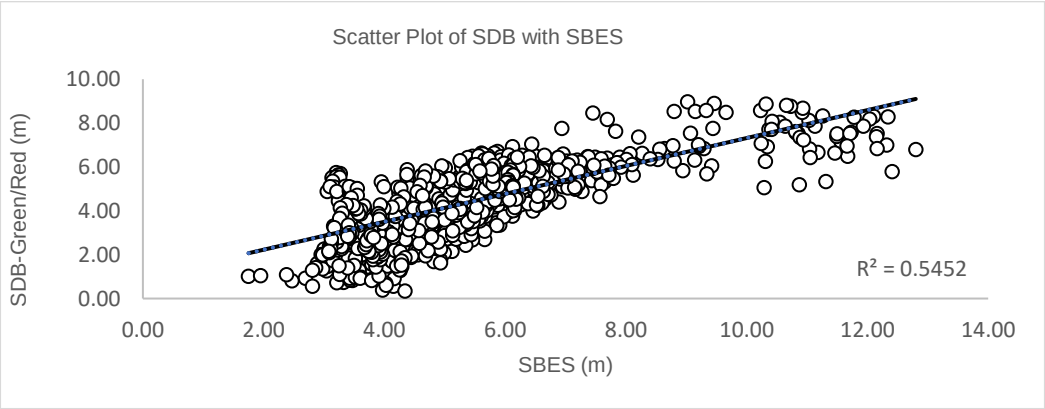


Figure 5(a): Scatter plot of Landsat-8 SDB_{GR} against reference depth

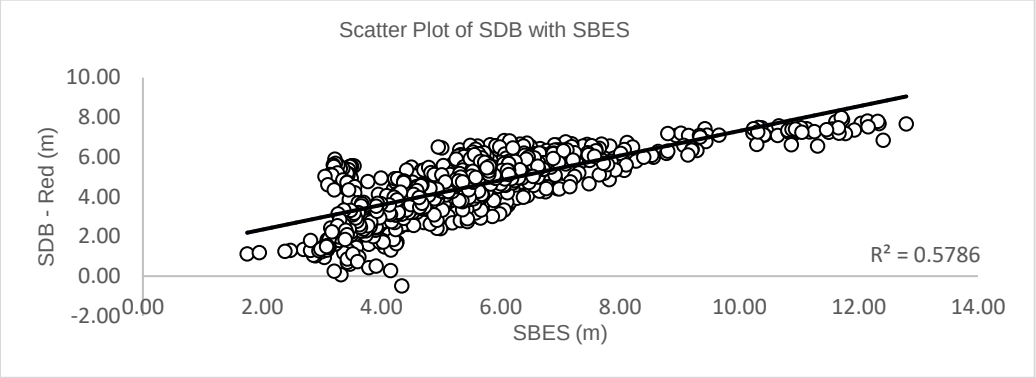


Figure 5(b): Scatter plot of Landsat-8 SDB_{RED} against reference depth

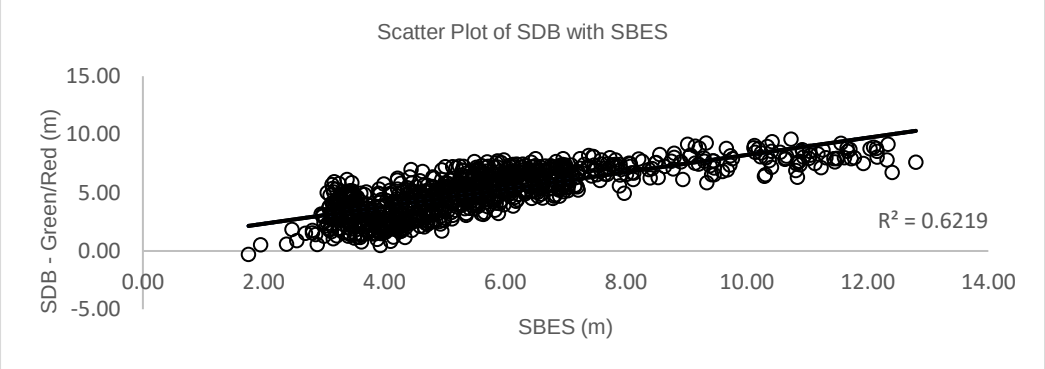


Figure 6 (A): Scatter plot of Sentinel-2 SDB_{GR} against reference depth

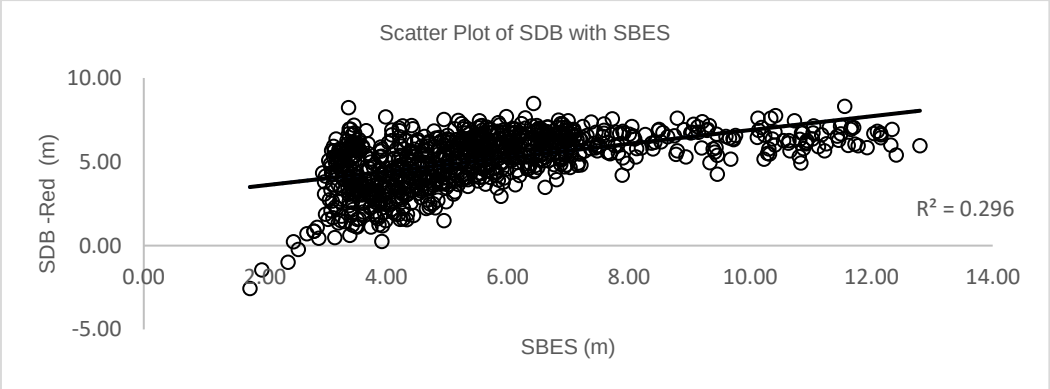


Figure 6 (B): Scatter plot of Sentinel-2 SDB_{RED} against reference depth

Figure 5 (a & b) represent a scenario of average correlation of estimated bathymetry with in-situ depth where the depths are clustered between 3.00m and 6.500m. But bathymetry from the red band (figure 5b) show slightly higher correlation ($R^2 = 0.5786$) than the green-red band ratio (figure 5a) usually adopted for bathymetry estimation. This implies practicable application of Landsat-8 red band for bathymetry estimation of turbid water bodies. On the contrary, green-red band ratio of Sentinel-2

(figure 6a) with higher resolution than Landsat-8 yielded higher correlation ($R^2 = 0.6219$) than the red band output presented in figure 6b.

Result evaluation (table 2) shows that the SDBs met IHO specification and standard for "special order". Accuracy for special survey of IHO specification and standard at 95% confidence level computed based on the survey was ≤ 0.391 m (IHO S-44, 2020). This compares well with the TVU presented in table 2 for all the SDB which were approximately 0.300 m.

Table 2: Result of IHO TVU standard analysis for special order

	Bathymetry	**d (m)**	**TVU_max**
	SBES	12.96	0.268
SDB - Landsat L2SP	Lyzenga model (Red)	8.33	0.258
	Stumpf model (Green/Red)	9.96	0.261
SDB - Sentinel MSIL2A	Lyzenga model (Red)	9.11	0.259
	Stumpf model (Green/Red)	10.47	0.262

Results of SDB statistical evaluation on the bases of depth ranges classified at 4 m interval into 0-3 m, 3-6 m, 6-9 m, and 9-12 m and above are presented in Table 3. For Landsat-8 SDB (Table 3), result from Stumpf's model (SDB_{GR}) have greater correlation with reference depth in the shallow region (0 – 6 m) than for deeper depths (6 – 12 m and above). Only 2% of estimated SDB_{GR} of Landsat correlated with 6 -9 m depths of the sounding depths. Landsat recorded high correlation (56%) for the SDB_{Red} (based on Lyzenga model) in the 6 – 12 m depth range. Correlation of Sentinel-2 SDB based on Stumpf model was comparatively better than for Landsat-8 over the depth ranges. For instance, Sentinel-2 SDB had 57% and 77% correlation with reference depths in the 0 - 3 m and 3 - 6 m region while Landsat had 35% and 17% respectively. This also holds true for depths based on Lyzenga's model. This infers that ratios based on red band provided better measurements of shallow depths below 9 m but poorly depicts depths above 9 m. This result was reported by Amrari *et al.* (2021) and could be attributed to the fact that at deeper depths, longer wavelengths are impacted by water volume scattering resulting in poor reflectance and poor bathymetry output.

Table 3: Results of statistical analysis for depth ranges

Depth Range	**Landsat-8**				**Sentinel-2**			
	RMSE		**R^2**		**RMSE**		**R^2**	
	SDB_{GR}	SDB_{RED}	SDB_{GR}	SDB_{RED}	SDB_{GR}	SDB_{RED}	SDB_{GR}	SDB_{RED}
0 -3 m	1.36	1.46	0.35	0.08	1.35	2.44	0.57	0.73
3 - 6 m	0.94	0.84	0.17	0.12	0.90	1.08	0.77	0.58
6 -9 m	1.28	1.18	0.002	0.15	0.88	1.60	0.60	0.33
9 -12 m and above	3.17	3.28	2E-05	0.56	2.53	4.38	0.01	0.03

RMSE of 4.38 m obtained based on Sentinel-2 compared relatively with output from Meliala *et al.* (2019) of about 4 m for depths ranges of 3 - 15 m using Lyzenga model. Comparing RMSE of 1.35 and 0.90 m based on Stumpf's model SDB from Landsat 8 in 0 - 3 m and 3 - 6 m region with values obtained by Ekpa and Ojinnaka (2018), for Mbo River from Landsat 7 Level-1, a superior performance of the model was noted with RMSE of 0.821. Higher coefficient of determination (R^2) of 0.346 was also recorded by Ekpa and Ojinnaka (2018) against 0.35 and 0.17. This could be attributed to optical transparency and relatively shallow depth (about 5 m) of Mbo River. Whereas, Imo River is relatively more turbid with a depth of about 12.96 m. Evagorou *et al*. (2022) also reported good

results for 6–8 m depth derived from Sentinel based on Stumpf's model. Said et al. (2018) recorded standard deviations of 2.027 m and 2.342 m for Stumpf and Lyzenga model respectively across depth ranges mapped. The better estimation (low RMSE) by both Stumpf and Lyzenga algorithm for shallow depths and poor RMSE of up to 4 m for deeper depths (3 - 15 m) was also reported by Meliala *et al.* (2019). Thus, result in this study were not unexpected.

Generally, both Stumpf and Lyzenga algorithms tend to under estimate depth within 9-12 m and above. This could be due to the fact that at this region, light ray may be completely attenuated due to turbidity and sediment factor. As reported in other studies (Freire, 2017; Olayinka and Okolie, 2017; Zwolak *et al.*, 2020; Vargas *et al*., 2021), areas deeper than the extinction depth (9-12 m and above) tend to show almost constant values that represents only the water column with RMSE spanning between 2.76 and 3.28 m for Landsat and 2.53 to 4.38 m for Sentinel. Besides, turbidity played a major role as depths were generally underestimated in this region (9-12 m and above). This case was asserted by Casal *et al.* (2019) and Cahalane *et al*. (2019). Besides, both Landsat-8 and Sentinel-2 satellite data estimated up to 10 m depths. This depth range is reliable as the estimation result has met expectation given the characteristics of Imo river as a type 2 - complex water with turbidity and sediment load. The result relates well with Yunus *et al*. (2019) where Landsat-8 and Sentinel-2 satellite images were reported to estimate SDB up to 10 m in coastal waters.

Result of accuracy of the SDBs based on CATZOC is presented in Table 4. From the table (4), depth accuracy obtained from estimated depths for Category B were approximately 1.20 m. This value met the IHO ZOC B depth accuracy where "controlled, systematic survey achieving similar depth but lesser position accuracy less than ZOC A2 and using a modern survey echosounder, but no sonar or mechanical sweep system" (Rutkowski, 2018) was carried out.

Table 4: Result of CATZOC depth accuracy

CATZOC	Depth accuracy	SBES (m)	Landsat L1TP (m)		Landsat L2SP (m)		Sentinel MSIL2A (m)	
			SDB_{Red}	SDB_{BR}	SDB_{Red}	SDB_{GR}	SDB_{Red}	SDB_{GR}
		d=12.96	d= 8.76	d= 9.51	d= 8.33	d= 9.96	d= 9.11	d= 10.47
A1	0.50+1% d	0.63	0.59	0.60	0.58	0.60	0.59	0.60
A2	1.00+2%d	1.26	1.18	1.19	1.17	1.20	1.18	1.21
B	1.0 +2% d	1.26	1.18	1.19	1.17	1.20	1.18	1.21
C	2.0 +5% d	2.65	2.44	2.48	2.42	2.50	2.46	2.52
D	Worse than ZOC C	-	-	-	-	-	-	-
U	Unassessed	-	-	-	-	-	-	-

Conclusion and Recommendation

Blue, green, red and NIR bands of Landsat-8 OLI and Sentinel-2 MSI of December 19 and 20, 2021 satellite data were used to estimate bathymetry for Imo River using Stumpf *et al.* (2003) as well as Lyzenga *et al.* (2006) empirical models. It was found out that the red band and its combination performed better than the blue and green bands which are usually used for bathymetry estimation. Green/red ratio was employed based on Stumpf's model while log transformed reflectance of the red band modelled the river bathymetry better using Lyzenga algorithm.

Estimated satellite-based bathymetry was validated using sounding depths. Root mean squared error, standard deviation and coefficient of determination statistics for the estimated bathymetry based on the two models were computed. Stumpf et al model produced R^2 of 00.55 and 0.62 between predicted depth from Landsat-8 and Sentinel-2 respectively. R^2 of 0.58 and 0.30 were obtained based on Lyzenga's model from Landsat-8 and Sentinel -2 respectively. Accuracy assessment based on depth ranges at 4 m interval covering 0-3 m, 3-6 m, 6-9 m, and 9-12 m indicated that estimation and depth accuracy decreased substantially for depths ranging from 9 to 12 m and above. However, estimated

SDBs from the two models reliably describe the water depth of the study area. This study has proven that although light penetration is limited by turbidity in complex waters, depth retrieval from satellite images is still possible and reliable. Also, Landsat-8 and Sentinel-2 can be utilized to derive bathymetry of the river to 10 m depth.

Given the result for the study area, the use of multispectral images for estimation of bathymetry for turbid rivers is recommended. Howbeit, images should be subjected to radiometric corrections to enhance bathymetry fidelity

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ASSESSMENT OF ABANDONED RESIDENTIAL PROPERTIES IN UYO URBAN

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Abstract
Abandoned residential properties are noticeable in both developed and developing countries, these abandoned residential properties are found barely in every street particularly in developing countries. This study assessed abandoned residential properties in Uyo urban, Akwa Ibom State, Nigeria. Abandoned residential properties along the major roads in the study area were identified and assessed, the study also examined the environmental effects of abandoned residential properties in the study area. The method of data collection included administration of questionnaire and field observations. ***Findings revealed the number of residential properties found along these major roads differed significantly.*** *The study further revealed the major effects abandoned residential properties have on the environment of Uyo urban which were; abandoned residential properties being used as hideouts for taking hard drugs, molestation of people and that it also causes decline of property values, it have a huge effect on community and neighbourhood aesthetics. Hence, it was concluded that there is need to mitigate abandoned residential properties in the area as it would help shape the physical pattern of the area, improve property values and the overall aesthetics of the area and lastly mitigate illegal activities in the neighbourhood. The following recommendations were suggested: proper costing and appropriate schedule of project duration, due consultations with the necessary planning authority, availability of needed funds before initiation of a particular housing development and transparency in selection of competent and trusted contractors.*
Keywords: *Abandonment, residential properties, buildings and projects*

INTRODUCTION

Abandonment of landed property is a global issue and abounds everywhere; both in the developed and developing countries (Hoe, 2013). The significant effects of such structures are obvious on the economy, residents and environment as a whole. Abandonment has been observed as an indicator of real estate market failure, symptom of urban disinvestment and the product of urban shrinking (Gospodini, 2012). Abandoned landed property has been viewed as an image of uninhabited structure or building in a grave ruin, possibly boarded up with trash, and cramped with vandalism (Cohen, 2001). Abandonment indicates a practical symbol of wastage which occurs when a developer decides to discontinue temporarily or permanently a project under development (Cohen, 2001; Ewusi-Mensah and Przasnyski, 1991).

Mallach (2006) established that abandonment contributes to increasing danger of public health, safety, building collapse and incidence of fire disaster. Similarly, Skogan, and Spelman, (1993) reported that crime rate in term of drug use and prostitution is in relation with abandoned landed properties. Researchers have stated that abandonment contributes to property value decline, arson and other crimes (Goetz, 1998; Bruhns, 2000; Shlay and Whitman, 2006; Adedibu and Akindele, 2007; Han, 2014). According to Akindele (2013), abandon structures provides meeting places where offenders who perpetrate crimes elsewhere can gather meet and plan their activities. Stolen goods are also temporarily kept in abandoned structures (Mallach 2004, Akindele 2013). However, property development and maintenance being a capital-intensive undertaking should be critically analyzed to ascertain its feasibility and viability before embarking on it. However, on several occasions and as it had been observed, governments, contractors, and agencies have abandoned old buildings and development projects mid-way into construction and completion. The causes and effects of these residential building abandonments are not just peculiar to a particular reason rather cut across several reasons (Ayodele and Alabi, 2011),

Nigerian cities are characterized with abandoned structures due to net result of inconsistent government policies, corruption, obsolete infrastructures, community interference, inadequate planning among others (Franks, 2006; Efenudu, 2010; Ikpefan, 2010). The situation in Uyo urban; the

study area is no exception. Abandoned landed properties in Uyo downgrade quality of life, create unattractive urban environment for the citizens, visitors as well as future investors. This contradicts the fundamental objective of planning to make the city safe, healthy, beautiful and sustainable. Pearsall and Lucas (2014) opined that abandoned property can be recognized as both a problem and an opportunity for planners and non-governmental organizations (NGOs) seeking to address community social and land use concerns. Therefore, to achieve the purpose of planning in any built up environment, prevalence of abandoned landed properties and their environmental impacts on the aesthetics and the general livability of towns and cities should be examined.

Aim and Objectives of the Study

The aim of the study was to assess abandoned residential properties in Uyo urban. The following objectives were pursued:

i. To identify and examine the number of abandoned residential properties in Uyo Urban.
ii. To examine the environmental effects of abandoned residential properties in Uyo urban.

The study area

The study area is Uyo urban, under Uyo Local Government Area which is the headquarters of Uyo Local Government Area and the capital of Akwa Ibom State (Figure 1). It is bordered on the North by Itu, Ikono and Ibiono Ibom Local Government Areas, on the South, by Etinan, Nsit Ibom and Ibesikpo Asutan Local Government Areas, to the East by Uruan which stretches from the north – east around Ibiaku Uruan to Ndon Uruan in the south eastern corner. It is located between latitudes 40 53' and 50 04' north of the equator and longitudes 70 48' and 80 02' east of the Greenwich Meridian. Uyo urban is located about 55 kilometres from coastal southern Nigeria (Asuquo, 2010).

Uyo urban falls within the sub-equatorial climate belt with a mean annual rainfall of 216mm in 2008 and 282mm in 2018 (University of Uyo, Meteorological Centre, 2019). The rainy season usually begins from March to November, with violent storms between March and May. This is why the study area is always characterized by heavy flooding. The situation is aggravated by land use changes in the city. The relative humidity is usually within the average of 70 and 80 percent throughout the year except for the short dry period of Harmattan. The monthly average temperature is between 26°C and 29°C (University of Uyo, Meteorological Centre, 2019).

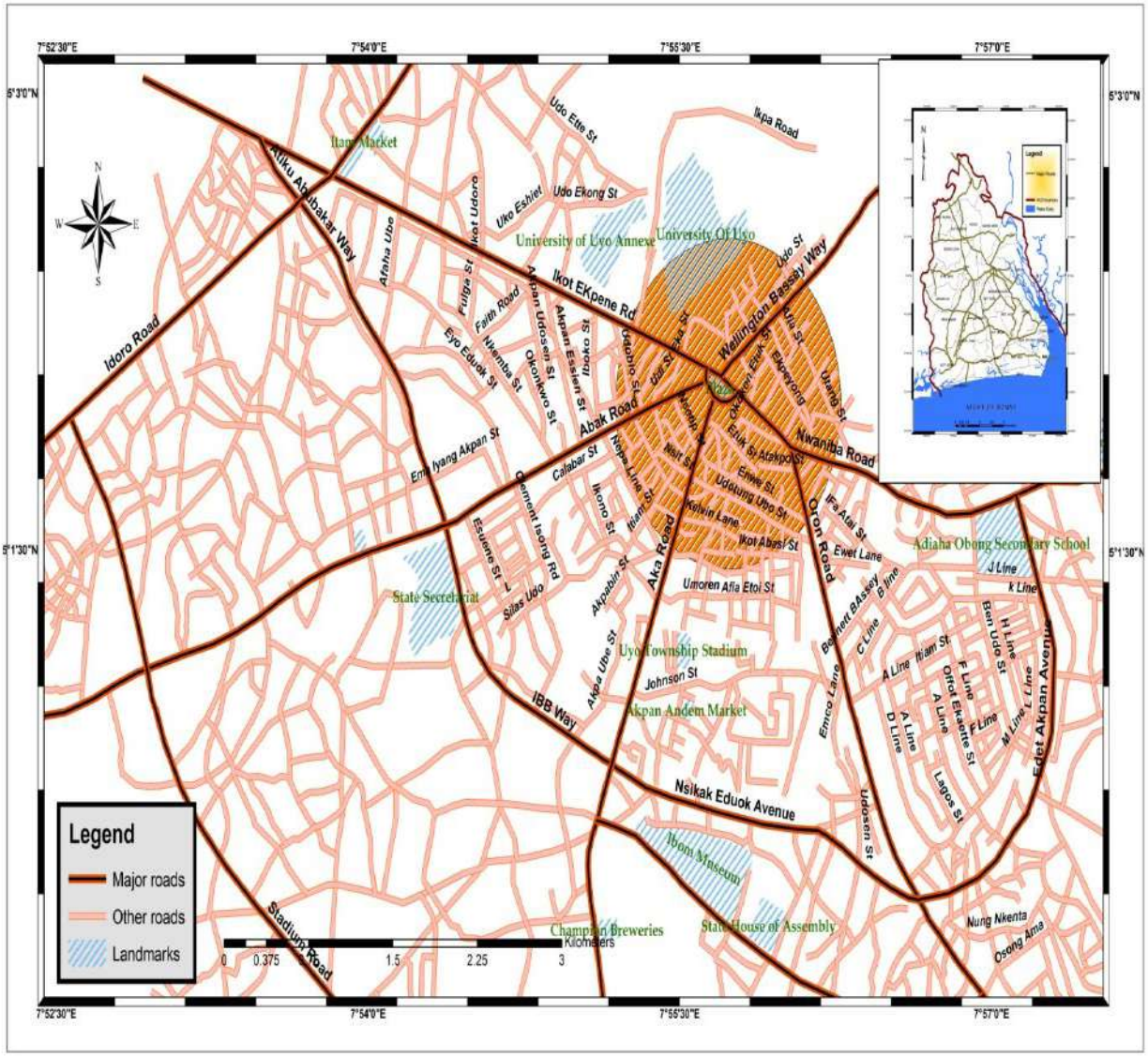

Figure 1: Map of the study area (Uyo urban)
Source: ArcGis Software (2023)

The vegetation of Uyo urban falls within the tropical evergreen forest. Initially, this vegetation type covered most of the town from north to south but with the increase in population and land use activities, much of this forest disappeared leaving secondary vegetation in remnant areas. When there is heavy downpour, the soil is no longer protected. Consequently, cases of erosion and flooding become severer. The nature of Uyo topography is fairly flat with isolated troughs that get flooded whenever there is an appreciable amount of rainfall. Uyo has relatively gentle sloping relief with a general elevation of about 150 meters above sea level (University of Uyo, Meteorological Centre, 2019). This relatively flat plain has a gentle slope from the north to the south and is marked by two dominant landform areas. In the north, the valley of Ikpa River runs in the northwest-southeast direction. The valley of one of the tributaries forms the ravine which has been declared undevelopable because of its steep slope. Parts of this area, especially the junction of old Itu road along Ikpa road are also badly eroded. The Southern part of the town is characterized by fairly gentle slopes with incidental water logged areas but remains largely suitable for urban development. There are

prominent ravines found in Uyo Urban such as the University of Uyo ravine around the University of Uyo, Oku ravine along the Uyo village road and Anua Offot ravine.

Series of population statistics had been compiled at different periods for Uyo urban. In 1931, the population of Uyo urban was 743 people. Another population census was conducted in 1975 and the population of Uyo urban was 50,939, 52,213 in 1976; and an annual projection with 2.5% growth rate as follows: 62, 020 in 1983; 63,571 in 1984; 65,160 in 1985; 66,789 in 1986; 68,459 in 1987; and 70,170 in 1988 (NPC: Uyo, 2006). The sex ratio is placed at 104 females to 100 males. During the 1991 census conducted by the National Population Commission (NPC), Uyo urban was said to have 244,762 people with 120,875 males and 123,887 females. The 2006 census figure of Uyo Local Government Area stood at 309,573 (NPC: Uyo, 2006). Therefore, the study area has a projected population of 765, 893 in 2023.

Literature Review

The causes of abandoned construction projects identified from existing kinds of literature can be broadly grouped into five categories; mismanagement, unfavorable government policies, the inefficient public delivery system, unfavorable economic conditions and financial problems. According to Ewa (2005), who identified that many projects are conceived without a well-defined objective in mind, poor costing, no specific start and endpoints, poor documentation of contract, lack of performance criteria and properly developed monitoring and evaluation template by supervising organizations, fluctuation in government policies, lack of planning, project mismatch, over-ambitious projects, political influence in establishing projects, disbursement constraints, failure for successive regimes to issue appropriate white papers on failed contracts and granting of injunctions under motions by Nigerian courts. The abandonment of building projects in Nigeria – Causes and Solutions by Olapade and Anthony (2012), gave reasons for failed construction projects, which are: incorrect estimation; lack of available skilled personnel; inadequate planning; poor risk management; misunderstanding of work requirement; corruption and communication gap among the personnel. According to Ugofunle (2007), the factors leading to abandoned projects are: economic factors. human factors, natural factors and social factors.

The role of the client must be analyzed to know how the abandonment of a project can be caused by the client. Knowing full well that, all participants in the construction industry have a role to play. The fund is an important factor that provides both the private and public sectors the required provision to embark on the project; therefore, adequate financial provision must be made before any project could be embarked upon. Any lapse in this regard might lead to total abandonment of the project. Therefore, it is the role of the client to provide sufficient funds for the project. According to Barwell (1987), clients do not consider the availability of funds before the award of a contract which in turn leads to project abandonment knowingly or unknowingly. Furthermore, design improvement and modification by the client can cause project suspension or abandonment, that is, after which the project has been embarked upon, the client decided to make some vital changes or modifications, which can cause delay or abandonment of the project. Ugofunle (2007) stated that cases where there is a direct contract between the contractor or the sub-contractor and the client, the Architects' authority is weakened and his instruction might not be treated the way it should be and this may affect the successful completion of the project. Also, the death of the client is a major cause of project abandonment. Cases of death, whereby the client (i.e. an individual) dies intestate, and the project may be suspended or completely abandoned.

Osemena (1987) listed the effects of abandoned projects on the national economy as: waste and under-utilization of human resources, reduction in employment, increase in bankruptcy of firms, companies, and incidence of bad debt, effects on community and neighborhood aesthetics, impact on public health and safety, promotion of illegal activities, liability as a result of the uncompleted project, problems arising from the high accommodation rate and housing problems, low turn-up of foreign investors due to a total loss of trust in the professional competence of local contractor and declining property values.

According to Akindele (2013), the effects of abandoned residential buildings are enormous especially the dilapidating ones are potential accident points where suspended debris or the whole building can fall on passersby. Junks and thrashes can contain sharp objects that can injure residents in the neighbourhood. Also, the presence of abandoned buildings negatively affects the property value or precipitates the loss of value of properties. Abandoned buildings are potential crime facilitators. Crimes that could be connected with abandoned buildings are theft, rape, drug or hemp smoking, arson amidst others.

Research Methodology

The survey design was adopted in this study. Survey design is appropriate because it was useful in illustrating a general condition. The method of data collection included administration of questionnaire and field observations. The structured questionnaire was administered to the respondents in the sample villages randomly selected. The sample size adopted for the study was statistically determined using Yamane (1967) formula for finite population after population was projected to 2023. Sample population (Uyo urban) is 765,893 using Yamane (1967) formula.

$$n = \frac{N}{1 + [N(e)^2]}$$

Where: n = Sample size

N = Total or Finite Population

$(e)^2$ = Limit of Tolerable Error $(0.05)^2$

1 = Unity (a constant)

$$n = \frac{765893}{1 + [765893(0.05)^2]}$$

$$n = \frac{765893}{1 + [765893 \times 0.0025]}$$

$$n = \frac{765893}{1 + 1914.73}$$

$$n = \frac{765893}{1915.73}$$

$$n = 399.791$$

$$n \simeq 400 \text{ (approximately)}$$

Stratified sampling technique was adopted, this sampling technique divides the population under study into strata to enhance efficient coverage of the area and also allow for equal representation of each stratum. A total of 400 copies of questionnaire were administered to the respondents. However, 388 copies of questionnaire were returned and used for analysis while 12 copies were not returned from the field. Ranks were assigned based on the highest value on the weighted mean values. Weighted mean was used to assess the environmental effects of abandoned residential properties.

Results and Discussion of Findings

Abandoned residential properties are found barely in every area of Uyo urban. The survey done on the five major roads (Ikot Ekpene, Aka, Oron, Nwaniba and Abak Road) in Uyo urban on the number of abandoned residential properties indicated a total of 118 abandoned residential properties some of which attachments were done at the front of these buildings to carryout commercial activities. Table 1 indicates the total numbers of abandoned residential properties along the five major roads (Abak Road, Aka Road, Ikot Ekpene Road, Nwaniba Road and Oron Road) in Uyo urban. Ikot Ekpene road have the least abandoned residential properties, followed by Aka Road with 24, followed by Oron Road with 25, with Nwaniba Road with 26 and lastly Abak Road with 28 abandoned residential properties which is the highest.

Table 1: Number of Abandoned Residential Properties on the Five Major Roads in Uyo Urban

Major roads in Uyo Urban	Number of Abandoned Residential Properties
Ikot Ekpene Road	15
Aka Road	24
Oron Road	25
Nwaniba Road	26
Abak Road	28
Total	118

Field survey (2023)

The environmental effects of abandoned residential buildings in Uyo urban cannot be over emphasized as seen in the analysis. Table 2 highlights the effects abandoned residential properties have on the environment pointing out the most impacting effects to the least impacting effect. The most impacting was that these abandoned properties promote illegal activities such as hooliganism, serving as hideout where hard drugs and smoking is being carried out. The least impacting effect of abandoned residential properties in Uyo urban Liability was liability as a result of uncompleted project.

Table 2: Environmental Effects of Abandoned Residential Properties

Effect of Abandoned Residential Properties	Strongly Agree (SA)	Agree (A)	Undecided (U)	Disagree (D)	Strongly Disagree (SD)	Weighted Mean (WM)	Rank
Effect on Community and Neighbourhood Aesthetics	102	202	58	18	8	3.95	2nd
Impact on Public Health and Safety	98	197	60	28	5	3.91	3rd
Promoting Illegal Activities such as Hooliganism, hideout for taking hard drugs among others	106	210	56	10	6	4.03	1st
Liability as a result of Uncompleted Project	74	161	89	40	24	3.57	6th
Waste and Under-utilization of Human Resources	94	196	68	22	8	3.89	4th
Declining Property Values	100	201	61	18	8	3.95	2nd
Low Turn up of Foreign Investors due to Limited Trust in the Professional Competence of Local Contractors	82	176	80	30	20	3.69	5th

Field Survey & Researcher's computation (2023)

From Table 2, environmental effects of abandoned residential properties, the perceived environmental effects of abandoned residential properties were being grouped according to respondent perceived degree of assessment (SA – strongly agree, A - agree, U – undecided, D – disagree and SD – strongly disagree). Weighted mean was used to assess the environmental effects of abandoned residential properties. Ranks were assigned based on the highest value on the weighted mean values and they are as follows: promoting illegal activities such as hooliganism, hideout for taking hard drugs among others was ranked 1st, effect on community and neighbourhood aesthetics and declining property values were ranked 2nd, impact on public health and safety ranked 3rd. waste and under-utilization of human resources ranked 4th, low turn up of foreign investors due to limited trust in the professional competence of local contractors ranked 5th while liability as a result of uncompleted project ranked 6th.

Findings revealed the number of residential properties found along these major roads differed significantly. The study further revealed the major effects abandoned residential properties have on the environment of Uyo urban which were; abandoned residential properties being used as hideouts for taking hard drugs, declining property values, waste and under-utilization of human resources. The findings of this study corroborates with that of Akindele (2013) whose findings in the study on environmental effects of abandoned properties in Ogbomosho and Osogbo revealed that the presence of abandoned buildings negatively affected property values and also, facilitated criminal activities in these areas.

Conclusion and Recommendations

In this study, abandoned residential properties in Uyo urban were assessed. Abandoned residential properties were identified in the area as represented in Table 1. It was realised that abandoned residential properties are found within and even along roads in Uyo urban and that a total of 118 abandoned residential properties were identified along the five major roads in Uyo urban. The study further revealed the major effects abandoned residential properties have on the environment of Uyo urban which were; abandoned residential properties being used as hideouts for taking hard drugs, molestation of people and that it also causes decline of property values, it have a huge effect on community and neighbourhood aesthetics. There is need to mitigate abandoned residential properties in the area as it would help shape the physical pattern of the area, improve property values and the overall aesthetics of the area and lastly mitigate illegal activities in the neighbourhood. The following recommendations were suggested: proper costing and appropriate schedule of project duration with due considerations of human controllable factors and uncontrollable/unforeseen factors as well as due consultations with the necessary planning authority, availability of needed funds before initiation of a particular housing development and transparency in selection of competent and trusted contractors.

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ASSESSMENT OF INDIGENOUS KNOWLEDGE OF FLOOD COPING STRATEGIES IN ITU LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA

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Abstract
Flood disaster has reached an alarming rate globally given its devastating effects on lives and properties. In Nigeria, more lives and properties have been lost to flooding than any other type of natural hazard. The response to the disaster thus varies from community to community. In Akwa Ibom State, flood is an annual experience and the people's response in form of preparedness, planning, management and recovery vary from community to community depending on strategies available. The study aimed at assessing the indigenous knowledge of flood coping strategies in Itu Local Government Area of Akwa Ibom State, Nigeria. The objectives were to (i) investigate the frequency of flood disaster in the area, (ii) identify the indigenous flood coping strategies in the area (iii) assess the effectiveness of the various coping strategies. The study employed survey research method. Primary and secondary data were used to obtain data for the study. Multiple Linear Regression was used to test the relationship between the severity of flood, and the functionality of the indigenous flood coping strategies while Relative Effective Index was used to assess the level of effectiveness of each coping strategy in the affected communities. Findings revealed a positive relationship between the severity of flood and the indigenous flood coping strategies. Furthermore, 13 out of the 14 coping strategies assessed were functional, and should be adopted as part of Flood Risk Management approaches in the State in order to curb flood related casualties.
Keywords: *Indigenous Knowledge, flood, coping strategies, disaster.*

1.0 Introduction

Peaceful existence of man has been threatened by numerous challenges, menaces and disasters. One of the foremost of such is flood disaster which according to World Metropolitan Organization (2014) has claimed over 170,000 lives, displaced 250 million people, and destroyed properties worth over 360 billion US Dollars in the last 5 years. Human societies globally have lived and died with flood from the very beginning, spawning a prominent role for flood within legends, religions and history, O'Connor and Costa, (2004). Flood is the most recurring, widespread, disastrous and frequent natural disaster in the world according to Herson and Donnel (2007), and it has caused about one third of all deaths, one third of all injuries and one third of all natural disasters in the world, claiming more lives and causing more damages to properties than any other natural phenomenon, Askew (1999).

No other natural catastrophe impacts as many people as flood with an estimated 500 million people affected directly and indirectly every year, including Nigeria which is yet to recover fully from the impact of flood experienced in the last eight years. Over these periods, the worst flooding Nigeria has seen in at least half a century has led to deaths of hundreds of Nigerians, the displacement of over a million people, and the destruction of hundreds of thousands of hectares of farmland. Huge swathes of the country have been affected, particularly in central and south-eastern regions, with houses, bridges and roads devastated (Akinloye, 2012).

Flood has been identified as an annual nightmare with wide range of negative impact across the country. In 2018, Nearly a quarter of a million households in Nigeria were at risk after heavy rains caused flooding that inundated 80 per cent of the country, affecting 34 of the 36 states, and causing 141 deaths and 265 injuries to date, requiring 12.13 billion Naira to provide relief materials to those affected. Furthermore about 13,031 houses were either destroyed or damaged while 122,653 hectares

of farmland were damaged (Punch, 2018, International Federation of Red Cross and Red Crescent Societies, 2018).

However, the extent of damages and vulnerability recorded in various settlements globally is highly dependent on the level of preparedness, resilience, and management, and community participation has been proven to be effective in disaster management.

According to the UN-ISDR Hyogo Framework for Action 2005-2015 (UN-ISDR, 2005), Community involvement has become one of the chief priorities for establishing effective partnerships for disaster risk reduction. This has witness gradual popularity and advocacy for the incorporation of society based knowledge, otherwise known as rural dwellers' knowledge or indigenous knowledge into the conventional methods of disaster management. Natural hazards are not new and people have been living in hazard-prone areas for centuries – in some cases for thousands of years. They have, inevitably, devised their own methods for protecting themselves and their livelihoods. These methods are based on their own skills and resources, as well as their experiences.

Over the course of history and up to this day, traditional local communities have continued to rely heavily on their own indigenous knowledge systems in observing the environment and dealing with natural disasters (Pareek and Trivedi, 2011). These communities, especially those in hazard prone regions have collectively generated a vast body of knowledge on disaster prevention and mitigation, early warning, preparedness and response and post disaster recovery. Sophisticated knowledge of the natural world is not confined to science. Human societies all across the globe have developed rich sets of experiences and explanations relating to the environments they live in. These 'other knowledge systems' are today often referred to as rural dwellers' knowledge or traditional ecological knowledge or indigenous or local knowledge. They encompass the sophisticated arrays of information, understandings and interpretations that guide human societies around the globe in their innumerable interactions with the natural milieu: in agriculture and animal husbandry; hunting, fishing and gathering; struggles against flooding, disease and injury; naming and explanation of natural phenomena; and strategies to cope with fluctuating environments Nakashima, Prott, and Bridgewater, (2000).

However, according to Peters, McCall, and Western (2009), coping strategies of the people are very diverse and rely on different factors like culture, social organisation, technology and economy. On the other hand a change in the economy and the social structure affects the indigenous knowledge and often undermines the knowledge system. Moreover, indigenous knowledge also varies depending on the natural disaster prevalent in the community. The understanding of mechanisms for coping and adaptation of natural phenomena and flooding in particular is very importance. This study therefore seeks to assess indigenous environmental knowledge of flood coping strategies in Nigeria in order to determine their effectiveness towards the improvement and sustainability of environmental safety and socio- economic productivity in the local communities.

The objectives of the study include:

(i) to investigate the frequency of flood disaster in the area,

(ii) to identify the indigenous flood coping strategies in the area

(iii) to assess the effectiveness of the various coping strategies,

(iv) to identify the most effective indigenous flood coping strategy in the area.

2.0 The Study Area

For the purpose of this study, the case study is Itu Local Government Area in Akwa Ibom State. The Local Government Area occupies a landmass of approximately 606.1 0 square kilometres. It is located between Latitude 5°0′12″ / 5°0′0″N and 7°0′59″E / 7°0′18″E It is bounded in the North and East by Odukpani in Cross River State and Arochukwu in Abia State, in the West by Ibiono Ibom and Ikono Local Government Areas, and in the South and South East by Uyo and Uruan Local Government Areas, respectively **as shown in Figure 1 (Usip, 2019).**

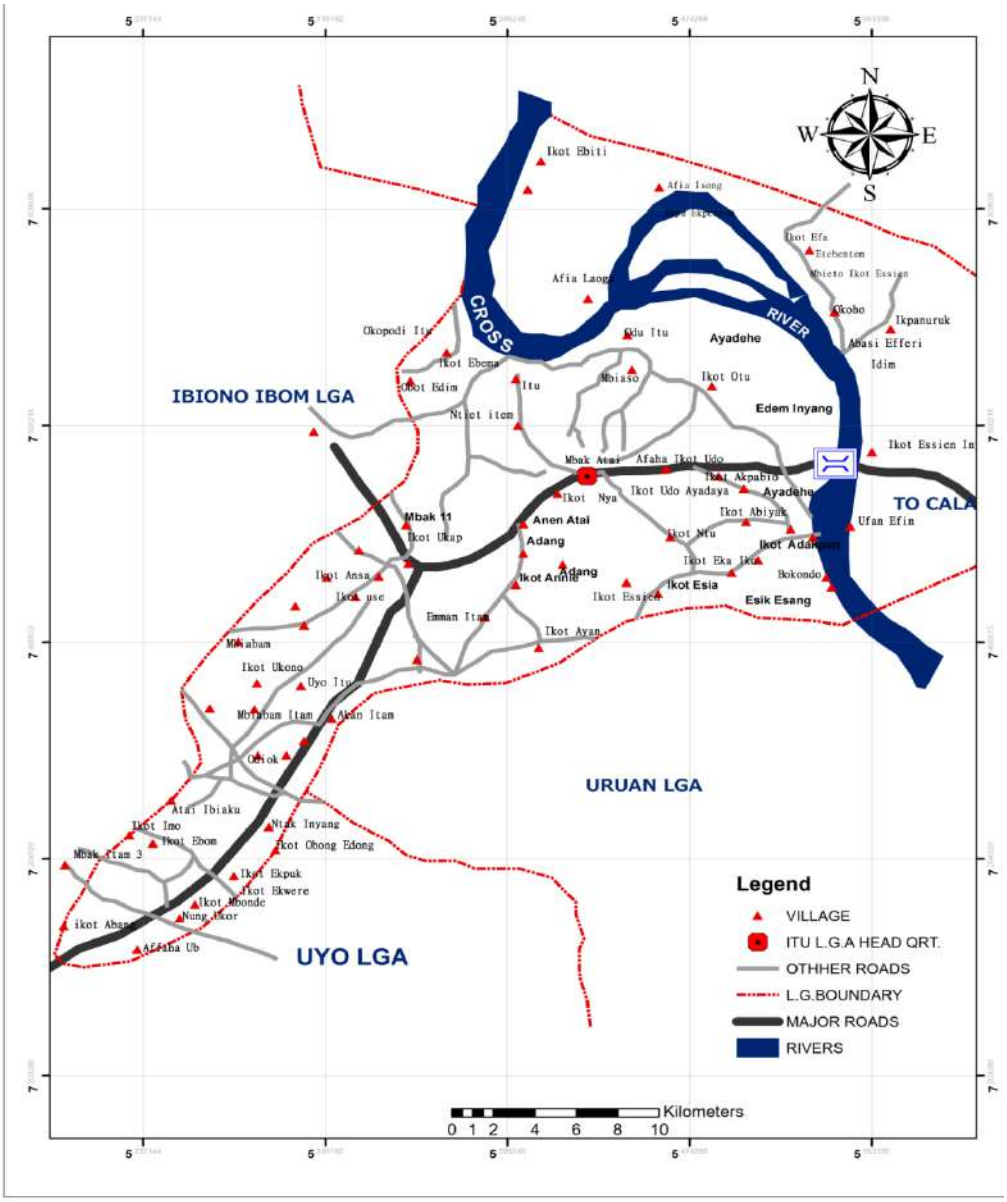

Figure 1. Map of Itu Local Government Area

The study area lies within the tropical climatic zone with two dominant seasons – the wet and dry seasons. It is mainly influenced by the warm humid maritime (MT) tropical air mass of the South West winds blowing from the Atlantic Ocean and to some extent by the Continental (CT) air mass of the north east winds blowing from the Sahara Desert. The difference in precipitation between the driest month and the wettest month is 363 mm (Usip, 2019).

The rainfall in Itu is convectional, particularly at the beginning and at the end of the rainy season. Atmospheric disturbances are usually characterized by thunderstorm and squally winds with heavy cloud cover. The rainfall usually destroys crops, houses and causes soil erosion and floods particularly in the low-lying areas. The peak annual rainfall is over 3,000mm in the area. Rainfall is experienced in all months of the year although the rainy months are between June and September, with an average rainfall of 400mm in a year. The area racks among the highest rainfall zones in Nigeria. (Bassey, Bassey & Opara, Kenneth & Usip, . 2020).

Temperature values are relatively high in Itu because of the latitudinal location of Akwa Ibom State between 4^0N and 6^0N, which makes the amount of insulation received relatively very high throughout

the year. The mean maximum temperature in the state are usually higher than 30^0C while the mean minimum temperature are usually less than 24^0C giving a monthly temperature range of about 6^0C or more. The annual mean temperature is 27^oC. The study area has an ecological vegetal equatorial rain forest. Part of the original forest cover has been depleted because of agricultural activities and other physical development activities. The general topography of the area is lowland with gentle slope towards the Cross River (Usip, 2019).

3.0 Methods

The study employed survey research method. 12 communities in Itu local Government Area, Akwa Ibom States constituted the case study. These are areas that have been identified by Akwa Ibom State Government as flooded communities given their consistent experience over the years. Primary and secondary data were used to obtain data for the study. Interviews, observations and questionnaire were utilized as the primary sources of data. The frequency of flood disaster and the level of effectiveness of the indigenous flood coping strategies in the area were derived from questionnaire administered. Relative effective Index was used to determine the effectiveness of the flood coping strategies while Multiple Linear Regression was used to test the level of functionality of the coping strategies. The sample size of 400 was determined using Taro Yamane's method, and purposive sampling technique was employed in its administration. Table 1.0 shows the distribution of questionnaire in the 12 communities.

Table 1 Showing the Distribution of Questionnaire

S/N	Villages	Population	Sample Size	Percentage %	Rate of Return
1	Odu Itu	868	22	5.5	20
2	Okoho	798	20	5	19
3	Edem Inyang	1022	26	7.5	25
4	Akpaekpeneton	980	25	6.3	24
5	Afia Isong	1176	30	7.5	28
6	Ikot Otu	1099	28	7	27
7	Etehentem	854	22	5.5	21
8	Mkpan Uruk	728	19	4.7	18
9	Mben Inyang	672	17	5	15
10	Mbiabo	1358	36	9	35
11	Ikot Adakpan	1722	45	12	44
12	Ayadehe	3906	100	25	98
	Total	**15,183**	**390**	**100**	**374**

Source: Field Research (2018)

4.0 Data Presentation

4.1 Frequency of Flood Disaster

To determine the frequency of flood disaster in the area, data on the frequency of flood occurrence, duration of flood and severity of flood damages were collected from the questionnaire.

The frequency of flood occurrence in each of the 12 communities investigated is revealed in 2 below

Table 2 Frequency of Flood Occurrence

Communities	Once in Four Years	Once in Three Years	Once in Two Years	Annually	No of Respondents	REI
Odu Itu	-	1	2	17	20	3.80
Okoho	-	-	-	19	19	4.00
Edem Inyang	-	-	-	25	25	4.00
Akpaekpeneton	-	2	-	22	24	3.83
Afia Isong	-	-	-	28	28	4.00
Ikot Otu	-	1	3	23	27	3.81
Etehentem	-	-	-	21	21	4.00

Mkpan Uruk	-	-	1	17	18	3.94
Mben Inyang	-	-	1	14	15	3.93
Mbiaso	-	-	-	35	35	4.00
Ikot Adakpan	-	-	2	42	44	3.95
Ayadehe	-	-	-	98	98	4.00
TOTAL	**-**	**4 (1.1)**	**9 (2.4)**	**361 (96.5)**	**374**	

Source: Field Research (2018)

From the table above, 96.5% of the respondents agreed that flood occurs annually in the communities, 2.4% agreed it happens once in two years while the remaining 1.1% agrees it happens once in three years.

Duration of flood varies once it occurs from community to community, depending on the proximity to the water body, water volume, velocity of flow, and the terrain. Also it varies from one individual to another, depending on his/her location, and the effect/impact of flood on him/her in a whole. Moreover people's respond to flood could also be influenced by how long the hazard last. Thus, the duration of flood in these communities investigated is revealed in Table 3

Table 3 Duration of Flood Experience

Communities	One week	Two weeks	Three weeks	One Month and Above	No of Respondents	REI
Odu Itu	-		1	19	20	3.95
Okoho	-	1	1	17	19	3.84
Edem Inyang	-	-	1	24	25	3.99
Akpaekpeneton	-	1	2	21	24	3.83
Afia Isong	-	-	5	23	28	3.82
Ikot Otu	-	-	7	20	27	3.74
Etehentem	-	1	1	19	21	3.95
Mkpan Uruk	-	-	4	14	18	3.77
Mben Inyang	-	-	2	13	15	3.87
Mbiaso	-	-	3	32	35	3.83
Ikot Adakpan	-	-	4	40	44	3.82
Ayadehe	-	-	18	80	98	3.74
Total	**-**	**3(1%)**	**49 (13%)**	**322(86%)**	**374**	

Source: Field Research (2018)

As presented above, 86 % of the respondent agreed that flood last beyond one month every year in the communities. 13% agreed it last for three weeks while the remaining 1% agreed it last for just two weeks.

Flood, has been described as one of the world's worst disaster from ancient times given its widespread effect, wide coverage area, duration, and sometimes its unpredictability. Flood could be less damaging and mild, and can also be very devastating given the terrain, the volume and velocity of water flooding and its receding rate. The extent of severity of flood is categorized into not severe, less severe, severe and very severe and it is presented in Table 4 below

Table 4 Severity of Flood

Communities	Not Severe	Less Severe	Severe	Very Severe	No of Respondents	REI	Ranking
Odu Itu	1	1	2	16	20	3.50	11TH
Okoho	1	1	1	16	19	3.68	5TH
Edem Inyang	-	1	1	23	25	3.88	1ST
Akpaekpeneton	1	2	3	18	24	3.58	7TH
Afia Isong	-	1	2	25	28	3.86	3RD
Ikot Otu	-	1	4	22	27	3.77	4TH

Etehentem	1	1	2	17	21	3.66	6TH
Mkpan Uruk	1	2	1	14	18	3.56	8TH
Mben Inyang	1	1	1	12	15	3.87	2ND
Mbiaso	2	3	5	25	35	3.51	10TH
Ikot Adakpan	4	5	4	31	44	3.40	12TH
Ayadehe	6	6	13	73	98	3.56	9TH
TOTAL	**18**	**25**	**39**	**292 (78%)**	**374**		

Source: Field Research (2018)

All the communities investigated recorded high level of severity as their index score is higher than the 2.5 mean value of the Relative Effective Index. Furthermore, the level of severity resulting from flood differs from community to community. A close examination of the table reveals that 78% of the respondent agreed that flood is very severe, 10.5% observed flood to be severe, 6.7% rather agreed that it was less severe while 4.8% agreed that flood was not severe in the communities. Figure 2 reveals one of the challenges posed by flood in the communities.

Figure 2: Building Foundation Exposed by Flood in Ayadehe Community
Source: Field Research (2018)

4.2 Indigenous Flood Coping Strategies and Their Effectiveness

Various strategies are developed by rural dwellers to enable them cope with natural and manmade hazards and disasters. In this study, the following coping strategies were identified and their level of effectiveness investigated.

1. Use of Contours and Barriers - CB
2. Use of cover crops - CC
3. Early Planting - EP

4.	Building Elevated Surface	-	BES
5.	Indulging in Other Economic Activities	-	EA
6.	Assistants from Help Group	-	AHG
7.	Movement of People	-	MP
8.	Strengthening of Building Materials	-	SBM
9.	Protection of Vulnerable Groups	-	PVG
10.	Change of Harvesting Date	-	CHD
11.	Immediate Procession of Groups	-	IPC
12.	Use of Crop Varieties	-	CV
13.	Use of Floated Canoes	-	FC
14.	Use of Local Building Materials	-	LBM

Their level of effectiveness was investigated using Relative Effective Index. The summary of the level of effectiveness of each strategy is presented in table 5 below.

Table 5: Summary of Levels of Effectiveness of the Coping Strategies

S/No.	Coping Strategies	Communities													
		Odu Itu	**Okoho**	**Edem Inyang**	**Akpa-ekpeneton**	**Afia Isong**	**Ikot Otu**	**Etehentem**	**Mkpan Uruk**	**Mben Inyang**	**Mbiabo**	**Ikot Adakpan**	**Ayadehe**	**Total**	**Rank**
1.	CB	3.87	3.84	3.90	3.82	3.84	3.87	3.89	3.89	3.89	3.88	3.85	3.91	3.87	3rd
2.	CC	3.35	3.36	2.88	2.66	3.10	3.22	3.19	2.94	3.20	3.08	3.61	3.42	3.17	11th
3.	EP	3.81	3.92	3.96	3.84	3.88	3.87	3.96	3.95	3.94	3.95	3.90	3.92	3.91	1st
4.	BES	3.78	3.89	3.88	3.80	3.85	3.83	3.88	3.86	3.83	3.86	3.90	3.87	3.85	6th *
5.	EA	3.56	3.73	3.86	3.58	3.76	3.79	3.53	3.37	3.51	3.44	3.41	3.40	3.58	8th
6.	AHG	2.35	1.89	1.92	2.33	2.14	2.14	1.71	1.83	1.73	1.77	1.56	1.55	1.91	14th
7.	MP	3.60	3.42	3.41	3.33	3.30	3.50	3.55	3.41	3.20	3.48	3.70	3.44	3.45	10th
8.	SBM	3.87	3.84	3.89	3.86	3.85	3.82	3.89	3.86	3.81	3.89	3.86	3.89	3.86	5th *
9.	PVG	3.78	3.86	3.88	3.81	3.87	3.76	3.88	3.87	3.85	3.89	3.86	3.86	3.85	7th *
10.	CHD	2.45	2.78	2.84	2.58	2.53	3.25	2.71	2.72	3.00	2.60	3.00	1.94	2.70	13th
11.	IPC	3.74	3.89	3.82	3.76	3.86	3.80	3.89	3.92	3.90	3.92	3.87	3.89	3.86	4th *
12.	CV	2.60	2.42	2.84	2.54	2.57	2.88	3.19	2.83	3.53	3.20	3.59	3.60	2.98	12th
13.	FC	3.60	3.63	3.79	3.68	3.83	3.80	3.32	3.21	3.57	3.47	3.48	3.40	3.57	9th
14.	LBM	3.89	3.90	3.91	3.89	3.89	3.82	3.92	3.88	3.87	3.91	3.86	3.91	3.89	2nd
	Total	3.45	3.46	3.48	3.39	3.45	3.53	3.47	3.40	3.49	3.45	3.53	3.43		
	Rank	7th *	6th	4th	12th	8th *	1st *	5th	11th	3rd	9th *	2nd *	10th		

Source: Field Research (2018)

The table above reveals two set of data. The first is the ranking of the level of effectiveness of all the coping strategies used in the study area, while the second is the ranking of the communities according to the effectiveness of the strategies put together.

Of all the coping strategies used, the most effective, as revealed from the table above in the ranking is Early Planting with index score of 3.91. This is followed by the Use of Local Building Material with 3.89 index score. The 3rd position is occupied by the use of Contours and Barriers with 3.87 score. Immediate Procession of Crops and Strengthening of Building Materials are in the 4th and 5th position with the same index score of 3.86. Likewise, the 6th and 7th position is occupied by Building Elevated Surface and Protection of Vulnerable Groups with a tie score of 3.85. The 8th, 9th and 10th positions are occupied by Indulging in other Economic Activities, Use of floated Canoes, and Movement of People with index values of 3.58, 3.57 and 3.45. Use of Cover Crops (3.17), use of Crop Varieties (2.98) and Change of Harvest Dates (2.70) are in the 11th, 12th and 13th position. The last coping strategy is Assistance from Help Groups with index score of 1.91, which is below the mean Relative Effective 1ndex value of 2.5.

Having collected appropriate data on the coping strategies used, and damages experience in the study areas, Multiple Linear Regression was used to test the level of relationship. The coping strategies were the predictors while the damages (severity) made up the dependent variable.

The result of the study reveals that there is significant relationship between the indigenous coping strategies used in the area and the level of damages experienced as evident in the model summary presented in Table 2 where R = .916 at 0.05.

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.916[a]	.839	.823	.03025

The significant relationship infers that the application of the coping strategies has helped reduced the level of damages experienced in the study areas.

The most effective indigenous flood coping strategy as revealed in table 6 above is Early Planting (EP).

5. DISCUSSION OF FINDINGS

In the course of this study, investigations were carried out to determine the frequency of flood disaster in the study area using questionnaire. The findings revealed that 95% of respondents agreed that flood occurs annually in their communities, 3.3% rather observed it as a biennial experience while the remaining 1.4% viewed it as once in 3 years occurrence.

With regards to the duration of flood, 86.1% respondents agreed flood occurrence last for one month and above each year, 13.1% observed it last for 3 weeks while the remaining 0.8% respondents were of the opinion it last for 2 weeks.

Findings revealed that 95% of the respondents agreed that flood is experienced annually, 86% observed that it last beyond one month and 78% agreed that flood is always very severe. Frequency of flood disaster in the area is thus an annual experience; however, the severity of the disaster experienced in the communities varies as some communities are more affected than others.

From the study, flood is seen as an annual occurrence in all the 12 communities investigated with over 95% of respondents affirming it. This corroborates with the findings of Usip and Uduak (2020) which observed that flooding is now an annual occurrence in Itu Local Government Area and is widely attributed to climate change, chaotic development, and rapid urbanization.

Assessing the effectiveness of the flood coping strategies

The only non-effective coping strategy in the study area is Assistants from Help Group (AHG) which has an index score of 1.9. This is far less than the R. E. I. mean value of 2.5. In all the 12 communities investigated, it was found to be ineffective in all. On the other hand, the other coping strategies were found to be very effective.

The most effective coping strategy is Early Planting Strategy with index score of 3.91. This strategy involves the people clearing the farm land and planting the crops earlier in the months of December and January, other than March and April regular planting seasons. This is a strategy that will help them harvest crops before flood, and helps some crops grow to flood resistant level before the rainy season. This strategy is very effective in all the 12 communities investigated.

The 2nd highest ranked coping strategy is the use of Local Materials for Building with an index score of 3.89. Locally building materials are considered affordable and easily accessible as white sand and gravels are present in the communities. Also, lumber logs are readily brought on canoes to the communities from the forest across the cross river, and from other places using the water route.

The 3rd strategy is Building of Barrier and Contours with index scare of 3.86. These are built to restrict flood from reaching the individual homes, business centres and workshops/public buildings. The restriction keeps the premises accessible during flood, and equally limits the flood waters from eroding the foundations of structures as shown in figure 3.

Figure 3: Barrier and Contour Constructed in Afia Isong Community to Restrict Flood Water
Source: Field Research (2018)

Strengthening of building materials is ranked 4th with index scare of 3.86. Buildings are often strengthened during flood to avoid corrosion of foundation and total collapse. These are done in ways of strengthening the materials previously used. As observed in the communities, locally assessed materials such as gravels, and sand mixed with cement are used to strengthen the foundation of buildings to prevent corrosion and collapse during flood as shown in figure 4.

Figure 4: Raised slaps constructed round the buildings using a concrete mix of shells, gravels and cement to safeguard the foundation of a buildings in Akpaekpeneton Community.
Source: Field Research (2018)

The copping strategy ranked 5th is Immediate Processing of Crops. Food shortage is one of the common challenges experienced in the study areas during flood, thus all available ways are employed to avoid food wastage and loss. Here, crops are readily processed to prevent them from being washed away or spoilt by flood water. Some of these staple crops include cassava, water yam, sweet yam, plantain, melon, palm fruits, cocoanuts, etc. These crops are processed and extracted to a form that can be preserved over a long period of time. For instances some crops likes cassava are is processed into "Garri" and "fofo" which can be consumed for over a month, plantains are dried while fish is smoked. These crops are harvested prematurely and processed immediately once water level rises in the river, before flood water arrives.

Building of elevated surfaces is ranked 6th with index score of 3.85. Unlike building of barriers and contours, elevated surfaces are built to store farm produces, goods and precious items. For instance, an elevated surface is built in the area to store farm produce, fishing nets, smoked fish, water tanks. Etc. These surfaces are constructed using wood, concrete or a combination of both, and they are raised high above the ground level which is flooded during the rainy season.

Protection of Vulnerable Groups is ranked 7th with index score of 3.85. Various associations exist in the study areas which also function as help groups such as association of fishermen, family associations, agricultural groups, etc. These societies - based cultural groups help their members and other members of the society to prepare and recover after flood events. Children, the aged and physically challenged persons are protected during flood as volunteers from these help groups are drafted to help them escape where necessary, or strengthen their buildings, build contours and promote food, water and drug supply in the communities.

Involvement in other Economic Activities is ranked 8th with 3. 58 index score. During flood, some economic activities are put on hold such as fishing and crop cultivation. The people affected often diversify into other activities in order to generate some income that will sustain them and their families and recover through the flood period. Such activities include paddling commuters across flooded access road, buying necessary goods from town to sell them in the communities and moving some processed crops to the main road for sales since buyers find it difficult to get to their farms and fishing yard for their products. Figure 5 shows an abandoned market during flood. This affects the economic activities in the area, therefore calling for diversification of activities

Figure 5: Flooded Community Market @ Mbiabo
Source: Field Research (2018)

The 9th most effective coping strategy is the use of Floaters and Canoes for transportation during flood with 3.57 index score. Some access roads in the study area are completely submerged in water during flood, making it completing inaccessible by automobile. Also some homes are inaccessible as the whole or some parts of the communities are flood. This therefore makes the use of floaters and canoes the only available means of transportation. These are used to ferry people from community to community, and from homes to other homes, public buildings (such as Church) and outside the community as seen in figure 6.

Figure 6: A Boy using a Canoe to farm in Etehentem Community
Source: Field Research (2018)

Movement of people from flooded areas to regions of higher elevations is ranked 10th with an index score of 3.45. This strategy involves people abandoning their homes as a result of flood to other areas not reached by flood. This technique is only of one of the last resorts as people are often so reluctant to leave their homes. However, were the flood gets so severe and life threatening, people move upland abandoning their homes for a season as shown in figure 7. These often involve more resources as some belongings will be moved too to mostly a relations apartment, or public buildings such as church and schools located upland.

Figure 7: Abandoned Buildings During Flood in Mben Inyang Community.
Source: Field Research (2018)

Cover crops are used in the study areas to restraint flood. These crops are planted to reduce the velocity of advancing flood waters and also restrain the waters were necessary from flooding some areas. One of such crop used in the communities is Indian bamboos. This strategy is ranked 11th with index score of 3.17.

Some Crop Varieties that are flood resistant are planted during flood seasons. Some of these crops include local rice and vegetables. These crops are planted during the raining seasons, which the flood is expected. It is ranked 12th with an index score of 2.99. Although the index score is higher than the R. E. I mean value of 2.5; this strategy is not commonly used as it is ineffective in some communities investigated.

Change of Harvesting Dates ranks 13th with index of 2.70. This strategy involves people harvesting their crops prematurely to avoid lose during flood. It is the least effective strategy, and it is not found to be very effective in some of the communities investigated.

Presence of Help Groups is found to be the only ineffective strategy in the study areas with index scores of 1.91 which is far below 2.5 mean value of R.E.I. The help groups here refers to

Governmental and Non-Governmental Based groups constituted strictly for disaster risk planning, control, recovery and management.

The extent of benefits of the coping strategies as flood management strategy is revealed in their level of effectiveness. From the studies, all the coping strategies identified are highly beneficial except Assistants from Help Groups (AHG) whose index score of 1.94 and far below the REI mean value of 2.5. The communities for decades now have been using the effective coping strategies identified to plan, prepare, manage, recover and control flood disasters in their communities.

A Study by Fabiyi and Oloukoi (2013) showed that these indigenous knowledges of flood coping strategies have been in use by the people of Ilajes, Itshekiris and Ijaws. Similar studies by Ishaya and Abaje (2008) in Kaduna, and Theodory (2014) in Tanzania acknowledged that these indigenous knowledges have proven to be very instrumental to the sustenance and resilience of the peopled surveyed.

Multiple Linear regression was used to determine if there is a significant relationship between the damages (severity) experienced and the coping strategies used. The result revealed that the effectiveness of the coping strategies has help curtail the damages experienced in the area. With R^2 of 0.839 at 0.05 significant level, the positive result affirmed that the coping strategies are functional as there is a significant relationship with the damages experienced in the communities.

Conclusion

Whereas flood has been identified as the most widespread and damaging natural disaster, its impact is partly dependent on the preparedness of the communities affected. Flood disaster risk preparedness, resilience, recovery and management have been a major challenge especially in a developing country like Nigeria, thereby leading to more devastating impacts.

In spite of the damages caused by annual flood disaster in the communities investigated in Itu L.G.A, Akwa Ibom State, the use of various indigenous strategies have proven to be very effective and sustainable as flood coping strategies in the communities, thereby boosting flood preparedness, resilience, recovery and management in the communities. The benefits of indigenous flood coping strategies has shown to be very high, encouraging and very effective.

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CHALLENGES OF APPLYING BUILDING INFORMATION MODELING (BIM) IN PROPERTY MAINTENANCE BY ESTATE SURVEYORS AND VALUERS IN UYO, AKWA IBOM STATE

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Abstract
The traditional reactive approach to property maintenance by estate surveyors and valuers presents huge limitations in today's data-driven world. However, building information modeling (BIM) has emerged as a global transformative technology, offering a proactive, data-centric framework for optimizing maintenance operations. Presumably, the application of this model should be evident in Uyo, Akwa Ibom State as in other countries like United States (US) and United Kingdom (UK), but sadly, the reverse is the case. Hence, this study aimed at identifying the challenges hindering the application of BIM in property maintenance by estate surveyors and valuers in Uyo, Akwa Ibom State, the population for this study comprised 80 head of practicing estate surveyors and valuers firms in Uyo, Akwa Ibom State or their representative, using random sampling technique, 66 respondents from the study area were sampled with frequency table as method of data analysis. The findings showed barriers such as skill/training gap (8.61) being the paramount, resistant to change (8.30), lack of reliable and up-to-date building data (8.13) exist. Inferring from the findings, the study concluded that skill gap/training, cost of BIM software and training, compatibility issues, lack of reliable and up-to-date building data, lack of government support, among others are the major challenges of applying BIM in property maintenance. Hence, it was recommended that estate surveyors and valuers should learn to apply the contemporary model through seminars and workshops since it would enable them to be more efficient in undertaking property maintenance activities.
***Key words**: building information modeling (BIM), property maintenance, and estate surveyors and valuers*

Introduction

Building Information Modeling (BIM), which is a process involving the generation and management of digital representation of the physical and functional characteristics of building, has been gaining much popularity in the real estate industry, but its application in property maintenance is a relatively new area of research. Perhaps, many researchers such as Fazli *et al.* (2014) have acknowledged that countries who had applied this BIM model in their property maintenance activities had obtained improved communication, collaboration and efficient decision-making maintenance practices, despite its inherent challenges (Sampaio and Simoes, 2014). To this end, Wang *et al.* (2013) confirmed that BIM is a new approach to real estate design, construction and facilities management, in which a representation of the building process is used to facilitate the exchange and interoperability of digital information to achieve efficient result, especially as related to property maintenance.

Further, Azhar (2011) viewed BIM as a virtual process that encompasses all real estate aspects, disciplines and systems of a facility within a single and virtual model, allowing all the designing team members such as architect, engineers and other construction workers to collaborate more effectively and efficiently in comparison to traditional processes. The author also emphasized that the model is not just a software, but both a process and software, meaning that it serves a dual purpose and hence, performs more than expected. Based on this school of thought, Gu and London (2010) stated that BIM means not only using 3D intelligent model, but also making significant changes in the workflow and project delivery process to achieve efficient and effective results. More so, since it represents a new paradigm shift within the contemporary architects, engineers and construction workers, the author showed that it encourages the integral roles of all stakeholders on a real estate project. Observably, one would say that it has the tendency to promote greater efficiency and harmonize players who in the past saw themselves as rivals. Summarily, BIM has become increasingly prevalent in the field of property maintenance due to its ability to streamline and optimize real estate maintenance processes and this is in line with the thoughts of Succar (2009).

According to BIM Think Space (2013), record showed that BIM has been globally used in a variety of ways, with eight major countries among who are China, Singapore and South Korea adopting it at different rates from year 2000, its year of origin. For example, the United States (US), which is one of the early adopters, had applied BIM on about 85% of all federal real estate projects, and since they have identified the benefits, it is now being adopted in the private sector-application. Further on evaluation, in that same country, BIM enabled seamless collaboration and communication among various stakeholders involved in property maintenance, and also provided a centralized platform for sharing and accessing information, thus, leading to better coordination and reduction of 35% errors in its real estate sector. In Europe, the government had developed a number of standards for the applications of BIM so as to enable it facilitate its applicability across the continent on 65% real estate projects. Hence, all these reports on the application shows that BIM has integrated with sensor technologies and Internet of Things (IoT) devices to allow real-time monitoring of building systems, equipment and environmental conditions in the country. Observably, this application has been enabled by analyzed data collection from sensors embedded in the application on one hand and predictive maintenance strategies has been developed by reducing maintenance costs within a framework on the other hand. Also, its application is embraced by countries such as Australia, Canada and the United Arab Emirates (UAE) where historical data for maintenance decision-making are applied to store and manage historical data relating to maintenance activities, maintenance logs, repairs and replacements. This data has been leveraged for informed decision-making by identifying recurring issues, optimizing maintenance schedules and estimating maintenance costs (Eastman *et al.*, 2011).

In Nigeria, the application of BIM for property maintenance is still in the early stages of adoption. However, there is a growing recognition of its benefits in improving maintenance practices and overall asset management because of its effective data management as shown by Jambil (2020) and Nigerian Federal Ministry of Power, Works and Housing (2016). Babatunde *et al.* (2020) opined that some information on the national view of BIM and its relevance to property maintenance are that BIM enhances real estate project delivery, reduces costs and improved the overall quality of real estate products. Nigerian Federal Ministry of Power, Works and Housing (2016) had earlier recognized the importance of BIM and its benefits in the Nigerian real estate industry in general and specifically, as they had applied it to the maintenance of the presidency and national secretariat maintenance projects. With this purview, they had initiated effort to promote BIM application in the real estate sector and to every State of the federation. However, it is sad to note that its application within the industry is still in its low level by other interested parties.

Based on this premise and other research facts, Olanrewaju *et al.* (2020) concluded that many real estate professionals in Nigeria are not aware of BIM nor do they understand its benefits. One may say that the cost implication of applying BIM and its training is a major contribution to the set-back. However, another perspective is that there is no government regulatory policy that has specifically promoted the application of BIM in the real estate sector. Seemingly, this lack of support, on the surface, has continually made it difficult for real estate firms to justify the cost of investing in the application of BIM. Hence, there is a shortage of skilled BIM professionals in Nigeria. Unarguably, this makes it difficult for real estate firms to find people who could apply BIM effectively, especially in the area of property maintenance.

Assessment of Challenges of Applying BIM in Property Maintenance

There are challenges facing the application of BIM in property maintenance. Some of them as identified by Azhar *et al.* (2017) and Bolpagni *et al.* (2017) include collaboration and teaming, legal changes to documentation ownership and productivity, changes in practice and use of information, implementation issues, among others. Also, the Royal Institute of Chartered Surveyor (RICS) (2011) confirmed that lack of awareness among stakeholders, lack of standard to guide implementation, and lack of IT infrastructure, lack of education and training, lack of government direction are major challenges when applying BIM in property maintenance. Kineber *et al.* (2023) also enumerated challenges in the application of BIM to include incompatibility of different BIM programs legal problems, level of accountability from specialists, among others. For example, the authors show that lack of trained workers is a major roadblock to BIM's widespread application. Confirming this fact, Aranda-Mena *et al.* (2019) opined that there is much difficulty in discussing its application since there

are no individuals to execute it. On another part, Sebastian (2011) argued that the inadequacy of BIM's design to incorporate such cutting-edge technology made it impossible to apply it for property maintenance. However, specific challenges by many researchers include data integration, skill gap/training, initial implementation costs, data security and privacy, interoperability, resistance to change, data accuracy and maintenance, legal and contractual issues, data migration and legal systems and scalability (Kineber *et al.*, 2023; Aranda-Mena *et al.*, 2019; Sebastian, 2011).

For data integration, Eastman *et al.* (2011) opined that BIM and its tools may not always be compatible with each other, leading to interoperability issues. The author showed that different stakeholders in a construction project use different software and file formats, making it challenging to seamlessly integrate data. Hence, he was of the opinion that this result in information silos that hinders effective collaboration and data exchange. Also, development projects involve a multitude of data types, including architectural, structural, mechanical, and electrical information. Further, he opined that integrating these diverse data types into a single model could be complex and leads to fragmentation. Thus, this fragmentation results in inconsistencies, errors, and a lack of a holistic view of the project. Within this purview, he concluded that maintaining the integrity of the BIM data as the project evolves is crucial. Lastly, the author showed that ensuring that all stakeholders are working with the most up-to-date information could also be a challenge.

Succar and Kassem (2015) stated that data standardization is essential to ensure that all stakeholders in a construction project spoke the same "language" when it comes to data representation. Hence, the authors showed that there is no single global standard for BIM data. Hence, various countries and regions have developed their own BIM standards and guidelines, leading to fragmentation and inconsistency in data representation. For example, the US has its National BIM Standard (NBIMS), while the UK used the BIM Level 2 standard for its application. On the part of evolution of standards, the authors showed that BIM standards are continuously evolving to keep pace with technological advancements and industry needs. Therefore, the authors concluded that this creates challenges for organizations trying to align with the latest standards and ensure compliance. More so for resistance to change, the authors showed that some stakeholders resisted adopting standardized BIM practices, viewing them as an additional burden. Summarily, one may agree that resistance to change slows down the implementation of standardized BIM processes (Oti and Guo, 2015).

Another challenge already enumerated is skill gap/training, in which Kassem *et al.* (2016) showed that BIM implementation revealed a significant skill gap within the industry. Obviously, this gap encompasses various aspects since BIM requires specialized knowledge and skills. The author showed that many professionals, especially those who have been in the industry for years, may not be proficient in using BIM effectively. Also, professionals from different disciplines, such as architects, engineers, and contractors, may not be accustomed to working closely together or may not fully understand each other's requirements and constraints. Specifically, the authors showed that implementing BIM often requires a cultural shift within organizations. To this end, one would say that resistance to change and a lack of change management skills hinders successful adoption. On the part of training, the authors showed that addressing the skill gap and preparing professionals for BIM implementation necessitated comprehensive training programs. Based on formal education, the authors showed that many academic institutions have recognize the importance of BIM and has started offering courses and programs in BIM. However, there is often a lag between the industry's needs and the curriculum development in educational institutions. Hence, one would agree that continuing education in BIM technology is necessary as it evolves rapidly and professionals need continuous training to stay up-to-date with the latest software versions and best practices (Succar *et al.*, 2012).

On the part of initial implementation costs, Eastman *et al.* (2011) showed that implementing BIM requires significant investments in BIM licenses, hardware, and IT infrastructure. This is a substantial upfront cost for organizations. Training costs staff members needed training to effectively apply BIM software. Training programs and resources were expensive and time-consuming (Teicholz, 2018). On the part of data security, Pan *et al.* (2015) opined that controlling who could access and modify BIM data is essential. Implementing proper access control mechanisms is crucial to prevent unauthorized access. Also, Eastman *et al.* (2011) highlighted the importance of role-based access control in BIM systems. For data encryption, the author showed that encrypting data during

transmission and storage is essential to prevent data breaches. Pan *et al*. (2015) emphasized the significance of encryption in securing BIM data. However, for collaboration with external parties, the authors opined that BIM projects often involve multiple stakeholders, including contractors, subcontractors and consultants. Hence, sharing data with external parties raises concerns about data security. Further, Lee *et al.* (2019) discussed secure collaboration in BIM projects. The authors showed that privacy concerns arise when personal or sensitive information is collected, used, or share without consent or inappropriately. With this, one would agree that initial implementation cost is a major challenge.

Again, Yoon *et al.* (2018) also discussed privacy issues related to personal data in BIM. For example, in talking about geospatial data privacy, the authors showed that BIM often includes geospatial data, such as the location of buildings and infrastructure. Protecting the privacy of this information is crucial to prevent location-based privacy breaches. Also, Hjerppe *et al.* (2016) explored geospatial data privacy in BIM. Their finding showed that data anonymization or de-identifying data help protect privacy while still allowing data sharing. Jallow *et al.* (2020) discussed data anonymization techniques in BIM. In terms of regulatory compliance, the authors show that many countries had regulations and standards governing data security and privacy, such as the General Data Protection Regulation (GDPR) in Europe or the Health Insurance Portability and Accountability Act (HIPAA) in the United States. Hence, one would conclude that ensuring compliance with these regulations add complexity to BIM implementation and agrees with the thought of Tucker *et al.* (2018).

Interoperability is a critical challenge affecting the successful implementation of BIM as shown by Teicholz (2018). Basic challenges in this issue are that interoperability issues often arise from the lack of standardized data formats and protocols, AEC professionals often used various software applications for different tasks within a project and these software tools are not seamlessly integrating with each other. Eastman *et al.* (2011) highlighted the challenges of integrating BIM with various software platforms as BIM projects involve multiple stakeholders. Akinci *et al.* (2012) also explored the challenges of interdisciplinary BIM collaboration by showing that existing infrastructure and projects are manage with legacy systems that did not support BIM data exchange. Wang *et al.* (2011) discussed strategies for dealing with legacy systems in BIM adoption. Dawood *et al.* (2017) examined legal and contractual aspects of BIM interoperability. Succar and Sher (2013) discussed the need for education and training to improve BIM interoperability. Based on all these schools of thought, it could be said that interoperability is also a critical challenge.

Further on resistance to change in the implementation of BIM, Latham (1994) showed that lack of understanding and awareness is a major factor. Many individuals in the real estate sector did not fully understand the benefits and capabilities of BIM. This lack of awareness leads to resistance as stakeholders who perceive BIM as unnecessary or disruptive to their established workflows. Also, Love *et al.* (2019) reiterated that implementing BIM often requires a significant change in traditional work processes. Resistance arise when employees are asking to adapt to new roles and responsibilities. Some stakeholders resist BIM due to technological challenges, such as the need for new software and hardware, which were perceived as costly and complicated to implement. Resistance also stem from concerns about the learning curve associated with these technologies (Eastman *et al.*, 2011). Further, organizational culture and norms play a significant role in resistance to change. Employees and organizations are comfortable with traditional practices resisted to the cultural shift (Zayed and Kandil, 2012). No wonder, one would agree that resistance to change is a major challenge.

On data accuracy and maintenance, Eastman *et al*. (2011) showed that data accuracy in BIM is crucial in BIM implementation as inaccurate information leads to costly errors and rework during construction. Some of the factors that contribute to data accuracy challenges include data input errors and integration of multiple sources (Becerik-Gerber *et al.*, 2011). The authors show that as projects evolve, design changes occur. Managing these changes and ensuring that the BIM model accurately reflects them is a significant challenge (El-Diraby and Kashif, 2011). Also, BIM models go through different versions during a project's lifecycle. Maintaining version control to avoid conflicts and ensure accurate data is critical (Succar and Kassem, 2015). More so, regularly validating and controlling the quality of data in the BIM model is essential to maintain accuracy (Arayici and Coates, 2011). It could be said here that data accuracy and maintenance is a challenge worth addressing.

On the issue of legal and contractual framework, Sullivan (2018) stated that issues related to BIM ownership, liability, and intellectual property rights are complex and required clear contracts. Hence, BIM involves the creation and sharing of digital models that contains intellectual property, including design elements, software, and proprietary data. Determining who owns these rights and how they are licensed are complex (Barlish and Sullivan, 2012). Further, liability and responsibility of BIM blurs traditional lines of responsibility, making it challenging to assign liability in the event of errors or omissions. This leads to disputes over who is accountable for design flaws (Eastman *et al*., 2011). More so, in terms of contractual frameworks, traditional construction contracts were not adequately address BIM-related processes and responsibilities. Parties modify or develop new contract clauses to incorporate BIM effectively (Akintoye *et al.*, 2015). Also, with respect to data ownership and sharing, BIM rely on the exchange of data among project stakeholders. Determining data ownership, access rights, and data sharing protocols leads to conflicts and privacy concerns (Succar and Kassem, 2015). For standardization and interoperability, inconsistent BIM standards and file formats hindered interoperability between different software platforms and project stakeholders (Eastman *et al*., 2011). Risk allocation is another factor, in which is reevaluated to account for new risks introduced by BIM, such as the risk of data inaccuracies and the need for additional training and technology investments (Rostamzadeh *et al.*, 2017). Furthermore, in terms of privacy and security, storing sensitive project data in digital BIM models raises concerns about data security and privacy breach (Underwood *et al*., 2016). Lastly, for dispute resolution, disputes related to BIM implementation, such as model quality or interpretation, requires specialized dispute resolution mechanisms not covered by traditional contracts (Akintoye *et al*., 2016).

Another challenging factor is data migration and legacy system. These pose significant challenges in the implementation of BIM in property maintenance. Its implementation often involves transitioning from traditional, paper-based or 2D CAD workflows to a more sophisticated and data-driven approach. Data migration challenges - data quality and consistency when migrating data from legacy systems to BIM, ensuring the quality and consistency of the data be a major challenge. Inaccurate or incomplete data leads to errors in the BIM model, which has costly consequences during construction and operation (Eastman *et al*., 2018). Specifically, legacy systems use different data formats and standards than BIM, making it difficult to integrate and migrate data seamlessly. Ensuring compatibility between systems is crucial (Succar and Kassem, 2015). Also, legacy systems contain vast amounts of historical data. Managing and migrating this data efficiently while retaining its integrity is a substantial challenge (Zhang *et al.*, 2013). Undoubtedly, cost of transition replacing legacy systems with BIM is expensive in terms of software, hardware, and training costs. Convincing organizations to invest in this transition is a challenge. Interoperability legacy systems are not seamlessly integrated with BIM and platforms. Ensuring interoperability between the old and new systems could be a complex task (Succar and Sher, 2013).

Lastly is the variable of scalability. It is one of the challenges in the implementation of BIM. BIM, while offering numerous benefits such as improved collaboration, enhanced decision-making, and cost savings, face scalability issues as projects become larger and more complex. For example, as BIM models become more comprehensive and detailed, they demand higher computational resources for rendering, analyzing and collaboration. This leads to performance bottlenecks, particularly on lower-end hardware or in organizations with limited IT infrastructure (Tezel *et al.*, 2010). Also, scalability becomes a challenge when multiple stakeholders use different process tools or versions, leading to interoperability issues. Data exchange and integration become increasingly complex, causing delays and errors in the project. More so, large BIM models generated vast amounts of data. Efficiently storing, retrieving and managing this data becomes a challenge as project size increased. Traditional data management systems are not being suitable for handling BIM data at scale (Lee *et al.*, 2012). Furthermore, in larger projects with numerous stakeholders, coordination and collaboration becomes more challenging. Scalability issues arise when different teams need to work concurrently on different aspects of the model or when multiple models need to be integrated (Succar and Kassem, 2015). Also, scaling up BIM implementation often requires significant investments in software, hardware, training, and IT infrastructure. Managing these cost and allocating resources efficiently are a daunting task. Lastly, as BIM is adopted on larger and more complex projects, legal and regulatory challenges arise, including issues relates to liability, intellectual property rights, and compliance with industry standards (Bryde and Broquetas, 2013).

Methodology

In this study, cross-sectional research design type was applied. Cross-sectional study design is a type of observational study design, the investigator measures the outcome and the exposures in the study participants at the same time. The population for this study comprised head of practicing estate surveyors and valuers firms in Uyo, Akwa Ibom State or their representative. According to Nigeria Institution of Estate Surveyors and Valuers (NIESV), Akwa Ibom Branch (2022), there was eighty (80) practicing estate surveyors and valuers firm in Uyo, Akwa Ibom State.

Using sample size determination by Krejcie and Morgan (1970) who provided a formula for determining sample size for a given finite population as follows;

$S = X^2NP (1-P) – d^2(N-1) + X^2P (1-P)$

where S = required sample size, X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.44), N = the population size, P = the population proportion (assumed to be 5.48) since this would provide the maximum sample size) and d = the degree of accuracy expressed as a proportion (0.05).

Applying this formula, the result was 66 respondents. So the questionnaires were administered on 66 head of practice or their representatives. Random sampling was adopted, in which Maxwell (2005), defined it as a type of sampling where a respondent is chosen from among the list at random.

The instrument that was used in data collection in this study was a well-structured and developed questionnaire entitled "Framework for Application of Building Information Modeling (BIM) in Property Maintenance by Practicing Estate Surveyors and Valuers in Uyo, Akwa Ibom State".

Result and Discussion

Questionnaire Administrated

Table 1: Questionnaire Administered

Number of Questionnaire Administered	Number Returned	Percentage of Return	Number of Not Returned	Percentage Not Returned
66	63	95.45	3	4.55

Source: Researcher's Computation (2023)

Analysis from Table 1 showed that out of 66 questionnaire administered, 63 (95.45%) questionnaire was returned, while 3 (4.55%) questionnaires were not returned. The 63 questionnaires were used for the study.

Professional Status

The study sought to find out the professional status of the respondents by asking question The responses were tabulated on Table 2.

Table 2: Professional Status

Items	Number of Responses	Percentage (%)
Associate	55	87.3
Fellows	8	12.7
Total	**63**	**100.00**

Source: Researcher's Fieldwork (2023)

Analysis from Table 2 shows that there were 55(87.3%) respondents were Associates, while 8(12.7%) respondents were Fellows in the profession. So, the study comprised more of Associates than Fellows.

Factor that Influences Decision to use BIM

The result of the study showed the factor that influence decision to use BIM, Table 3 explains the data.

Table 3: Factor that Influence Decision to use BIM

Items	Number Responses	Percentage (%)
Not at all	4	6.35
A Little	4	6.35
Averagely	12	19.05
Considerably	15	23.81
To a very large extent	28	44.44
Total	**63**	**100.0**

Source: Researcher's Fieldwork (2023)

Analysis from Table 3 shows that 28 (44.44%) respondents shows that there are factors that influence the decision to use BIM to a very large extent, is influence, 15 (23.81%) respondents agree considerably, 12 (19.05%) respondents are averagely in agreement, 4 (6.35%) respondents both shows settled for 'not at all' and 'a little' to factor influencing the use of BIM. To a very large extent, there is/are factor(s) that influence the decision to use BIM in property maintenance, which include awareness of the benefits of BIM, access to training, availability of data, software compatibility, cost, change management and support from clients.

With regards to specific challenges in adopting BIM technologies with estate surveying and valuation profession, Table 4 explains the data.

Table 4: Specific Challenges to Adopting BIM Technologies within Estate Surveying and Valuation Profession

Items	Number of Responses	Percentage (%)
Not at all	6	9.52
A Little	9	14.29
Averagely	16	25.40
Considerably	19	30.16
To a very large extent	13	20.63
Total	**63**	**100.0**

Source: Researcher's Fieldwork (2023)

Analysis from Table 4 shows that 19 (30.16%) respondents showed considerably that there are specific challenges to adopting BIM technologies in estate surveying and valuation profession, 16 (25.40%) respondents averagely accepted it, 13 (20.63%) respondents to a very large extent agreed, 9 (14.29%) respondents opted for a little while 6 (9.52%) respondents opted for not at all. The analysis showed that there is a considerably specific challenges to adopting BIM technologies in estate surveying and valuation profession.

For challenges in acquiring skills and training to effectively use BIM by estate surveyors and valuers, Table 5 explains the data.

Table 5: Challenges in Acquiring Skills and Training to effectively use BIM by Estate Surveyors and Valuers

Items	Number of Responses	Percentage (%)
Not at all	1	1.59
A Little	6	9.52
Averagely	15	23.81
Considerably	16	25.40
To a very large extent	25	39.68
Total	**63**	**100.0**

Source: Researcher's Fieldwork (2023)

Analysis from Table 5 shows that 25 (39.68%) respondents to a very large extent, show that there are challenges in acquiring skills and training to effectively use BIM by estate surveyors and valuers, 16 (25.40%) respondents considerably agreed, 15 (23.81%) respondents were on average, 6 (9.52%) respondents opted for a little while 1 (1.59%) respondents opted for not at all. The analysis showed that majority of the respondents went on to agree that to a very large extend, there are challenges.

For challenges to traditional method of property maintenance, Table 6 explains the data

Table 6: Challenges to Traditional Method of Property Maintenance

Variables	N	1	2	3	4	5	Sum	Mean	Rank
Limited predictive capabilities	63	3	7	9	13	31	251	3.98	1st
Inadequate technological integration	63	3	8	11	14	27	243	3.86	2nd
Manual processes	63	4	9	12	15	23	233	3.70	3rd
Limited transparency/accountability	63	4	11	13	14	21	226	3.59	4th
Reactive approach	63	5	8	16	19	15	220	3.49	5th
Risk of compliance issues	63	6	10	14	19	14	214	3.40	6th
Communication/collaboration gaps	63	5	11	16	18	13	212	3.37	7th
Limited data-driven decision-making	63	7	12	13	17	14	208	3.30	8th
Limited cost control	63	8	11	17	19	8	197	3.13	9th

Source: Researcher's Fieldwork (2023)

Analysis from Table 6 shows that limited predictive capabilities has the highest mean of 3.98 and is ranked 1st, inadequate technological integration with the mean of 3.86 is ranked 2nd, manual processes with the mean of 3.70 is ranked 3rd, limited transparency/accountability with the mean of 3.59 is ranked 4th, reactive approach is ranked 5th with the mean of 3.49, risk of compliance issues with the mean of 3.40 is ranked 6th, communication/collaboration gaps is ranked 7th with the mean of 3.37, limited data-driven decision-making having a mean of 3.30 is ranked 8th while limited cost control is ranked 9th with the mean of 3.13. Hence, the analysis shows that limited predictive capabilities occupied the highest point in the challenges to traditional property maintenance. This should serve as reason to try this innovative and technological driven method mean - BIM for effectiveness and efficiency in property maintenance as traditional data management systems are not being suitable for handling BIM data at scale (Lee *et al.*, 2012).

In terms of challenges/barriers to BIM application in property maintenance in the study area, Table 7 explains the data.

Table 7: Challenges/Barriers to BIM Application in Property Maintenance in the study area

Variables	N	1	2	3	4	5	Sum	Mean	Rank
Skill gap/training	63	4	6	10	13	30	248	3.94	1st
Resistant to change	63	3	9	11	14	26	240	3.81	2nd
Lack of reliable and up-to-date building data	63	3	7	14	19	20	235	3.73	3rd
Data accuracy and maintenance	63	2	10	15	21	15	226	3.59	4th
Data integration	63	4	7	19	20	13	220	3.49	5th
Initial implementation cost	63	5	8	17	19	14	218	3.46	6th
Compatibility issues	63	4	10	17	20	12	215	3.41	7th
Lack of government support	63	8	12	13	19	11	202	3.21	8th
Scalability	63	9	12	17	18	7	191	3.03	9th
Legal and contractual issues	63	10	11	17	19	6	189	3.00	10th
Cost of software	63	11	12	16	17	7	186	2.95	11th
Data migration and legal system	63	12	14	16	15	6	178	2.83	12th
Data security and privacy	63	11	16	19	13	4	172	2.73	13th
Interoperability	63	12	16	18	12	5	171	2.71	14th

Source: Researcher's Fieldwork (2023)

Analysis from Table 7 shows that skill gap/training has the highest mean of 3.94 and is ranked 1st, resistant to change with the mean of 3.81 is ranked 2nd, lack of reliable and up-to-date building data with the mean of 3.73 is ranked 3rd, data accuracy and maintenance with the mean of 3.59 is ranked 4th, data integration is ranked 5th with the mean of 3.49, initial implementation cost with the mean of 3.46 is ranked 6th, compatibility issues is ranked 7th with the mean of 3.41, lack of government support having a mean of 3.21 is ranked 8th while scalability is ranked 9th with the mean of 3.03, legal and contractual issues with the mean of 3.00 is ranked 10th, cost of software is ranked 11th with the mean of 2.95, while data migration and legal system is ranked 12th with the mean of 2.83, data security and privacy with the mean of 2.73 is ranked 13th and interoperability with the mean of 2.71 is ranked 14th. Thus, from the above analysis from the respondents, skill gap and training occupied the highest point in the challenges/barriers to BIM application. This mean that with adequate exposure to the skill on the use of BIM and continuous training, effectiveness and efficiency will be achieved.

Analysis from Table 7 showed that skill gap and training is the most important challenge/barrier of BIM application as confirmed by Kassem *et al.* (2016). BIM implementation often revealed a significant skill gap within the industry. This gap encompassed various aspects since BIM software required specialized knowledge and skills. Many professionals, especially those who had been in the industry for years, may not be proficient in using BIM software effectively. Also, professionals from different disciplines, such as architects, engineers, and contractors, may not be accustomed to working closely together or may not fully understand each other's requirements and constraints. Specifically, the author showed that implementing BIM often required a cultural shift within organizations. Resistance to change and a lack of change management skills hindered successful adoption. On the part of training, the author showed that addressing the skill gap and preparing professionals for BIM implementation necessitated comprehensive training programs. Based on formal education, the author showed that many academic institutions had recognized the importance of BIM and had started offering courses and programs in BIM. However, there was often a lag between the industry's needs and the curriculum development in educational institutions. Hence, continuing education in BIM technology was necessary as it evolved rapidly and professionals needed continuous training to stay up-to-date with the latest software versions and best practices (Succar *et al.*, 2012) through workshops and seminar to be organized by the professional body.

5. Conclusion and Recommendation

The study resolved that skill gap/training, cost of BIM software and training, compatibility issues, lack of reliable and up-to-date building data, lack of government support, and others are the challenges of applying BIM in property maintenance in the study area. Thus overcoming the challenges of BIM in property maintenance showed that its application by estate surveyors and valuers should significantly impact the environmental footprint of buildings. While the primary focus is on improving efficiency and cost savings, implications of this application include reduced energy consumption where BIM facilitates data-driven optimization of building systems like HVAC and lighting, leading to lower energy use and reduced carbon emissions, improved resource efficiency precisely. Hence, it recommends that the professional body should be organizing workshops and seminars at regular intervals so as to educate estate surveyors and valuers on how to apply this model.

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ASSESSEMENT OF THE LEVEL OF AWARENESS OF MORTGAGE FINANCING FOR HOUSING PROVISION AMONG CIVIL SERVANTS IN AKWA IBOM STATE

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Abstract
The concentration on the policies that affect housing provision through the mortgage financing options in Nigeria alone without asking if the people are aware of these options available to them is not a balanced approach. Mortgage financing has not achieved its aim in Nigeria and they have been several studies on the challenges of mortgage finance availability. Because of this very need, the study aimed at assessing the level of awareness of mortgage financing for housing provision among civil servants in Akwa Ibom State, Nigeria through the administration of questionnaire to 363 respondents in 22 ministries in the study area. The technique used in analyzing the questionnaire was sample mean item score and standard deviation. The study showed that about greater percentage of civil servants in Akwa Ibom state are aware of the mortgage financing options in the country. That brought us to the conclusion that the awareness level of civil servants about mortgage financing options for housing provision is high. There is a recommendation to further research on if the percentage of those who are aware fall into low income earners or middle income earners in the state.
Key words: *Mortgage Finance, Housing, Awareness, Civil Servants, Akwa Ibom State*

1. Introduction

Housing has an essential role in economic development of each country, accounting for 10–20 % of total economic activities in the country, as well as being the biggest fixed asset of households (European Commission, 2005). Housing is a material object, a goods that can be manufactured and demolished, produced and consumed, perceived and experienced, bought and sold. This is better tagged, housing. The need for housing is not only one of the basic human needs, but also the indicator of living standard of the population. Today it is a topical issue that housing has to be comfortable, economical and reasonably maintainable, as well as aesthetically expressive and compliant with the environment (Henilane, 2015).

Over the years, and all over the world, housing has been considered amongst the most pressing needs of mankind; the most important asset of man; and an important determinant of quality of life (Adedokun, 2012; Nkyi and Dinye, 2013; Afrane, 2014). Housing is not merely a mono-effect commodity, it has multiplier effects on the overall socio-economic setting of every nation through employment opportunities which neutralizes the adverse effect of unemployment, provides markets for building materials, and provides economic and social return to the developers (Wapwera et al., 2011; Windapo and Cattell, 2013).

According to World Bank (2020), housing plays a key socio-economic role and represents the main wealth of the poor in most developing countries. The UN estimates that the global population will reach 8.5 billion by 2030, with almost 60% of the population living in urban centers. Against the backdrop of rapid urbanisation putting pressure on housing delivery systems, many urban poor will not be able to afford formal housing without proper housing finance solutions. Globally, housing growth rate is often affected by many factors. Fin-Mark Trust (2010) highlighted some of these factors, and they include government policies, political uncertainties, financing and so on. Mortgage finance is one way housing development is able to be carried out especially in our developing economy. The Procedure of developing a structure is very expensive hence the need for mortgages as a way of financial assistance or support from the government and government approved organisations. Finance is an inevitable factor in housing development, because housing development is capital intensive and requires huge capital to succeed. (Hazman Usman, 2017). According to the UN Habitat (1984), financing is the process of obtaining funds or capital generally for the purpose of supporting a development and/or investment by gaining control over assets. Housing finance system is defined as a superstructure of laws, institutions and relationships between institutional and non-institutional units that facilitate the process of financial intermediation and capital formation in the housing sector. Mortgage finance has been identified as a key component of a shelter strategy. It is the provision of

finance or capital for housing. It can be taken, first, to mean the capital required for the construction of housing or housing projects. Second, it may be considered as the resources required for the construction of housing or housing projects and third, as the resources required for acquiring or accessing building by households or the credit supplied by housing finance institutions (UNCHS, 1991). Ifesanya (2012) described housing finance as the corner stone of housing construction. There are various vehicles of mortgage financing in Nigeria and one of it is domicile with federal mortgage bank of Nigeria (FMBN). The National housing Funds. This is the federal government of Nigeria's initiative to provide affordable housing to the people. NHF which is the popular acronym was enacted by the NHF act of 1992. Its sole aim was to mobilize funds for provision of affordable housing for Nigerians and its objectives was that commercial and merchant banks will contribute and insurances companies too will contribute 10% and 20% respectively. This policy is still in effect and it is controlled solely by federal mortgage banks and its partners. The study seeks to assess if civil servants In Akwa Ibom State are aware of these policies and the level of their awareness will be revealed at the end of this study.

1. Review of Related Literature:

1.1 Study Area

Akwa Ibom State is one of the six states that make up the South-South geopolitical zone of Nigeria. It has interstate boundaries with Cross River State to the East, Abia State to the North and Northwest and Rivers State to the Southwest. To its South is the Gulf of Guinea. Akwa Ibom State is a state in the South-South geopolitical zone of Nigeria on the east by Cross River State, on the west by Rivers State and Abia State, and on the south by the Atlantic Ocean. The state takes its name from the Qua Iboe River which bisects the state before flowing into the Bight of Bonny. Akwa Ibom was split from Cross River State in 1987 with its capital Uyo and with 31 local government areas. Akwa Ibom is the 30th largest in Nigeria and fifteenth most populous with an estimated population of nearly 5.5 million as of 2016. Geographically, the state is divided between the Central African mangroves in the coastal far south and the Cross–Niger transition forests in the rest of the state. Other important geographical features are the Imo and Cross Rivers which flow along Akwa Ibom's eastern and western borders, respectively while the Qua Ibo River bisects the state before flowing into the Bight of Bonny.

Akwa Ibom State covers an area of 7,081 square kilometres. It lies at latitude 05°00′ North and 07°50′ East. It has a population of 3,902,051 (2006 census) 5,482,177 (2016 forecast) and a population density of 551. The state accounts for 2.78% of Nigeria's total population.
Akwa Ibom has a tropical monsoon climate (Classification: Am) and is 42.58 meters (139.7 feet) above sea level. The city's average annual temperature is -0.99% lower than Nigeria's averages at 28.47°C (83.25°F). 342.56 millimeters (13.49 inches) of precipitation and 294.37 rainy days (80.65% of the time) are typical annual totals for Akwa Ibom. The Akwa Ibom region experiences tropical monsoons. All year long, there are high temperatures and a lot of rain. The region of Akwa Ibom experiences an average yearly temperature of 60 degrees and 672 inches of precipitation. With an average humidity of 80% and a UV-index of 7, it is dry for 52 days out of the year. The climate of Akwa Ibom is tropical with significant rainfall with only a short dry season.

1.2 Assessment of Awareness Level of Mortgage Financing for Housing Provision

It cannot be overemphasized that to increase home ownership in Akwa Ibom State, there has to be increased and sustained enlightenment of the people especially civil servants on mortgage financing. Other states of the federation are marking up awareness. At an expo in lagos, the managing director of Federal Mortgage Bank of Nigeria (FMBN) Mr. Ahmed Musa Dangiwa, urged home owners to enquire on how best funds for building, buying, renting and renovations of home can be accessed. He pride that there is an application where interest persons can log on to and get the required information without working into the physical office (Nwannekama ,2020).

Before we delve into what is happening to mortgage financing in other climes. We want to outline and discuss what home owners should seek to understand about mortgage financing. In Nigeria, The

National Housing Fund (NHF) is a **social savings scheme** designed to mobilize long-term funds from Nigerian workers, banks, insurance companies and the Federal Government to advance concessionary loans to contributors. NHF's fundamental characteristics and goals were to provide affordable homes, funds mobilization, disbursement of mortgage loans, regulations and governance of the Nigeria's housing Industry, facilitation of housing development, social impact and creation of wealth. In all these functions, no one mentioned about the process of how the citizens will be enlightened about these functions. That may just be the plug that needs to be set in place for NHF scheme to meet its goals. It is also a norm that the NHF loans are not accessible to non-citizens, criteria for accessing the funds are many and yet very few people are aware. The fund is open to contributors. Civil servants are contributors since a portion of their salaries are deducted to fund the scheme. This criterion and many others are what the citizens need to hear through various and effective means communications.

Omogor and Anigbogu (2015) studied Affordability, Accessibility and Awareness (Triple 'A') of Housing Finance sources among Low Income Earners in Jos, Nigeria. In the light of that development a study was carried out to examine the level of awareness of the existing sources of housing finance, assess the affordability and accessibility of the funds for the low income earners in order to determine their effectiveness and at the same time to evaluate the perception of government housing programmes and finance by the low income earners in Jos, Nigeria. Data were collected through interviews and administration of questionnaire. Analysis of data shows that the awareness level of existing sources of housing funds is low.
Sadly, there is no research that has been able to speak about the awareness level of sources of mortgage funds in Akwa Ibom state, hence the research.

In a study on housing finance in South Africa, Rust (2016) found that almost without exception, private sector developers, as well as government officials and knowledgeable experts, cite the unavailability of reasonably priced and well-located serviced land as the major constraint to the rapid expansion of housing for low and moderate-income families. The servicing of outstanding mortgages, determined in part by the dynamics of house prices, has an impact on the financial health of lenders' ability and willingness to extend credit. The pessimistic view of many researchers is that house price has been overvalued in many countries and will face downward correction (Tsatsaronis and Zhu, 2004). Maren (2014) evaluated the determinants for access to subsidized mortgage housing in Jos, Nigeria. During the study, a survey was conducted among workers in 24 randomly selected organizations. A total of 543 questionnaire were thus administered and 410 were retrieved. The data were analyzed using Pearson's chi-square which indicated a low level of participation and a lack of awareness about the National Housing Fund (NHF) scheme. The study also noted that there were negative feelings about the arrangement, and for the entire sample, gender and employment characteristics were found to have statistically significant relationships with participation in the NHF scheme. However, access to subsidized mortgage is influenced only by gender and tier of government employment.
Kalui and Kenyanya (2015) investigated some selected factors hindering access to mortgage finance in Kenya. In this study, data were analysed using Pearson's Product Moment Correlation Coefficient as well as multiple regression analysis. The results showed that the most important factor affecting access to mortgage finance was credit risk which greatly affects access to mortgage finance as banks take caution when lending.

Ozdemir and Altinoz (2012) conducted a study on the role of regional factors in determining mortgage interest rates in the United States. The study developed a new technique to analyse determinants of retail interest rates that are exposed to the same monetary policy but different regional conditions. The results show that monetary policy was highly influential on mortgage rates in the bubble period, while regional factors were more significant in the post-bubble period. More importantly, the analysis demonstrates that there is a significant difference in the factors determining fixed-rate and adjustable-rate mortgages.

Wanja (2015) also examined the determinants of mortgage uptake in Nairobi, Kenya. The study adopted a cross-sectional design of various mortgage lending institutions in Kenya and collected

secondary data from financial statements and government policy papers. The results reveal that various determinants of mortgage uptake include property prices, interest rates, level of income, costs of operations, the mortgage process as well as the size of the bank.

In Africa, income, property prices, land cost, demand and supply are identified as the factors influencing affordability of housing (Yap et. al., 2018). Raphael and Akumu (2018) provided that, Households' socio-economic factors, property attributes, loan characteristics, and macro-economic environment plays a major role in housing affordability. In specific terms, interest rate on mortgages, households' dependents quantity, loan to-ratio value ratio, type of mortgages instrument, quantity of households; income earners, real gross domestic product per capital and size of household influence housing affordability in Kenya.

The National Housing Fund which provides lowest interest rate in Nigeria for mortgages at 6% is bedeviled with operational challenges that includes among others as non-disbursement of National Housing Funds application loans as a result of non fulfilment of some unbearable conditions, lack of submission of an acceptable security of existing mortgage loans by Primary Mortgage Banks, perfection of mortgage funds delay and inability of PMBs to fund 20% of loan as one of the statutory requirements (Chiomuna, 2010; Bichi, 2012; Fortune Ebie, 2014).

The work of Jing (2014) gave full insight and modernized the details of housing affordability investigation in top-tier town and housing connected periodicals. The study reviewed 122 related literatures of housing affordability journal from 1990 to 2013. However, their analysis anchored on explanation and dimension of affordability, housing deficiency, affordable housing, effect of planning and zoning; econometric scrutiny of housing affordability; and housing policy. Their findings revealed the methodological development approach of housing affordability, its barrier and affordability measurement. In continuation, explained the environment extent and how affordability of housing and weakness of the conventional measurement were censoriously deliberated and commented.

Phang (2010) investigated housing affordability of Federal Civil Servants in Minna utilizing the typical yearly remunerations of 200 federal public workers of different cadre. The study also exposed twelve-monthly payment prices of houses inhabited by the civil servant and made know the percentage of once a year salary consumed on housing. Their work proved that federal civil workers in Minna devoted about 7.3% and 23.8% of their yearly salary on housing accommodation. In furtherance, they noted that civil servants' cadre of income that reflected in the index of 0.96, stood the prominent determinant in the decision of residential housing of federal public workers. However, the authors maintained that robust encouraging connection exist between the workers yearly salary and payment values of housing accommodation they inhabited. Their study concluded that home title programs should be available to enable federal civil servants own houses and pay without challenges as all the civil servant intend to acquire personal houses. As their current houses proved uninhabitable with the characteristics of poor quality, small sizes, and densely populated neighbourhoods etc.

Torluccio and Bologna (2011) researched the method of lending credit participation during the realization of approach able to measure housing affordability. Their process was initiated in mandate to tackle all associated with the physical acquisition capacity of families, considering the prevailing bank arrangements and the accessibility of housing mortgages. They also evaluated the prospective request of bank loan lending know to be capable arena of financial institution. In addition, the authors maintained that the evaluation may be observed by seeing the circumstances of housing mortgages from the major financial institutions and geometric data on the income of the inhabitants, including information of tangible estate interventions regarding the present equal of charges in the housing arcade. The study concluded that such projected measure may be of benefit to housing authorities, at the moment of housing strategies were initiated to pave way for realizing more real techniques of dislodging housing affordability challenges from a broad calculation of housing desires and chances of accessing loan in the banking scheme to involve in loaning.

In the same vain, Katrin and Anacker (2019) deliberated on some facets of housing affordability with respect to families 'costs, incomes and handpicked parts of purchasing affordable housing. However, the work made available a circumstantial background for admitting the connection between housing and affordability matters across the national, state, and local circumstances, as well as contemplating on selected possible and policy solutions on housing affordability.

Bakry and Liu (2018) viewed at the adequate and affordable housing of low income households in New York City (NYC) United State of America. The study considered(i) the Proposal's effort on utilizing the informal segment to actualized public aims and if this is possible to come with unintentional consequences which could concentrate on the poor and improvement of stressed districts, (ii) determine the functions of non-profit making division that has been a key performer in housing programmes historically across the New York City, and (iii) the level of control a metropolitan government has on monetary powers to circumvent deleterious consequences. Their work shown that the provision of any number of accessible housing components is a positive idea, may sound irrational to accept that this involvement specifically can sufficiently handle the accommodation affordability crisis in New York city. Their work added that the disclosure of other developing difficulties as the plan is carried out for execution while the prominent distress is that via tax credits and rezoning efforts to enhance private-sector advancement, the Strategy can squall up profiting housing developers and renovates more than actually reducing the housing problems in NYC. The work concluded that Housing affordability stood as multidimensional subject which involves a complicated tactic from federal and state governments working in agreement with local governments.

Elizabeth and Rosie (2007) studied the correlation between delivery of superior affordable housing and the profits to the bigger district. The study focused on the aspect of education and health but anchored on extraordinary unrestricted worry with the questions of education and health. The authors supported the momentum for making affordability of houses more than the core metropolitan issue. They explained that housing arrangement encounters are known and found to be multiplying on daily basis while the acute enemies maintained that making houses accessible for all the income class may attract no disposable assistances to the municipal, which in turn poses threat to a region property prices. The work finalized that everything about profit may be differently effective towards public deliberations on housing affordable while the research is a spring board for further study this direction. While considering the United States department of housing and urban development affordability directory for property holder and occupants, the national smaller income housing association accessibility catalogue for tenants (housing remuneration) and the domestic coalition of realtors reasonably priced guide for landowners.

Melanie and Lucy (2010) investigated housing affordability manifestations and discovered absence of capability to freely acclimatize housing affordability dealings to separate homes. In addition, their study shed more light on transportation costs, outstanding income tactic, housing market verses its affordability and other area connected to housing affordability processes. The authors maintained that subprime loan, baring and breakdown of 2007-2008 accentuated the reasons for the reassessment of ways a particular home's strength can acquire housing. As the deal required a strong direction to identify the affordability of a family and the measure of mortgage for which a family succeeds.
In all above researches. None has come into terms with the yet to be concluded fact that dearth of awareness could be a measure cause of failure to scale up mortgage financing patronage.
Therefore our study is apt. The method and results of the assessment of the level of awareness of mortgage financing by civil servants in Akwa Ibom state will be discussed below.

2. Methodology

In carrying out this study, the survey design was adopted, which is a flexible design technique. A flexible design allows for more freedom during the data collection process (Robson, 2013). The descriptive survey method was employed because it involves collection of primary data from the perception of respondents objectively. Ohaja (2003) opined that whenever the primary data was sourced from the views and perceptions of members of a particular/selected group, a survey

would be necessary. The population of respondents constitute State's Civil Servants being respondent relevant to this study. The choice of these respondents is because they are likely to have access to mortgage financing. Based on the 2020 Ministry of Economic Development Manpower Statistics there are 6607 workers in the 22 Ministries in Akwa Ibom State. A total of 6607 workers constitute the population of the study. In order to get a representation of the whole population, the Kothari formula for sample size determination was used in this study. According to Kothari (2004), to determine a sample from a population, the formula below was applied, which is:

$$n = \frac{z^2.p.q.\ N}{e^2\ (N-1) + z^2.p.q}$$

Where, n = Sample size
N = 6607 (Number of workers is state and federal ministries)
z= 1.96 (desired confidence level is 95% and value obtained from table)
p= 0.5 (sample proportion).
q= 0.5 {(1-0.5) i.e 1-p}
e = 5% or 0.05 (precision rate or acceptable error)
By putting the value,

$$n = \frac{(1.96)^2.\ (0.5).\ (0.5).\ 6607}{(0.05)^2(6607-1) + (1.96)^2.(0.5).(0.5)}$$

$$n = \frac{6345.3628}{17.4754}$$

$$n = 363$$

Following the above formula, questionnaires were administered to 363 staff of the state civil services in 22 ministries in Akwa Ibom using a simple random sampling method.

In order to explicitly attend to the aim in this study, the method adopted to analyze the objective was the comparing of sample mean with criterion mean and its standard deviation.

Sample Mean: A sample mean is an average of a set of data (Indeed, 2024). The sample mean can be used to calculate the central tendency, standard deviation and the variance of a data set. Calculating sample mean is as simple as adding up the number of items in a sample set and then dividing that sum by the number of items in the sample set. The formula for calculating sample mean is

$\bar{X} = X_1 + X_2 + \ldots\ldots X_n / n$

Where $\bar{X}$ = Sample Mean,
X_1, X_2 = different values,
n = Total number of terms.

Standard Deviation: Standard deviation is a statistic that measures the dispersion of a dataset relative to its mean and is calculated as the square root of the variance. The standard deviation is calculated as the square root of variance by determining each data point's deviation relative to the mean.

The instrument used in data collection for the study was a questionnaire.

3. Results and Discussion

What is the level of awareness of mortgage financing by State Civil Servants in Akwa Ibom State, Nigeria?

This question was raised to determine the level of awareness of mortgage financing by State Civil Servants in Akwa Ibom State, Nigeria. To determine this, the sample mean of each item was compared with the criterion mean. The result is as shown in Table 4.

Table 4: Mean Statistics of the Level of Awareness of Mortgage Financing by Civil Servants in Akwa Ibom State, Nigeria

Statement	N	Min	Max	Mean	SD
I am aware of mortgage financing for house construction.	363	2	4	3.20	.748
I never heard of mortgage financing for house construction.	363	2	4	3.29	.643
I heard of mortgage financing for house construction through consultation workshop.	363	2	5	3.49	.553
I heard of mortgage financing for house construction through television.	363	3	4	3.40	.490
I heard of mortgage financing for house construction through mass media.	363	3	4	3.20	.401
Cluster Mean				**3.32**	

Source: Researcher's Field Survey, 2023 and Computation, Criterion Mean = 3.00

The result presented in Table 4 reveals that the summary of the sample mean score for items 1 – 5, ranging from 3.20-3.49 were above the criterion mean of 3.00. The cluster mean of 3.32 was also greater than the criterion mean of 3.00. This implies that the level of awareness of mortgage financing by State Civil Servants in Akwa Ibom State, Nigeria is high. The Table also shows that the Standard Deviation of the items fell within the range of .401 - .748. This indicates that the respondents were not divergent from one another in their responses.

The finding of the study shows that the level of awareness of mortgage financing by Civil Servants in Akwa Ibom State, Nigeria is high.
The finding is opposed to the research findings by Omogor and Anigbogu (2015) who found that the level of awareness of the existing sources of housing finance was low in Jos, Plateau State. That affordability and accessibility of the funds for the low income earners in order to determine their effectiveness and at the same time to evaluate the perception of government housing programmes and finance by the low income earners in Jos, Nigeria was low. That the 2.5% of basic salary monthly contributions to NHF does not reflect reality of housing cost. Similarly, Maren (2014) found a low level of participation and a lack of awareness about the National Housing Fund (NHF) scheme.

4. Conclusion and Recommendation

The study concludes that: there is a significant level of awareness of mortgage financing by State Civil Servants in Akwa Ibom State, Nigeria. There is need to understand that there is a gap that would also need to be filled by another researcher. This study lumped all cadres of income earners amongst state civil servants in Akwa Ibom State. There is need to know if there would be a different results when separated. The recommendation of the study is that the state government should make good use of increased awareness of mortgage financing options as a means for housing provision in the state and create an increased access to mortgage loans by positioning mortgage market infrastructure in the state.

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THE ROLES OF FACILITY MANAGEMENT IN THE HEALTH CARE SYSTEM: (A CASE STUDY OF SELECTED HOSPITALS IN AKWA IBOM STATE, NIGERIA)

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Abstract
This research assessed the roles that facilities management played in effective healthcare system delivery and ascertain the present condition of facilities in hospitals understudy. A survey research design was applied in the study in combination with Purposive Sampling Technique. The main instruments of this research were, interview schedule and questionnaire. The data collected were coded and summarized through the use of the excel software, SPSS, bar chart and tables. It was found out that though there was an above average affirmation of facilities management expert in the selected Hospitals, but a further prove into the effectiveness of management of facilities showed a very high degree of poor facilities management. Further analysis revealed that effective facilities management depends on the overall maintenance policy of each hospital. This therefore means there is poor or lack of good maintenance culture which make hospital organizations reactive instead of proactive. Result of the assessment also revealed that the implementation of FM in the selected hospitals in Akwa Ibom State is carried out by "In-house Service", which is handled by technicians. However, the Chi-square test of the level of Association between Facility Management and Healthcare System indicated a significant relationship between facility management and the healthcare systems since P value from analysis of all tested variables were below (0.05) the strength of the relationship. From the foregoing, the study can deduce that quality healthcare system depend upon effective management of hospital facilities. Finally, for effective performance of healthcare facilities, both in-house and outsourced concept should be adopted.
Key words: *Facility Management, Healthcare System and Hospital*

1.0 **INTRODUCTION**

Organisations, whether public or private need property to accommodate it workforce and to deliver it products and services. For it to perform the said function effectively, the facilities embedded must be given proper management attention (Jones and White, 2012). The authors also Observed that the discipline of facilities management (FM) has evolved from increasing pressures for the economic operation of the built environment. Since the emergence of the discipline, facilities managers have been searching for the 'holy grail' of how to measure the role they play towards the core business or strategic goals.

The provision of health care in Nigeria remains the functions of the three tiers of government: the federal, state, and local government. The primary health care system is managed by the 774 local government areas (LGAs), with support from their respective state ministries of health as well as private medical practitioners. The primary health care has its sublevel at the village, district, and LGA (Adeyeye *et al* 2010).

The ministry of health at the state level manages the secondary health care system. Patients at this level are often referred from the primary health care. This is the first level of specialty services and is available at different divisions of the state. The state key health care comprises laboratory, diagnostic services and rehabilitation. In line with the view of (Adeyeye et al 2010), (Ahmed and Gidado 2010) added that Teaching hospitals and specialist hospitals provide the tertiary health care. At this level, the federal governments also engage the voluntary and nongovernmental organizations, as well as private practitioners.

One of the strategies introduced to help adapt to changing demand is the recognition of the strategic role of services, leading to the introduction of facility management (FM).

In some countries the facility manager is originally a manager of the workplace; in Italy the role of facility manager has been taken on by maintenance technicians who have developed managerial and

organizational competence in order to understand the estate management and all the non-core services needed to carry out the company mission. UK and Europe are the most important FM market (BIFM 2004); In agreement to this assertion, (CRESME 2002) added that Germany and France are also relevant markets. In particular, the German market is rapidly changing both on the supply and demand sides. French suppliers have internationalized their market, above all in Italy About 90% of contracts are still for a single service but in some sectors (health, universities) integrated contracts are increasing (BSRIA 2003). In Spain, after some delay, FM is becoming relevant, above all in the banking, telecommunications, and energy sectors. The growing importance of the public sector is

paralleled all over the world by an increasing outsourcing of FM due to the generalized downsizing of public administrations (Ancarani and Capaldo 2005). In the USA, innovative approaches are being applied, both through partnerships with private partners and
partnerships with public employees who are motivated to produce cost-saving and quality services
Further, attempt has been made by several studies related to facilities management in addressing the topic of maintenance management of hospitals facilities. Perhaps, many researchers such as Oladejo, (2014); May and Pinder 2008) had contributed immensely in their work, yet little research and literature is available on how the role play by facility managers can improve the healthcare system of Nigeria's medical institution. Theoretical models of the healthcare facility management are grossly under researched. The lack of unifying benchmarks to tag progress and concept of facility management means that the role of facility management to the occupier organization and the possibilities that exist for adding value were often not recognized nor properly considered. These gaps in literature and research have been the main motivation for carrying out this research.
The application of effective management methodologies, such as outsourcing, if applied to a set of healthcare authorities present in an area, could favor both the achievement of high performance and the fulfilment of a high level of management flexibility and financial-economic requirements.
Maintenance management of hospital facilities is one of the complex subjects in the field of facilities management (Shohet, 2005). Contributing to this is the complex nature of hospital facilities, the delicate mechanical and electrical systems, and inadequate maintenance budgets.
In Nigeria, The World Health Organization in 2010 reported that the growth of performance measurement uses in FM amongst public hospitals is very slow compared to other developing countries. It ranked Nigeria 187 out of 191 in health system performance. Confirming this fact, (Pati *et al* 2010) opined that Nigerian government must strategize on how to improve the position as most public hospital facilities in Nigeria suffer from inadequate physical conditions.
Public hospital facilities in Nigeria are generally old and in a poor state. Hospitals in Nigeria are faced with many challenges including poor maintenance culture and there is a need for the professionalization of FM. The lack of proper performance FM system in public hospitals resulted in problems of various nature (Orubuloye 2008, Abukhder and Munns 2013). FM is viewed as a secondary function in public hospitals, with professional FM expertise barely exists amongst most of them, some do not have maintenance schedule put in place, to prevent crucial equipment failures, the problems of identifying what are the indicators that can be use to proof the roles of FM in the healthcare system of most public hospital is a great challenge that need to be addressed, also the qualities of facilities manager that will lead to effective maintenance management of hospital facilities are grossly misunderstood, thus few hospitals determine the maintenance needs for their facilities (Ilozor 2013, Kirkham *et al* 2012). It is regrettably to note here that most hospitals facilities compliment their basic functions at a very low rate while others do not satisfy users requirement One may say that some of these facilities are ineffective and may had been either obsolete or due for replacement and inadequate funding for either mentainence or replacement are responsible for the set-back. Hence, this anomalies and other research fact have necessitated the research effort into this topic with a view to proffer solution to the problems militating against effective healthcare facilities management in Nigeria using selected hospital in Akwa Ibom State as a case study.

2.0 Review of Related Literature

Facility Management, commonly abbreviated as FM, is a fairly new concept in the management discipline. Widespread use of the term dates from the creation of the Facility Management Institute at Ann Arbor, Michigan, in 1979 and the founding of the National (later International) Facility Management Association in 1980.

However, facility Management of large and diverse facilities has long been practiced by the military government, North American College and University campus officials usually under the name of post engineering, public works, or plant administration.

According to the Centre for Facilities Management, FM is the process by which an organisation delivers and sustains a quality working environment and delivers quality support services to meet the organisational objectives at best cost.

Similarly, Barrett and Baldry (2003). Studies and experiences have described FM as 'an integrated approach to maintaining, improving and adapting the building of an organisation in order to create an environment that strongly supports the primary objectives of that organization'. Therefore, the discipline of Facilities Management (FM) can greatly influence the physical environment in ways, which can satisfy the organisational core objectives.

Facility can be seen from an organization's point of view as any useful, tangible asset. The management of these assets is the main focus of facilities management. In relation to real estate, the term 'facilities' consists of those equipment that enhance the utility, enjoyment, safety and convenience of the occupants, e.g. Power generators, air conditioning systems, lifts, pumps, sewage treatment systems, security gadgets etc.

Facilities management is a relatively new field. Its origin is in the United States where it has been in practice for over 20 years. In 1989, the International Facilities Management Association (IFMA), a professional body of facilities managers was formed with membership strength of over 12,000 professionals from the United States, Canada, Japan, Europe, Australia, Netherlands, Switzerland, United Kingdom and Germany. It is interesting to note that in Japan in particular, the facilities management function has been promoted through government agencies, whereas elsewhere the onus has tended to be on individuals and independent professional associations to develop facilities management. The view point of facilities management tends to be colored in many countries by the existence or otherwise of strong professional bodies in the property management and architectural fields.

Problems of Facilities Management Practice in Nigeria.

Osagie (2004) noted that there are certain problems that have been militating against an effective facilities management practice in Nigeria. Some of these problems included;

1. Conception of idea
2. Operational problems
3. Funding Cost
4. Assembling the right professionals.
5. Planning problems
6. Frequent change in management
7. Inadequate training of facilities manager

Before any organization decides whether to implement facilities management systems or to expand existing procedures, it is imperative to consider a cost Benefit Analysis (CBA) and an Associated Returns on investment analysis. The benefit to the organization should outweigh the cost of procuring the system. There is also need further for a thorough analysis of;

i. Cost of procuring and installation of equipment
ii. Cost of maintaining the program
iii. Purchase of auxiliary component software
iv. Staff and employee training
v. Hidden cost

As these will make up the cost of facilities management to the organization. His study found out that efficient facilities management in some banks studied resulted in;

i. Increase in productivity
ii. Reduction in project delays

iii. Financial management effectiveness
iv. Reduction in errors
v. Improving user satisfaction
vi. Development of good will
vii. Quicker responses to problems

This work on the roles of facilities management in healthcare system of selected hospital in Akwa Ibom state seeks to find out the problems which militate against effective facilities management as it concerns the following:

i. Adequate provision of basic facilities that could enhance effective healthcare service delivery.

ii. Availability of competent professionals in the management of facilities in hospital organizations.

iii. Adequacy of budgetary provisions and actual management of available facilities

Challenges Facing Healthcare Facilities in Nigeria

Many hospital organizations are transforming their culture as a means by which they may improve performance. FM has a positive role to play in enabling the transformation either by supporting the hospital organization as part of the holistic drive for change or by acting as a catalyst, leading the way for others to emulate. For these benefits to be realized it is necessary for hospital organisations to implement an effective performance measurement system (Neely 2008). Public hospital buildings in Nigeria are often in a poor state so it is essential for every hospital to have an effective FM performance measurement plan of its facilities. The hospitals in Nigeria have poor maintenance culture and are faced with many other challenges. Considering the importance of performance measurement systems as the basis for management to perform better. (Abukhder and Munns, 2013), observed that the lack of proper performance FM system in public hospitals in Nigeria is caused by problems of various nature. There is a major challenge that arises from government subvention due to the irregular flow of funds. This implies that the hospitals must rely on the other sources of finance for running the healthcare facilities (Nutt 2010). There are delays in the payment of the subvention confronting the hospital and at times, the subvention for some periods is not received. There is also a gradual reduction in the amount of subventions received exacerbated by the fact that the monies received from government are often ‘ring fenced’ for only health workers' salaries and administrative expenses. There is no component of the subvention
directed specifically for investments and the delivery of FM services (Kirkham *et al* 2012). The inability of patients to pay fees and charges is another problem and some patients often default in settling their hospital bills (Ilozor 2013). There are additional problems including government's influence in determining the fees to be charged.

Other challenges include exploitation largely around control of resources and lack of accountability for resources in the hospital creating crisis. Poor accountability and the control of financial resources flowing around various units of the hospital is always a cause of friction (Okoroh 2012). There is also the problem of incompetence due to poor recruitment practices. When appointment to management/administrative positions are made based on entry level qualifications and specialty, regardless of experience and further training, the best candidate may not be favored (Ahmed and Gidado 2010). While entry qualification and specialty are basic, it must be appreciated that further training and experience are required in order to function effectively in a top management position (Adeyeye *et al* 2010). There is a widespread culture of government sponsoring public officials abroad for treatment at the expense of investing and modernizing the healthcare infrastructure delivery system (Okoroh 2012). Even the leaders who ought to show their commitment by example are guilty of this practice demonstrating a lack of faith in the Nigerian healthcare system, which is why they support health tourism by flying themselves and their cronies to other countries with highly developed healthcare systems.

Finally, there are also inadequate tools for measuring output. Most government hospitals have no tools for measuring the work output of their staff (Ilozor 2013). Significant latitude is therefore given to individual staff to work as expected, but this is largely abused, creating divided loyalty and double-

dealing. Measuring outputs should be linked to the inputs that are required to deliver the standard of healthcare facilities.

Poor understanding of FM performance measurement in public hospitals in Nigeria is major barrier to healthcare service delivery (Ilozor 2013). Redefining standards and developing performance management benchmarks is crucial in developing and transforming FM as a profession in Nigeria.

2.2 Theoretical Framework

The early set of people who came in contact with what is now referred to as facilities management restricted their view of the discipline to space management as against the other aspects. This was because departments or sections of organizations are often charged by management for space which they occupy and therefore they are becoming more aware of the cost of space and are demanding more effective quality and performance in their accommodation, as a result of factors of supply and demand in the market for buildings.

In recent years, the area of space management has excited great interest on the part of real estate groups and facilities engineering departments of major corporations as well as institutions, government and environmental design disciplines. Recent developments and research into the discipline particularly since the late nineteen eighties have shown or revealed a wider and more embracing scope. Facilities management has

been promoted as the solution to most problems encountered by building occupants, owners, managers as well as architectural designers. It combines all property management systems, occupancy consulting, planning, procurement, implementation and controlling service for space management, commercial management and technical management.

2.3 Empirical Review

Many authors have worked on facilities management though not directly related to it roles in the healthcare performances but has helped in providing a bases and direction to this studies. This subsection provided summary of their work which included;

The work of Durodola (2009), on "Management of Hotel facilities in South– western Zone Nigeria". Being a published PH. D thesis of the Department of Estate Management, Covenant University, Ota. The aim of the study was basically to investigate the degree of beneficial application of facilities management principle in the management of hotel organizations in the study area. Insight from this work contributed significantly to understanding of some issues I needed to handle in my work.

The presentation of findings from primary research seeking how developed the corporate real estate (CRE) outsourcing market in Poland was the work of Robert Bocian Jill Fortune, (2005). A mixture of qualitative and quantitative research was conducted among CRE managers representing the financial sector in Poland. Financial companies mostly outsource individual functions within facility and transaction management areas. The research data suggested that outsourcing of space planning, moves and valuation is utilized by appropriately 50% of researched CRE managers with portfolio and project management determined as the most unpopular real estate (RE) outsourcing area. In relation to motivation to outsource, the participant of the research cited "cost reduction" as they key motivator followed by "improved service quality" and "focus on management and strategy". Improved business flexibility seems to be the least important factor justifying potential RE outsourcing functions. Companies generally prefer to have as much control over the CRE management as possible and therefore decided to keep the management function in house. This growing orientation to outsourcing is what my work is advocating, even as, result of the assessment so far revealed that the implementation of FM in the selected hospitals in Akwa Ibom State under studies is majorly carried out by "In-house Service". This type of FM according to Peter Barrett (2019) has its advantages and disadvantages as earlier stated in the literature review, therefore, for effective performance of healthcare facilities, both in-house and outsourced concept should be adopted.

Price (2004) Looking specifically at the NHS, observed that in recent years there has been a change in attitude towards facilities services and its role to healthcare system. This key evidence that demonstrates their roles to business is needed in the management of hospital facilities in Akwa Ibom State and entire Nigerian nation which is significant issue in this research.

The work of Oladejo (2014) in a study conducted on tertiary hospitals in South East Nigeria, he observed that healthcare facilities management and maintenance centered mainly on structure, equipment and machinery used by healthcare institutions while the cleaning of wards, offices and general areas as well as the supply of clean linen and disposal of waste bins were carried out by the facility management unit. The maintenance units of tertiary hospitals were responsible for maintaining the structural aspects of healthcare buildings, equipment and plants and machinery. This reduces the responsibility of the maintenance unit but by no means reduces the complexity of their duty.

In his work on problems of facilities in south west Nigeria Universities and the way forward Babatope (2010) sought to know if there was adequate financial support for university Education, whether the universities were provided with adequate facilities. The study concluded that adequate financial assistance should be given towards provision of new facilities while effort should be directed towards maintaining the existing ones to facilitate quality learning environment. In the news release titled University campuses under heavy pressure: sharing of facilities inevitable, Alexandra den Heijer (2011) opined that the financial pressure on universities is steadily increasing. Investment in real estate and other campus facilities are suffering greatly under this trend.

A cursory look at the management of the assets of most organizations point to the possibility that property assets are not managed to provide maximal benefits obtainable (Godfrey Okon Udo and Akwa Kalu, 2010).

The goal of the facility maintenance organisation in a hospital environment is to achieve zero defects in the hospitals physical operation, especially in areas where small problems can have huge consequences and be a matter of life and death. One of the main challenges of managing

hospital facilities are the highly diverse network and range of functions which are needed to maintain operations as well as the complexity of services which are required to support them.

In Nigeria, according to Adenuga and Iyagba (2005), public buildings are in very poor and deplorable conditions of structural and decorative disrepairs. In spite of millions of Naira spent to erect all these buildings, they are left, as soon as commissioned to face premature but steady and rapid deterioration, decay and dilapidation.

However, the lack of proper performance FM system in public hospitals in Nigeria is caused by problems of various nature (Orubuloye 2008, Abukhder and Munns, 2013).

Buildings are required to provide a conducive and safe environment for various human activities. This, essentially, is the question of function. The extent to which the buildings provide the required environment for the required activity is a measure of the functionality of the building Oladapo (2005).

The goal of every health institution is to provide patient care, produce medical and health manpower. In furtherance of this goal, staffs and expertise based on the highest skill are motivated in an environment that is clean, conducive and patient friendly. Hospital buildings are places where care and cure should be available to the public but due to lack of maintenance, public hospital facilites have become a place where people working in the built environment and patients have allergic – like reactions to unspecified stimuli, reactions like

dizziness, nausea, irritation of mucous membrane, eye and/or nasopharyngeal irritation and sensitivity to bad odour from human waste, poor toilet facilities, insufficient cleaning methods (Iyagba, 2005). These are key issues research work is set to address.

In Nigeria available fact in the literature review has proved that the profession of facilities management is quite young. At present, professionals such as Engineers, Architects, Builders, Surveyors, Estate managers and a host of others undertake it. Recently, a body known as the International Facilities Management Association (IFMA) established a Nigerian chapter. Due to the depressed state of the public and private sector of the economy, our facilities and public infrastructure are in poor state, this is one of the reasons this research is undertaken.

The PH. D thesis of Ernest Njungwen, (2016) on Contribution of Corporate Real Estate Management Practice to goal attainment in Universities in southeastern Nigeria. The aim of the study was to investigate into the current management practices, priorities, planning horizons, motivations and attitude of managers of university real estates with the view to evolving a frame work for managing universities as corporate real estate, in such a way that they achieve the mission and vision of each university. Ernest work has formed a basis and also gave a remarkable insight into this research work.

Okoroh (2012), work on Challenges Facing Healthcare Facilities in Nigeria, he observed that exploitation largely around control of resources and lack of accountability for resources in the hospital creating crisis. Poor accountability and the control of financial resources flowing around various units of the hospital is always a cause of friction.

Still on the same subject, Ahmed and Gidado (2010), pointed out the problem of incompetence due to poor recruitment practices.

Adeyeye *et al (*2010). Concluded that while entry qualification and specialty are basic, it must be appreciated that further training and experience are required in order to function effectively in a top management position

There is also a widespread culture of government sponsoring public officials abroad for treatment at the expense of investing and modernizing the healthcare infrastructure delivery system (Okoroh 2012).

From the foregoing one suggest here that the costs of providing a facility are mere peanuts when compare with the cost of operating and maintaining it in the long run. It is therefore important to formulate an all-encompassing maintenance culture which would ensure value over time while preventing obsolescence or breakdown.

Furthermore, Result of the assessment so far revealed that the implementation of FM in the selected hospitals in Akwa Ibom State is majorly carried out by "In-house Service", which is handled by technicians. This type of FM according to has its advantages and disadvantages as earlier stated in the literature review, therefore, for effective performance of healthcare facilities, both in-house and outsourced concept should be adopted. Facility Management should be administered by use of practical engineering standard tools such as the internal maintenance requisition form with which users of equipment and infrastructure identify or highlight their requirement to the Maintenance Staff of the Hospital, and another Standard form - work order should be used to facilitate the work by in-house managers of the Projects where the external managers are not available.

3.0 Methodology

This study adopted the survey research design using some three selected Hospitals, as case study. They included the University of Uyo Teaching hospital, St. Luke General Hospital Anua, Methodist Hospital Ituk Mbang, these hospital organizations used provided data for the study. All public hospitals in Akwa Ibom State form the population of this research. Eze, Obiegbu, and Jude – Eze (2005) defined the population of a study as the totality of people, material/ items about which the study intends to obtain information.

For the purpose of this dissertation, a total number of 99 questionnaire were administered to obtained the views of the users on the state of the facilities which they managed and used respectively A sample of three (3) hospitals were selected from all the public hospitals in Akwa Ibom State for this research. These are the University of Uyo Teaching Hospital Uyo, St. Luke General Hospital Anua and Methodist General Hospital, Ituk Mbank, Uruan, Uruan L.G.A. Purposive sampling was applied in the selected hospitals to focus on particular

characteristics of a population that are of interest, which will best enable the researcher to answer research question.

Chi-square was used as a method for testing a hypothesis measures the reliability and significance of data to see whether the deviation of the actual observations (observed frequency) from the expected is significant so that it may lead to acceptance or rejection of the null hypothesis. Also level of Association between Facility Management and Healthcare System was tested with P value of (0.05) as the strength of the relationship.

Chi-square as defined by (Hoel, 1974) is the sum of the ratio of difference between observed and expected values Its use involves the determination of the observed (actual) and the expected frequencies, the deviation squared, and the summation of the expected frequencies.

Thus:
Chi-square (X2) = (0-E)2/ E
Where: 0 = Observed values (frequency)
E = Expected Values (frequency)
S = Summation.
The instrument that was used in data collection in this study was a well-structured and developed questionnaire ‘‘The roles of facility management in the healthcare system: (a case study of selected hospitals in Akwa Ibom State)

4.0 Result and Discussion

A total of 99 questionnaires were administered and all were correctly filled, returned and analyzed. This represents 100% of the number distributed. The returned questionnaires formed the basis for the analysis.

Table 1: Analysis of the Distributed and Returned Questionnaires

S/N	SAMPLE GROUP	Questionnaires Distributed		Questionnaires Returned	
		Freq.	**%**	**Freq.**	**%**
1	Methodist Hospital	26	26.3	26	26.3
2	St. Luke Hospital	30	30.3	30	30.3
3	UUTH	43	43.4	43	43.4
	Total	99	100	99	100

Source: Author’s Computation (2023)

Interpretation:
Table 1 above showed that Twenty-six (26) questionnaires were administered to Methodist hospital Ituk Mbang, representing 26.3% of 99 questionnaires distributed, and all the 26 questionnaires were correctly filled and returned. Thirty 30 questionnaire were administered to ST. Luke hospital representing 30.3% of 99 questionnaire distributed and all questionnaires were correctly filled and returned. In like manner, Forty-three questionnaires
were administered to UUTH representing 43.4& of 99 questionnaire distributed, and all were correctly filled and returned. The correctly filled and distributed questionnaire totaling 99 represent 100% of the total number of questionnaire distributed. The rate of return is statistically high and justifies its use in the data analysis.

Table 2: Socio-Demographic Characteristics of Respondents (n=99)

Variables	Category	Frequency (%)
Sex	Male	46 (46.5)
	Female	53 (53.5)
Age	16-25	11 (11.1)
	26-45	29 (29.3)
	46-55	33 (33.3)
	56-65	26 (26.3)
	66-75	-
Position	Administrative Officer	17 (17.2)
	Director of Works	7 (7.1)
	Director of Physical Planning	18 (18.2)
	Medical Doctor	22 (22.2)
	Nurse	24 (24.2)
	Project Manager	11 (11.1)

	Other	-
Years of Service	0-5 6-10 11-15 16 +	28 (28.3) 48 (48.5) 23 (23.2) -
Educational Qualification	FSLC WAEC/NECO B.Sc/HND M.Sc PhD	- - 50 (50.5) 49 (49.5) -

Source: Author's Filed survey, 2023

Table 2 above demonstrated a Socio-demographic details of a total of 99 participants who involved in the study. The majority of participants were female (53.5%), and those aged between 46 and 55 years old (33.3%) were the majority age group among respondents. Also, over a great majority of participants (24.2%) were nurses, and a good number of study participants had 6 to 10 on-the-job years of service (48.5%). More so a greater 49.5% of study participants attained Masters' level of education.

Table 3: Hospital Response Item

Hospital Data Item	**Response**	**Frequency (%)**
Hospital of work	Methodist Hospital St. Luke Hospital UUTH	26 (26.3) 30 (30.3) 43 (43.4)
Availability of Maintenance Schedule	Yes No	90 (90.9) 9 (9.1)
Management Expertise/department responsible for FM.	Yes No	94 (94.9) 5 (5.1)
Quality of Facility Manager determining the performance of Healthcare Facilities	Yes No	95 (96.0) 4 (4.0)
Method of FM adopted.	In-house Out-source In-house/Out-sourced None of the above	58 (58.6) - 35 (35.4) 6 (6.1)
Types of facility own by hospital	Real Estate Machinery & Equipment Furniture &Fittings Motor Vehicles Other	4 (4.0) 20 (20.2) 3 (3.0) 62 (62.6) 10 (10.1)
Determinant of the method of FM adopted at hospital	Size of Asset Cost Minimization Uniqueness of services Risk Minimization Owner's Requirement	41 (41.4) 10 (10.1) 23 (23.2) 25 (25.3) -
Adequacy of available facilities	Yes No	9 (9.1) 90 (90.9)
Effect of inadequate facilities	High service delivery Low service Service remains the same	7 (7.1) 92 (92.9) -

Source: Author's Field survey, 2023

From table 3 above, majority of respondents (90.9%) affirmed that there are maintenance schedules geared toward preventing equipment/facility failure as illustrated in figure 1 below

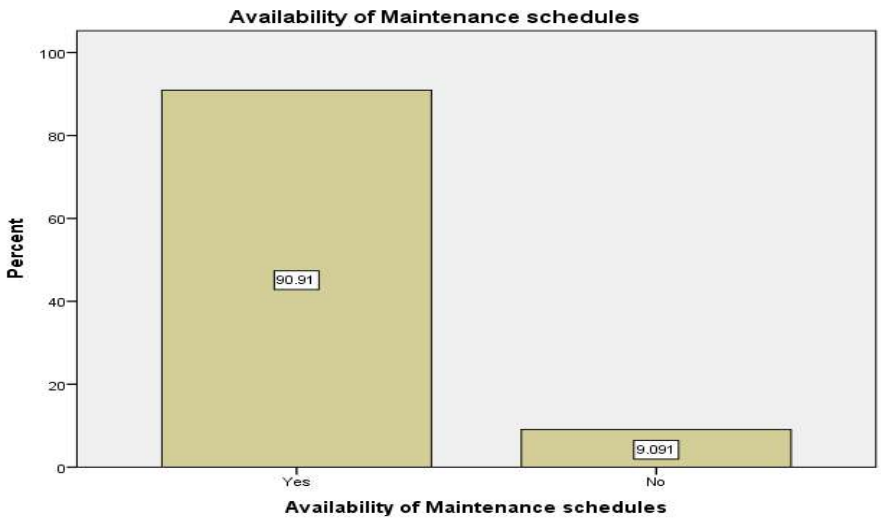

Figure1: Availability of Maintenance Schedules

A higher number of study participants (94.9%) affirmed that there exist the management expertise/department for managing hospital facilities in the study area (Figure2). Despites their existence there are still some anomalies in the process this could be due to the fact that most of them are still adopting the traditional method hence there is need for upgrade.

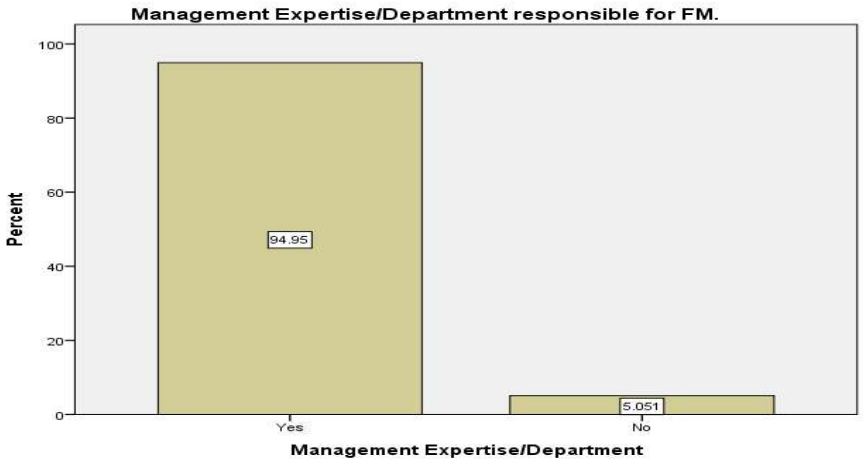

Figure 2: Management Expertise/Department responsible for effective FM.

A good number of the study respondents (96.0%) affirmed that quality of Facility Manager determines the effectiveness of healthcare system in the study area. the (Figure 3). This is reason why competence and professional hands should be engaged in proper management of the hospital facilities.

Figure 3**:** Quality of Facility Manager

A good number of study participants (58.6%) affirmed that the In-house method of facility management is adopted in their facility (Figure 4). Result of the assessment so far revealed

that the implementation of FM in the selected hospitals in Akwa Ibom State under studies is majorly carried out by "In-house Service". This type of FM according to Barrett (2019) has its advantages and disadvantages as earlier stated in the literature review, therefore, for effective performance of healthcare facilities, both in-house and outsourced concept should be adopted. The former should not be ignored because of its importance in handling complex maintenance works that needs special professionals to be carried out. This growing orientation to outsourcing is what this research work is advocating.

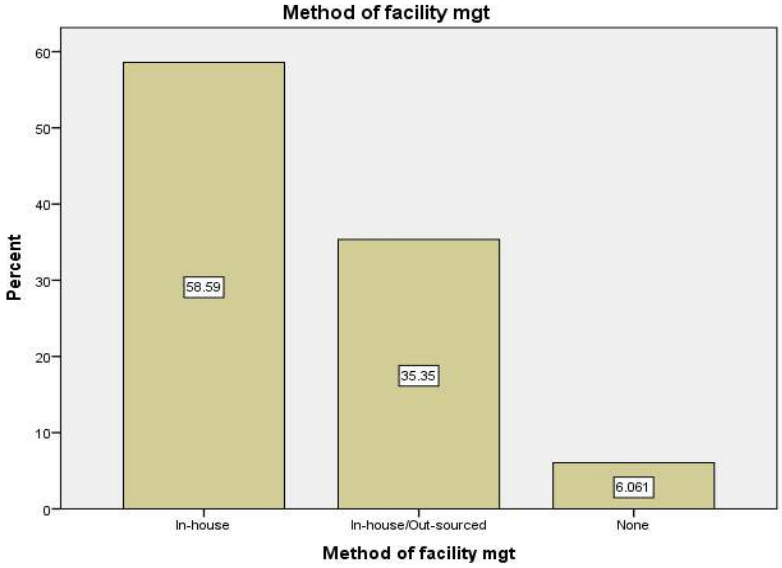

Figure 4: Method of Facility Management

A higher percentage of respondents (62.6%) affirmed that their hospital owns motor vehicles more than every other facility (Figure 5).

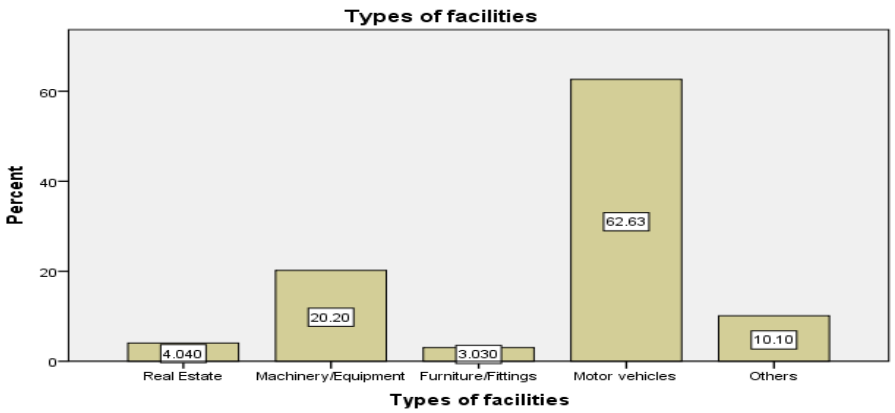

Figure 5. Types of facilities own by hospital

Majority (41.4%) of participants affirmed that the size of asset and sophistication of service determines the facility management method adopted in their hospital. This result is in harmony with in interview conducted where most respondent agreed that most hospitals are suffering from competence facilities management personnel with modern technology driven knowledge to care for facilities with sophisticated component, and this could be reasons why most facilities after installation remain without operation due to lack of trained personnel, this has brought serious setback in the attainment of goal of some organization.

To avert this ugly trend, the staff strength of the maintenance crew and engineering departments should be strengthened to enable them cope with handling of facilities with sophisticated component. This should be backed up with by engaging services of special facilities management consultants when the need arises to handle special or complex facilities. Management should invest in staff training and sponsoring programs, which will contribute to competence in executing tasks. All the maintenance staff must be proficient and professionals in their different fields.

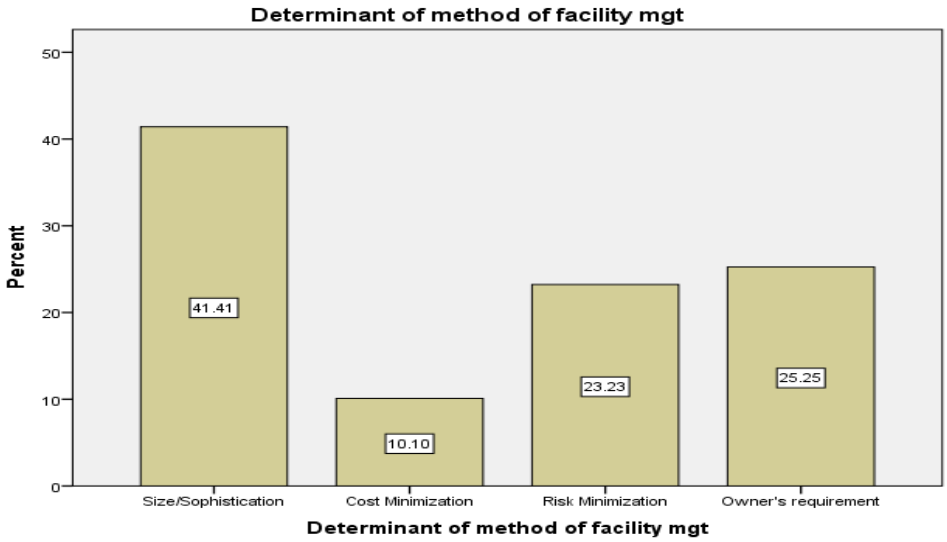

Figure 6: Determinants of FM method

Almost all participants (90.9%) affirmed that the available facilities in the hospital are inadequate. Also, a majority of respondents (92.9%) affirmed that low service is the primary effect of inadequate facilities provided in the hospital.

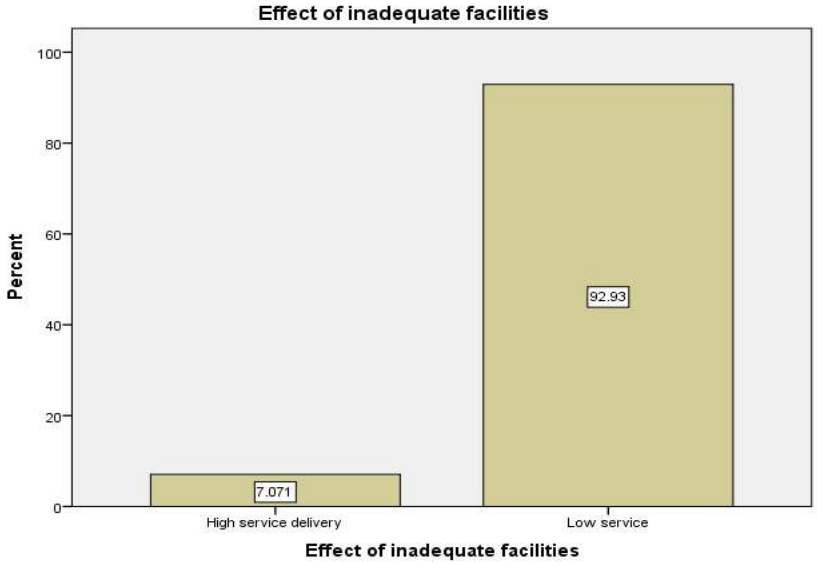

Figure 7: Effect of Inadequate Facilities

Table 4: Hospital Response Item Cont'd

Hospital Data Item	Response	Frequency (%)
Facilities compliments basic functions	Yes No	14 (14.1) 85 (85.9)
To what extent does it compliment	Very large extent Large extent Low extent Very low extent	6 (6.1) 18 (18.2) 40 (40.4) 35 (35.4)
Rate the effectiveness of FM in hospital	Good Fair Poor Very Poor	12 (12.1) 51 (51.5) 31 (31.3) 5 (5.1)
Assessment of Hospital Facility in the past 5 years	Improving Stable Shrinking	4 (4.0) 24 (24.2) 71 (71.7)
Present condition of the facility	Functional Under Repairs Obsolete Due for replacement Other	7 (7.1) 5 (5.1) 11 (11.1) 72 (72.7) 4 (4.0)
Adequacy of finances provided for FM.	Yes No	37 (37.4) 62 (62.6)
If No, Reasons	Absence of budget for FM. Inadequate budget for FM. Inconsistent budget for FM. Others.	19 (19.2) 66 (66.7) 14 (14.1) -
Modern automated facilities	Fully modern automated Not Fully modern Not modern automated	- 28 (28.3) 71 (71.3)
Satisfaction of the user requirement of facilities users	Yes No	14 (14.2) 85 (85.9)

Source: Author's Field Survey, 2023

Majority (85.9%) of participants were negative on the fact that facilities do not compliment basic functions in their hospitals as depicted in (Figure 8) below.

The facilities compliment their functions at a very low extent. The facilities used in the study areas are either sub-standard or performing under capacity thereby reducing the quality of healthcare system, which is one of the reasons most patients, opt for foreign healthcare services. The basic facilities provided are either out of use or performing poorly, these included the air-conditioners, Ambulances, generators/plants etc. This result is in line with the work of (Udo and Kalu, 2010)) on the management of corporate real estate asset in selected manufacturing organization in Aba, Abia State. They pointed out that most property assets are not managed to provide basic function expected. Proper management attention should be given to the facilities once they installed to ensure efficient and effective performance while those that due replacement should as a matter of urgency be done with.

Government should discourage the widespread culture of healthcare tourism while investing and modernizing the healthcare infrastructural facilities for effective healthcare service delivery.

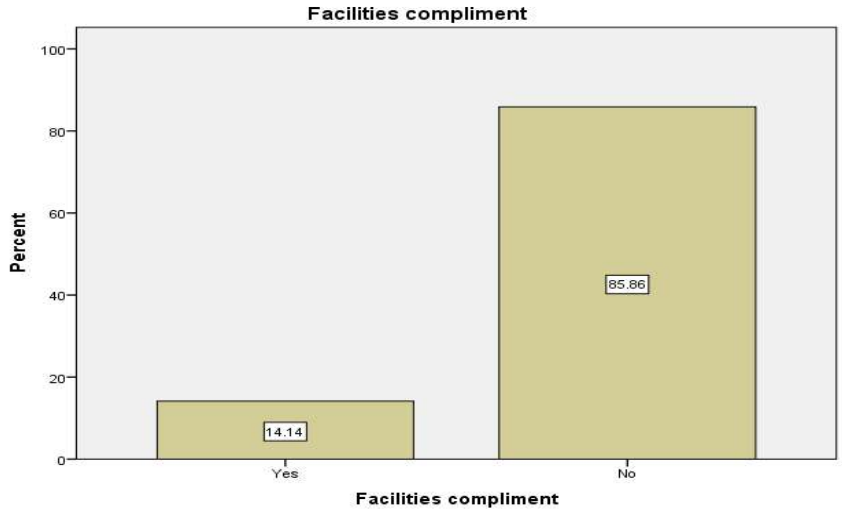

Figure 8: Facilities compliment basic functions in at a very low extent

Over half of respondents (51.5%) rated "fair" on the effectiveness of FM in hospitals (Figure 9). This could be as a result of some factors such as incompetence personnel, lack of routine training, corruption in recruitment process of facilities managers, inadequate funding, delay in subvention and the like.

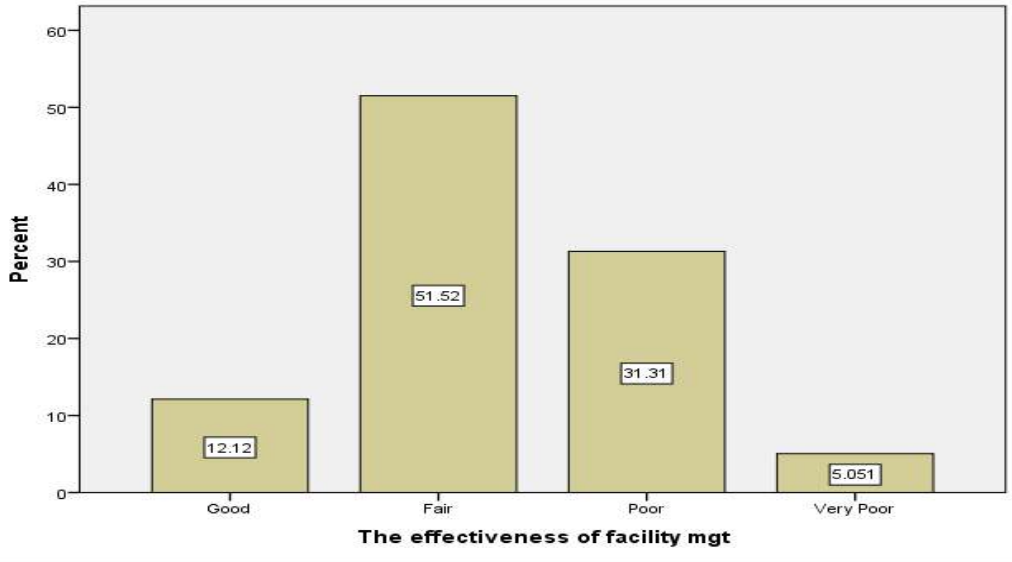

Figure 9: Effectiveness of FM in hospitals

On the assessment of hospital facility in the past 5 years, a higher percentage of study participants (71.7%) affirmed that hospital facility was shrinking (Figure10). One could conclude that this is responsible by poor maintenance culture, lack of proper funding for maintenance activities. To address this ugly scenario, A Good maintenance schedule should be designed as described in the literature and adequate funding should be guaranteed on the part of government.

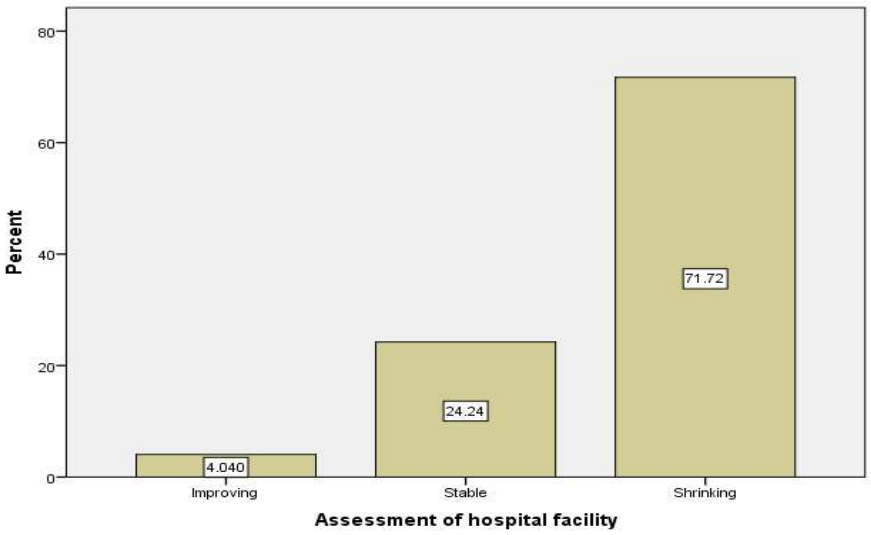

Figure 10: Assessment of hospital facility in the past 5 years

By present condition of facilities in hospitals, a good number of study participants (72.7%) affirmed that the facilities are due for replacement (Figure 11). For safety purpose, facilities that are certified for replacement the process should be carried out in earnest to avoid being a threat to the life of its occupants.

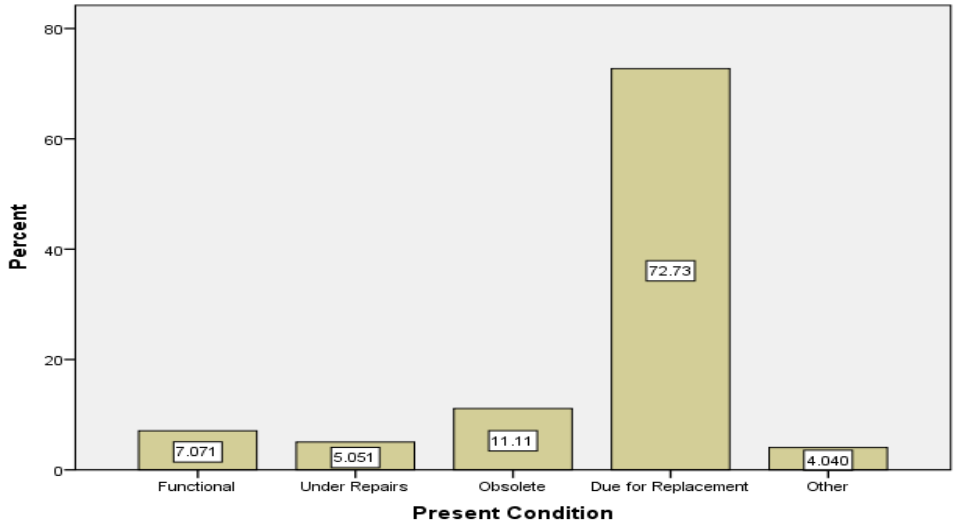

Figure 11: Present condition of facilities

Majority (62.63%) of participants were negative on the adequacy of finances provided for FM (Figure 12). This result is in consonant with the work of Babatope (2010) on problems of facilities in south west Nigeria Universities and the way forward the study sought to know if there was adequate financial support for university Education, whether the universities were provided with adequate facilities and whether available facilities were such that 88% of the respondents agreed that government did not give adequate financial assistance towards facilities while 76% indicated that there was no internally generated revenue to provide facilities. Up to 83.5% respondents agreed that erratic allocation of funds contributed to inadequate facilities.

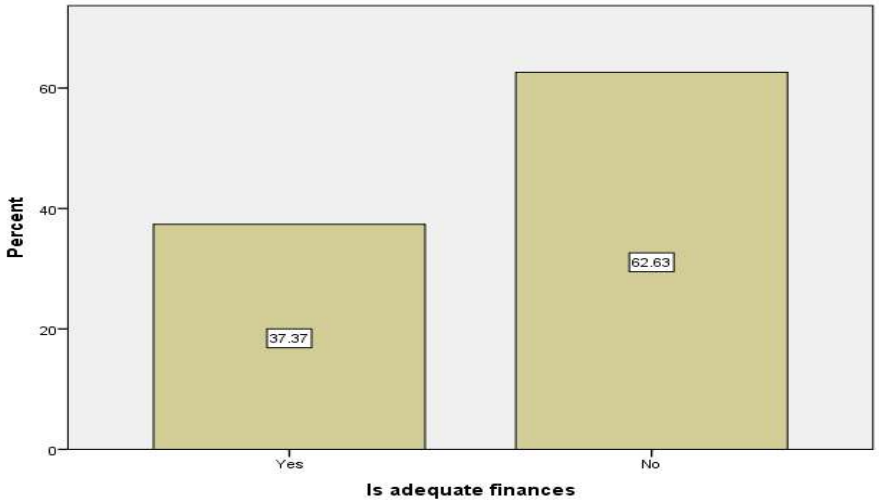

Figure 12: Adequacy of finances provided for FM

Furthermore, a higher percentage of participants (66.7%) affirmed that inadequate budgetary provision for FM is the major reason for the inadequate finances provided for FM (Figure 13). This fact is in line with the work of (Nutt 2010) who opined that there is a major challenge that arises from government subvention due to the irregular flow of funds. This implies that the hospitals organization should strategies for additional sources of finance for running the healthcare facilities rather than relying majorly on the government subventions which are characterized by corruption, delay in

approval of fund and gradual reduction in the amount of subvention. More so, Hospital management should have clear goals and objectives and must plan to operate within its budgetary limits. In order to ensure that maintenance operations are not held up by shortage of funds.

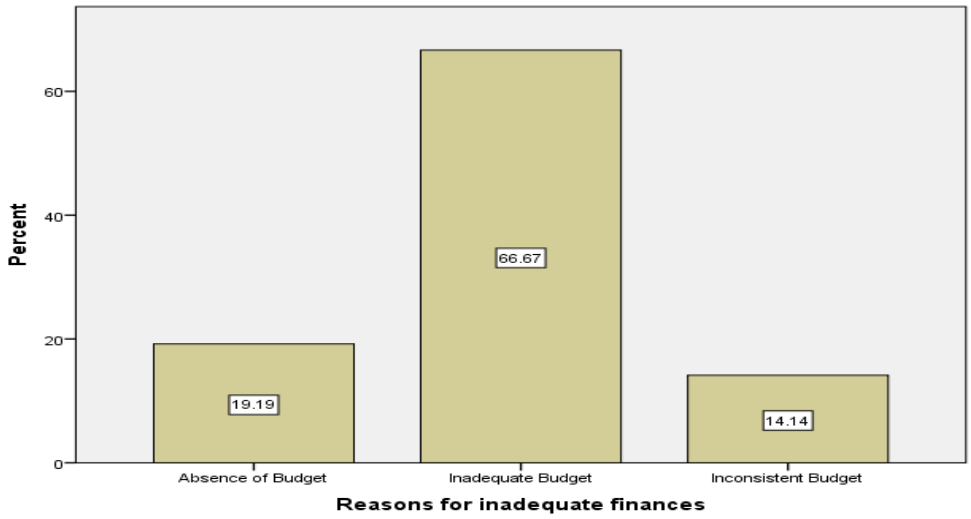

Figure 13: Reasons for Inadequate Finances for FM.

A greater number of respondents (71.3%) affirmed that facilities in hospitals are not modern automated (Figure 14). As the world is evolving with technology most of the facilities are not meeting the present day demand, hence the need for hospitals to apt for facilities with state of the art to meet the changing demand in technology.

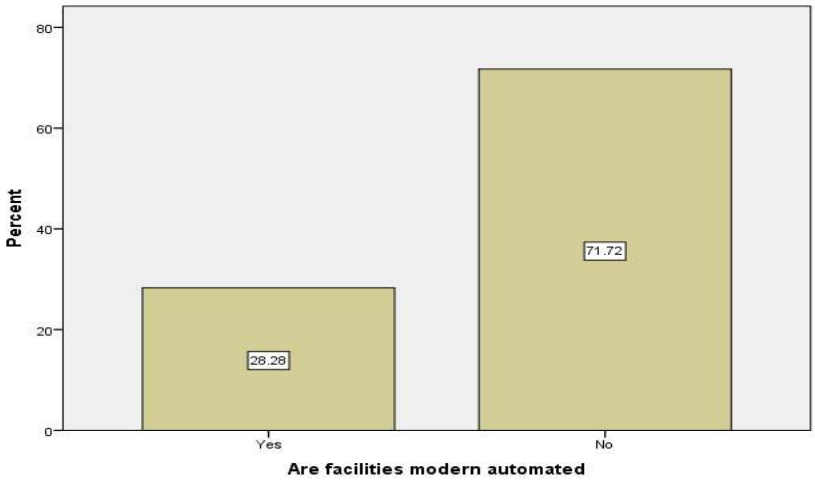

Figure 14: Modern automated facilities.

Table 5: Hospital Response Item Cont'd

Hospital Data Item	Response	Frequency (%)
Extent of satisfaction of facility user requirement	Very Large extent Large extent Low extent Very Low extent	6 (6.1) 15 (15.2) 12 (12.1) 66 (66.7)
Extent of constraint by poor funding	Highly constrained Moderately constrained Slightly constrained Not constrained	88 (88.9) 1 (1.0) 10 (10.1) -
Extent of constraint by bureaucracy	Highly constrained Moderately constrained Slightly constrained Not constrained	13 (13.1) - 35 (35.4) 51 (51.5)
Extent of constraint by Inflation	Highly constrained Moderately constrained Slightly constrained Not constrained	84 (84.9) 5 (5.1) 5 (5.1) 5 (5.1)
Extent of constraint by environmental effect	Highly constrained Moderately constrained Slightly constrained Not constrained	14 (14.1) 15 (15.2) 68 (68.7) 2 (2.0)
Extent of constraint by availability skilled labor	Highly constrained Moderately constrained Slightly constrained Not constrained	83 (83.8) 8 (8.1) 8 (8.1) -
Extent of constraint by safety/health	Highly constrained Moderately constrained Slightly constrained Not constrained	32 (32.3) 20 (20.2) 42 (42.4) 5 (5.1)
Extent of constraint by security provision	Highly constrained Moderately constrained Slightly constrained Not constrained	14 (14.1) 30 (30.3) 51 (51.5) 4 (4.0)
Extent of constraint provision by difficulty in procuring materials	Highly constrained Moderately constrained Slightly constrained Not constrained	63 (63.6) 36 (36.4) - -
Extent of constraint by automation	Highly constrained Moderately constrained Slightly constrained Not constrained	94 (94.9) 5 (5.1) - -

From table 5 above, a greater percentage of participants (66.7%) affirmed "Very low extent" on the extent of satisfaction of facility user requirement. Also, the majority of participants (88.9%) affirmed that they were highly constrained by poor funding as a facility management problem. Over half of study participants (51.5%) said they were not constrained by bureaucracy as a facility management problem. More so, 84.9% of participants were highly constrained by inflation as a facility management problem. Also, 68.7% of participants were slightly constrained by environmental effect as a facility management problem. 83.8% were highly constrained by availability skilled labour as a facility management problem. A greater Percentage of the study participants 42.4% were slightly constrained by safety/health, 51.5% slightly constrained by security provision, 63.6% were highly constrained by difficulty in procuring materials and a whopping 94.9% of study participants were highly constrained by automation.

Table 6: **Chi-Square Test of Association Between Facility Management and Healthcare System**

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.094	1.279		.073	.942	-2.447	2.634
	Poor funding	1.713	.459	1.403	3.735	.000	.802	2.625
	Bureacracy	.309	.133	.411	2.328	.022	.045	.572
	Inflation	-1.060	.440	-1.121	-2.410	.018	-1.935	-.186
	Environmental Effect	-.006	.171	-.006	-.034	.973	-.345	.333
	Availability of skilled labour	.630	.293	.499	2.151	.034	.048	1.212
	Safety	.069	.088	.089	.787	.433	-.106	.244
	Security provision	.005	.095	.005	.054	.957	-.185	.195
	Procuring materials	-.768	.206	-.498	-3.721	.000	-1.177	-.358
	Automation	.584	.312	.172	1.875	.064	-.035	1.204

a. Dependent Variable: Rate the effectiveness of facility mgt

Association between Facility Management and Healthcare System

However, the Chi-square test of the level of Association between Facility Management and Healthcare System as shown in (Table 6), highlighted those indicators that can be used to proof the roles of facility management in the healthcare system and indicated that there is significant relationship between facility management and the healthcare systems since P value from analysis of all indicators/problems were below (0.05) which is the strength of the relationship. These indicators are poor funding, bureaucracy, inflation, availability of skilled labour and difficulty in procuring materials and they were found to be statistically significantly associated with facility management and quality healthcare system in Akwa Ibom State. This result is in harmony with the work of Osagie (2004) in the literature review on 'the Problems of Facilities Management Practice in Nigeria' and (Babatope 2010) on problems of facilities in south west Nigeria Universities and the way forward. The authors noted that there are certain problems that have been militating against an effective facilities management practice in Nigeria.

The regression coefficients table below (Table 7) shows this result Conversely, environmental effect, safety, security provision and automation were not significantly associated with facility management and quality healthcare system in Akwa Ibom.

Table 7: **Regression Analysis of Indicators or Predicators of FM in Healthcare System**

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	78.366[a]	3	.000
Likelihood Ratio	28.503	3	.000
Linear-by-Linear Association	21.841	1	.000
N of Valid Cases	99		

5 cells (62.5%) have expected count less than 5. The minimum expected count is .205.

5.0 Conclusion and Recommendation:

An effective facilities management policy is indicated by the extent to which the requirements of the users, staff and owners are met. These are reflected on the physical, aesthetic condition of the facility, its functionality in performing its basic services and the ability of facilities maintenance or

management team to overcome challenges that constraint them. Facilities management need to be proactive, flexible, adapting to changes in a continuous changing world.

In the light of the research findings, and conclusions, the following recommendations are made;

1. For effective performance of healthcare facilities, both in-house and outsourced concept of FM should be adopted. the former should not be ignored because of its importance in handling complex maintenance works that needs special professionals to be carried out.
2. Continuous training programmes and refresher courses should be offered to employees.
3. Proper management attention should be given to facilities by way of involvement and integration of professional/key players to carter for the management needs of hospital facilities. Maintenance of sophisticated equipment should be outsourced to service providers who specialize in them. Adequate facilities should be provided to create a conducive environment for the achievement of core business objectives
4. Government should increase funding to allow for provision of more facilities. Government should discourage healthcare tourism for it officials and rather use the fund to invest and modernize the existing healthcare infrastructural facilities for effective healthcare delivery in Nigeria.
5. Investment should be made in computers and software packages that are relevant to space and data management. This will enhance management performance and introduce modern technology in tackling facilities management problems.
6. Continuous training programmes and refresher courses should be offered to employees. Also the emerging trend of demanding continuous upgrading of company services should be echoed in the demand of individuals for more focused facilities management training.
7. 6.Benchmarking should be employed to help identify trends and the changes you need to make to be more competitive or to be more effectively support the mission of the overall organization. Benchmarking will help to identify the gaps between your current practices (where you are now) and best practices (where you want to be).

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INFLUENCE OF HUMAN DEVELOPMENT ON THE BARRIERS TO HOUSE OWNERSHIP IN SOUTH-EAST AND SOUTH-SOUTH, NIGERIA.

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Abstract
The problem of house ownership in Nigeria has remained unresolved, despite all the efforts, policies, legislations, and strategies, government have devised over the years in an attempt to solve it. However, the emergence of the new paradigm, human development, which increases the capability of humans to meet their needs via improvement in health, education and standard of living, has changed the dynamics. This study therefore, examined the influence of human development on the barriers to house ownership using the South-East and South-South of Nigeria as case studies, with the view to promote house ownership. Ex Post Facto and Survey research designs were employed, while research request for information form, document from website, and quantitative structured questionnaire, were used to generate secondary and primary data, in the eleven state capitals in the study area. Out of 1412 questionnaire administered, 1,123 were returned, valid, to achieve a return rate of 83.78%. Data collected were analyzed using Fussy Set Theory, SEM, amongst others. The study found among others, that human development could mitigate the barriers to house ownership. Result shows that education has the highest impact in mitigation of barriers to house ownership, followed by standard of living, and health. Furthermore, among others, result shows that improvement in education can predict changes or mitigate house ownership barriers by 70%-95% directly to enhance house ownership. Consequent upon the findings, the study therefore concluded that human development has significant influence on the barriers to house ownership. Therefore, if human development is not improved, barriers to house ownership will not be mitigated, and as a consequence, house ownership will not be promoted. To this end, the study amongst others, recommended that economic policy makers, government officials involved in the economy, government agencies on housing provision and stakeholders on house ownership should prioritise the indices of human development in devising economic policies in order to enhance human development and the consequent mitigation of barriers to house ownership in Nigeria.

1.0 INTRODUCTION

Universally, housing is regarded as the second most important need of humans after food, which is the first (Ajayi, 2017; Iyagba, 2005). In other words, housing is one of the most essential needs of humans (Ikediashi and Ajiero, 2019). This underscores the enormous importance of housing to humans.

According to Udoh (2020), there are two major housing tenures - renting and house ownership. House ownership is a form of housing tenure where a person called 'house owner' owns the house in which he lives. Udoh (2020) indicated that house ownership is preferred over renting. There are many reasons for this. However, two of the reasons are because, apart from providing shelter, houses also serve as a measure of social standing and prestige (Ayedun and Oluwatobi, 2011), and a source of self-esteem to their owners (Elsinga and Hoekstra, 2005).

In recognition of the enormous importance of house ownership, government of various countries have been making efforts to promote house ownership for its citizens (Udoh, 2020). According to the School of Estate (2015), governments of countries like India, Mexico, Jamaica, Malaysia, Brazil and Thailand had used several strategies and models including House Loans Guarantee, Mortgage Insurance, Liquidity Facilities, Pass, amongst others in order to improve house ownership rates in their countries. In Nigeria, governments at different tiers have over the years, articulated several policies, legislations, and strategies (Ibimilua and Ibitoye, 2015; Ibem and Amole, 2010). These efforts by government have amongst others resulted to provision of mass housing, establishment of agencies like the Federal Housing Authority, Federal Mortgage Bank of Nigeria, promulgation of policies and programmes to aid the public and private sector's house ownership efforts etc. Apart from the government, the private sector and individuals have also been involved in house ownership promotion (Olotuah and Taiwo, 2015; Ibem and Amole, 2010; Ayedun and Oluwatobi, 2011; Aliyu, Kasim and Martin, 2011). However, despite all these efforts, house ownership still remains one of the most intractable challenges in Nigeria (Amao and Odunjo, 2014), as over 80% of Nigerians do not have houses of their own (Udoh, 2020).

The study by Udoh (2020) believed some factors are responsible for the failure of the efforts by the government, and other stakeholders to successfully promote house ownership. These factors are barriers inhibiting house ownership. Without these factors being mitigated, the problem of house ownership will persist. With the concerted efforts by the government and others failing to mitigate these factors and promoting house ownership, there is no gainsaying that the problem of house ownership still remains an intractable challenge in Nigeria. However, the emergence of the new paradigm, human development, has changed the dynamics.

Human Development (hereafter, HD) is a development paradigm that stands on a tripod; health, education, and standard of living (Omodero, 2019). The ultimate aim of the new paradigm is to increase the capability of humans to meet their desired needs (Maddela, 2014). In other words. HD ensures people are empowered to have access to all they need to live a productive and fulfilled lives, in addition to achieving what makes their lives valuable (Berenger and Verdier-Chouchane, 2007). The paradigm achieves this aim by enhancing the capabilities of humans (Berenger and Verdier-Chouchane, 2007; Bagolin and Comim, 2008). Capability of humans can only be enhanced when progress is made in the three components that make up HD: health, education and standard of living (Idowu, 2011). Essentially, the more progress is made in the three dimensions that constitute HD, the more citizens of the country are empowered with more capability to pursue their needs which include house ownership amongst others.

According to Angelo (2018), there are four levels of human development a country can fall under; Very High Human Development, High Human Development, Medium Human Development, and Low Human Development. From the computation of human development levels for countries, which is done by the United Nation Development Programme (hereafter, UNDP) annually, Nigerians has never exceeded the the Low Human Development (which is the lowest level of human development), over the years. This is because, Nigeria is not making progress in the areas of health, education, and standard of living. The significance is that citizens are not empowered enough to pursue their needs. It is against this background, that this study aims to examine the influence of human development on the barriers to house ownership, with the view to promote house ownership in Nigeria. The specific objectives are to establish the barriers to house ownership in Nigeria, evaluate the barriers to house ownership in Nigeria, and examine the influence of human development on the barriers to house ownership.

2.0 LITERATURE REVIEW

2.1 Human Development

HD can be defined as a development paradigm that seeks to promote an enabling environment for humans to have access to the things, which are needed by humans to live a productive and fulfilled life (Maddela, 2014). In essence, the ultimate objective of the paradigm is to empower and increase the capability of humans to meet their needs. The paradigm achieves this objective by encouraging progress in three broad areas of the economy; health, education, and standard of living (Omodero, 2019). This is because, the more progress is made in these three areas of the economy for a country, state, region etc., the more the human capabilities of the citizens to meet their needs increases (Idowu, 2011). Conversely, without progress in the three areas, human capabilities would be limited and as a consequence, many needs would not be met as a result of low or no capability (Edewor, 2014).

The level of human development for a country, state, region etc. is measured by a composite indicator known as the Human Development Index (hereafter referred to as HDI; Maddela, 2014).

2.2 Human Development Index

HDI measures the level of HD by evaluating the indicators of the three basic dimensions of HD; Health (measured by life expectancy), Education (measured by a combination of expected years of schooling and mean years of schooling), and Standard of living (measured by Gross National Income (GNI) per capita adjusted by purchasing power parity (PPP), UNDP, 2015). Studies by Maddela (2014); and Edewor (2014) defined HDI as a composite index that is derived by statistically combining the indicators of the three basic components of HD. Essentially, when a country, state, region etc. makes progress in the areas of health, education, and standard of living, its HDI value

increases (Edewor, 2014). In other words, when the HDI of a country, state, region etc. increases, the capability of citizens to meet their needs, increases.

Every year, the UNDP and some other international institutions like the Institute for Management Research, Radboud University, Nijmegen, Netherlands, calculate and publish the HDI of a number of countries, regions, and states. When calculated, the value of the HDI varies between zero (0) to one (1). 0 (zero) means no human development at all, and signifies the lowest level of human development possible (Edewor, 2014). While one (1) signifies the highest level of human development possible (Edewor, 2014). Depending on the value of its HDI for the year under review, a country is slotted into one of four tiers of HD (Urowayino, 2017). Angelo (2018) listed the four tiers to include; Very High Human Development (HDI value between 0.800 and 1.000), High Human Development (HDI value between 0.700 and 0.799), Medium Human Development (HDI value between 0.550 and 0.699) and Low Human Development (HDI value between 0.000 and 0.549). After the HDI for the different countries are computed, the countries are then ranked in accordance with the values of their HDIs. The country with the highest HDI value is ranked number one, followed by the next, in that order. Also, depending on the HDI values, the countries are classed under one of the four HD level tiers (Angelo, 2018). All this information amongst others is compiled and published annually by the UNDP in a report known as the Human Development Report (referred hereafter as HDR, Edewor, 2014).

The HDR attracts significant attention especially from the media and national policymakers of many countries (Klugman, Rodríguez and Choi, 2011). Attention on these reports, is as a result of the wide acceptance of the HDI, which has come to serve as the standard for government agencies, media, policy circles, academic researchers and others who are interested in measuring and comparing progress in HD for a country between years, or to compare the progress between countries, regions, states etc.

2.3 Health

Health is defined by the World Health Organization (WHO) as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (Eme, Uche and Uche, 2014). The study by Adedeji (2015) indicated that without health, there will be no life. This is why health is seen as the most significant ingredient of life (Eme *et al.*, 2014). According to Adedeji (2015), many studies suggested that progress in health (improvement in life expectancy) leads to increase in labour productivity, income, savings and economic growth. Similarly, the study of Cabrera (2012) indicated that the probability of house ownership increases as an individual grows older. In essence, improvement in life expectancy increases the chances of house ownership. However, in Nigeria, the health system is in shambles with few functional hospitals, few drugs, inadequate and substandard technology, and a lack of infrastructural support including electricity, water and diagnostic laboratories (Obasana and Orimisan, 2013). Generally, Nigeria lacks the facilities to take care of very serious illness (Eme *et al.*, 2014). Apart from lacking in facilities, there is also the case of brain drain in the country (Eme *et al.,* 2014). Instead of fixing the health system in the country, Eme *et al.* (2014) observed that government preferred to sponsor its officials abroad for treatment when they are ill. Even private individuals who are rich and can afford treatment abroad also travel abroad for medical treatment, leaving those who cannot afford such a luxury to their fate (Akinkuolie, 2018; Eme *et al.*, 2014). As a consequence of all these ills, data from the UNDP showed that the probability of not living past the age of 40 in Nigeria is 39% (Terfa and Umar, 2011). In essence, the longevity and life expectancy in Nigeria have been adversely affected by all these ills.

2.4 Education

Education is a process of acculturation by which an individual is assisted to attain the maximum activation of his potentialities according to the right reason, to achieve his self-fulfilment or self-realization (Asaju and Adagba, 2014). Education is the basis and the main criteria of the progress of every single community (Pajaziti, 2013). Investment in education brings a range of returns that benefit both the person investing in the education and the community in which they live (Ionescu, Ionescu, and Jaba, 2013). Some of these returns are monetary while others are non-monetary (Ionescu, *et al.*,

2013). Earnings, income, wealth and productivity have been identified as some of the possible monetary outcomes of learning (Ionescu, *et al.*, 2013). Generally, education means better jobs, better earnings, and better life conditions (Pajaziti, 2013). Similarly, studies by Land *et al.* (2012); and Javed, Javed, and Khan (2016) indicated that higher educational attainment attracted higher occupational status (an individual's initial level of entry), and affects how much an individual earns. This is because, increasing education (human capital) increases worker's productivity, leading to better employment and income for an individual (Land *et al*., 2012). In this regard, Udoh (2020) indicated that people with higher educational qualifications have higher chances of owning houses than people with lower or no education. Similarly, the result from the study by Fasakin *et. al.* (2019) among others, showed that education is one of the major determinants of house ownership. However, in Nigeria, the educational system is in crisis (Popoola, 2014). Asaju and Adagba (2014) listed problems of the educational system in Nigeria to include amongst others, low quality of the products of the educational system, high frequency of teachers' strike, poor quality of teachers, gross underfunding of the education sector, infrastructural decay, dearth of infrastructural facilities, inadequate teaching and learning materials, incompetent teaching and learning materials, inconsistent and lack of clear-cut education policy etc. As a result of all these, there is little or no progress in the educational sector.

2.5 Standard of living

Standard of living is a term used to describe how well people can live their life in terms of objective well-being (Graham, 2015). According to the study by Abdu (2017), standard of living of countries is reflected in their per capita incomes. In essence, a low per capita income indicates a low standard of living for a country. Conversely, a high per capita income indicates a high standard of living. The study conducted by Fasakin *et. al.* (2019) found that income is one of the main determinants of house ownership. The study reviewed a number of studies and concluded that the level of income is important for house ownership. In this regard, a higher income is more likely to guarantee house ownership than a lower income. According to Fasakin *et. al.* (2019), as income increases, the likelihood of owning a house also increases. Similarly, a past study which relied on data from the 1967 Survey of Economic Opportunity (SEO) in the United States of America, found that income positively increases house ownership probability (Cabrera, 2012). In Nigeria, however, the study by Asaju and Adagba (2014) observed that poverty had continued to soar despite efforts by government and other stakeholders to tackle it. The study lamented that many citizens of Nigeria find it very difficult to meet the basic necessity of life i.e., food, clothing, and shelter, despite being one of the richly blessed countries in terms of human and material resources. Similarly, the study by Popoola (2014) observed that the number of Nigerians living in poverty is increasing too rapidly. As at 1980, only 28.1 per cent or about 17.7 million Nigerians were in poverty earning less than one dollar a day, but by 2012, this figure had moved to 67 per cent or 112 million people earning less than one dollar a day (Popoola, 2014). According to Asaju and Adagba (2014), data from the National Bureau for Statistics (NBS), UNDP, and the World Bank indicated that poverty incidence in Nigeria is over 60%.

2.6 Barriers to House Ownership

Barriers to house ownership are inhibitors of house ownership. They are factors which inhibit house ownership. In other words, they are factors which are directly against house ownership efforts. In essence, barriers to house ownership are factors actively working against the promotion of housing/house ownership. Hence, without mitigating these factors, efforts towards house ownership would not be fruitful. In this wise, this study established and collated 29 of these factors (barriers to house ownership) from literature and presented the same in Table 1.

Table 1: Barriers to House Ownership in Nigeria.

BARRIERS	SOURCE
Bad government policies on housing	Ezeigwe, 2015; Ibimilua and Ibitoye, 2015; Olugbenga and Adekemi, 2013; Ayedun and Oluwatobi, 2011
Lack of political will and commitment by government on housing provision	Ayedun and Oluwatobi, 2011; Iheme, et al., 2015
Availability, ease, and affordable cost of land acquisition	Ezeigwe, 2015; Ibimilua and Ibitoye, 2015; Olugbenga and Adekemi, 2013; Ayedun and Oluwatobi, 2011; Aliyu, *et al*., 2011; Udoh, 2020; Kitila, 2019; Jayantha and Oladinrin, 2019
High cost and difficulty of securing residential building permit	Jayantha and Oladinrin, 2019; Odekunle, *et al.*, 2019; Fasakin, *et al.*, 2019
Low profit employment and unfavourable business environment resulting in inadequate disposable income	Yadeta, 2020; Lemire, 2022; Jayantha and Oladinrin, 2019; Effiong and Nissi, 2018; Kitila, 2019; Khorunzhina and Miller, 2019; Okeke *et al.*, 2020
Indebtedness	Goodman *et al.*, 2018; Jayantha and Oladinrin, 2019
Absence of job security and unstable job tenure resulting in lack of pensionable opportunities	Goodman *et al.*, 2018; Jayantha and Oladinrin, 2019
High unemployment rate	Okeke *et al.*, 2020; Hilber, 2007; Lemire 2022; Tan, 2008; Effiong and Nissi, 2018; Kitila, 2019
Lack of supplementary income	Tan, 2008; Lemire, 2022; Okeke *et al.*, 2020; Hilber 2007; Fasakin *et al.*, 2019; Cabrera, 2012; Udoh, 2020; Ayedun and Oluwatobi, 2011; Hilber, 2007
Low standard of living/Poverty	Ajayi, 2017; Ezeigwe, 2015; Ibimilua and Ibitoye, 2015; Olugbenga and Adekemi, 2013; Aliyu, *et al*., 2011; Kitila, 2019; Jayantha and Oladinrin, 2019; Effiong and Nissi, 2018
Difficulty to access housing credit service	Yadeta, 2020; Kitila, 2019; Hilber, 2007
High credit interest rate	Yadeta, 2020; Kitila, 2019; Hilber, 2007
Difficulty in accessing loan	Yadeta, 2020; Kitila, 2019
High loan interest rates with uncomfortable repayment period	Yadeta, 2020; Kitila, 2019; Jayantha and Oladinrin, 2019
Non-availability of mortgage facilities	Hilber, 2007; Lemire, 2022; Jayantha and Oladinrin, 2019; Yadeta, 2020; Goodman *et al.*, 2018
Stringent (inflexible) loan conditions from mortgage banks	Hilber, 2007; Lemire, 2022; Jayantha and Oladinrin, 2019; Yadeta, 2020; Kitila, 2019; Goodman *et al.*, 2018
High cost of living	Udoh, 2020; Sukereman et al., 2021; Yadeta, 2020; Jayantha and Oladinrin, 2019
High cost of building material	Udoh, 2020; Ezeigwe, 2015; Ibimilua and Ibitoye, 2015; Olugbenga and Adekemi, 2013; Ayedun and Oluwatobi, 2011; Kitila, 2019

High construction cost	Olugbenga and Adekemi, 2013; Udoh, 2020; Jayantha and Oladinrin, 2019; Yadeta, 2020
Absence of low-cost housing	Yadeta, 2020; Ibimilua and Ibitoye, 2015; Sukereman *et al.* (2021)
Poor access to low-cost housing	Yadeta, 2020; Ibimilua and Ibitoye, 2015; Sukereman *et al.* (2021)
Low level of education arising from rising cost of education and poor education facilities	Udoh, 2020; Fasakin *et al.*, 2019; Goodman and Mayer, 2018
Declining health status arising from inadequate health facilities	Sukereman et al., 2021; Edewor, 2014; Eme *et al.*, 2014
Low rate of urbanization	Yadeta, 2020; Ajayi (2019)
Declining gross domestic product	Popoola, 2014; Falaki *et al*., 2013; Abdu, 2017; Iheme, 2017
Rising inflation rate/consumer price index	Ayodele and Alabi (2011); Ayedun and Oluwatobi, 2011; Udoh (2020); Sukereman *et al.* (2021)
Inadequate financial inclusion	Yadeta, 2020; Goodman *et al.*, 2018; Kitila, 2019
Inadequate infrastructure provision	Udechukwu, 2008; Ajayi, 2017; Adediran *et al.*, 2020; Sukereman *et al.*, 2021
Lack of investment in building material manufacturing companies	Ayedun and Oluwatobi, 2011; Yadeta, 2020

Compiled by the Researcher from literature

2.7 Conceptual Framework

For this study, Human Development and barriers to house ownership were conceptualized using two principal variables; Human Development and barriers to house ownership variables. Human Development is the independent variables while barriers to house ownership is the independent variable. The sub-variables of Human Development include, Life expectancy index, Education index, Income index and Human development index. The sub-variables of barriers to house ownership include; Bad government policies on housing, Lack of political will and commitment by government on housing provision, non-availability, difficulty, and unaffordability of land acquisition, Low profit employment and unfavourable business environment, among others.

The study hypothesises that Human Development influence house ownership barriers via its indices, Life expectancy index, Education index, Income index and Human development index. The conceptual framework for the study is depicted in Figure 1

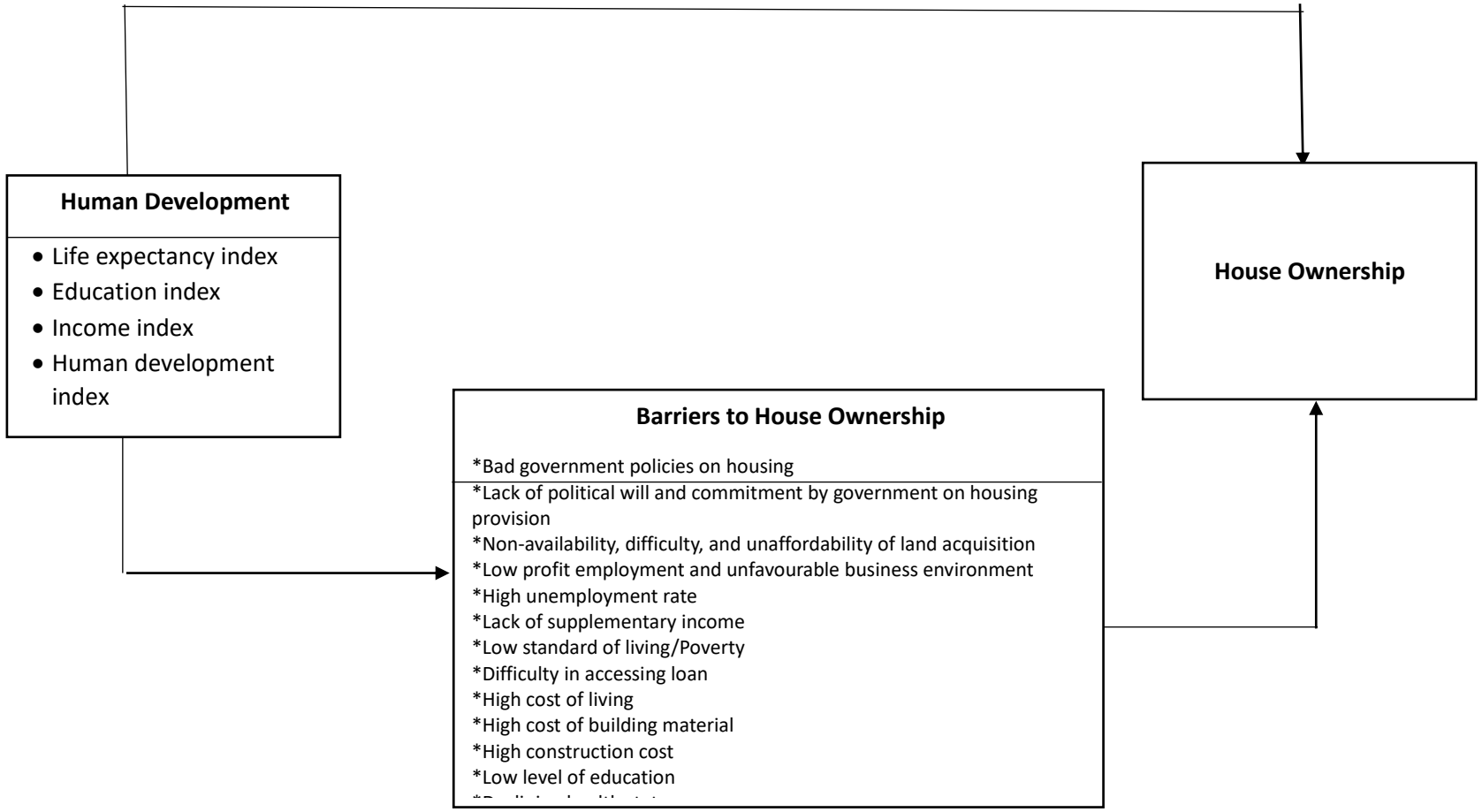

Figure 1: Conceptual framework for exploring the relationship between human development, barriers to house ownership, and house ownership in South-East and South-South, Nigeria **Source: The Researcher**

3.0 Methodology

3.1 Study Area

This study was conducted in the South-East and South-South Geopolitical Zones of Nigeria. South East comprise five states – Abia, Anambra, Ebonyi, Enugu, and Imo. The zone has a population of 16,381,729 people (Nwaiwu *et al*., 2014). On the other hand, the South-South Geo-Political zone comprise six states - Akwa Ibom, Cross River, Bayelsa, Rivers, Delta, and Edo (Awa, Kalu and Awara, 2010). According to Awa *et al.* (2010), the zone is a significant area of the Niger Delta region. Based on the 2006 census, the South-South zone has a total population of more than twenty-one (21) million people (Iheme, 2017). In terms of natural resources, the zone is blessed with huge crude oil reserves, and as result, produces more than eighty (80%) percent of total Nigerian crude oil which accounts for over eighty (80%) percent of the Federal Government revenue (Iheme, 2017). Fishing and peasant farming are the main occupations in this region with more than 45% engaged in these sectors while 17% are engaged in trading and selling activities (Iheme, 2017).
The study focused on the capitals of all the states that comprise the two geopolitical zones. They are eleven states in total. The capitals include; Umuahia, Awka, Abakiliki, Enugu, Owerri, Uyo, Calabar, Yenagoa, Port-Harcourt, Asaba and Benin.

3.2 Questionnaire Administration

The population of the study comprise the total number of selected stakeholders considered to be involved in house ownership issues consisting of House Owners, Architects, Builders, Estate Surveyors, Urban and Regional Planners, and Land Surveyors, in the areas selected for the study. In terms of numbers, the housing stakeholders comprise 3,598 house owners, and 2,569 selected professionals for the study (Architects, Builders, Estate Surveyors, Urban and Regional Planners, and Land Surveyors). Taro Yamane formular was employed to get the sample size. To ensure that the returned valid questionnaire does not fall short of the sample size for the population of the study, and also to beef up the sample which was small, the sample size was increased by 100%. A pilot tested was first carried out to test the questionnaire before the main study. Total questionnaire administered was 1412. For valid questionnaires, 1,123 were retrieved. Generally, the valid questionnaire obtained surpassed the calculated minimum sample size for the study with an overall efficiency rate of 79.53% while the overall response rate is 83.78%.

Table 2: Questionnaire Administration

Respondents	No. Administered	No. Retrieved	% Retrieved	Valid responses	% Efficiency
House owners	720	501	69.58	441	61.25
Professionals	692	682	98.55	682	98.55
Total	1412	1183		1123	
Overall Response rate			83.78		
Overall Efficiency rate					79.53

Source: Field Study (2023)

The study was anchored on Ex Post Facto, and Survey research designs. Data for the study was collected through document from website, structured questionnaire, and research request for information form. The data sourced from document from website has to do with data on human development and its indices. They were sourced from the website of Radboud University, Nijmegen, Netherlands https://globaldatalab.org.

The structured questionnaire consists of five sections; Section A, B, C, D, and E. Section A dealt with the demography and bio data of respondents. Questions in this section were closed ended. Section B dealt with the evaluation of barriers to house ownership. Section C has to do with the assessment of the influence of improved health (life expectancy) in mitigating the barriers to house ownership. Section D involved the evaluation of the influence of improved education in mitigating the barriers to house ownership. Section E dealt with the assessment of the influence of improved standard of living in mitigating the barriers to house ownership. For section B, C, D, and E, Likert scale with the minor and major symmetric scaling was employed; where one (1) represented minor, and five (5) represented major. The research request for information form was used to collect data on house ownership via the number of building permits issued in the year 2021 in the eleven state capitals in the study area by the relevant authorities. The number of building permits was used as the indicator of potential house ownership (number of house owners). Collected data were analysed using Standard Deviation, Mean Item Score, Structural Equation Modelling (SEM), and Critical Ratio (CR).

4.0 **Results and Findings**

4.1 **Respondents Characteristics**

In order to get a proper perspective on respondents who participated in the survey, their demographics were analysed using descriptive statistics. The result is presented in table 3.

Table 3: Respondents Characteristics

Category of respondents	N	%	Age group	N	%
House owner	441	39.3%	Less than 25	16	1.4%
Builder	154	13.7%	25-35	233	20.8%
Architect	167	14.9%	36-45	401	35.7%
Estate Surveyor	128	11.4%	46 and above	473	42.1%
Urban/ Regional Planner	121	10.8%	Marital status	N	%
Land Surveyor	112	10.0%	Single	277	24.7%
Gender	N	%	Married	731	65.1%
Male	766	68.2%	Divorced	41	3.7%
Female	357	31.8%	Widowed/Widower	74	6.6%
Current Employment	N	%	Type of employment	N	%
Employed	882	78.5%	Self-employed	336	29.9%
Unemployed	241	21.5%	Public Servant	441	39.3%
Monthly income range	N	%	Private sector	185	16.5%
Below N200,000.00	549	48.9%	Business	37	3.3%
N200,000.00 - N400,000.00	363	32.3%	Pensioner	81	7.2%
Above N400,000.00	211	18.8%	Others	43	3.8%
Education level	N	%	Profession	N	%
HND	153	13.6%	Builder	163	14.5%
BSC	474	42.2%	Architect	182	16.2%
MSc	322	28.6%	Estate Surveyor	135	12.0%
PhD	89	7.9%	Urban & Regional Planner	138	12.3%
Others	85	7.6%	Land Surveyor	117	10.4%
Experience in Construction	N	%	Others	387	34.5%
None	248	22.1%	Work experience	N	%
Less than 5years	183	16.3%	Less than 5years	209	18.6%
6-10 years	144	12.8%	6-10 years	239	21.3%
11-15 years	167	14.9%	11-15 years	183	16.3%
16-20 years	174	15.5%	16-20 years	211	18.8%
Above 20 years	207	18.4%	Above 20 years	281	25.0%

Source: Field Study (2023)

Result in Table 3 shows that under the sample category section, house owners have the highest number at 441 which is 39.3% of the total sample. The number of male respondents (68.2%) far exceeds that of female (31.8%). In terms of age, majority of the respondents (42.1%) are 46 years and above. Over 65% of the population are married (still married). In terms of employment, over 78.5% are employed while the remainder (21.5%) indicated unemployed. Based on income, over 48.9% earn below N200,000.00 monthly while a paltry 18.2% earn above N400,000.00. In terms of education, 100% of the respondents have at least a first degree (HND/BS.c). 65.4% of the respondents belong to the selected built environment professions (builders, architects, estate surveyors, land surveyors, and urban and regional planners) used for the study. In terms of experience, over 33.9% of the respondents have 16 years and above experience in the construction industry.

4.2 House Ownership

Apart from the general characteristics of respondents, the study also examined the housing/house ownership related characteristics of respondents in the study.

Table 4: House Ownership

House ownership	N	%	Tenure of house ownership	N	%
Yes	737	65.6%	I own the house where I live	678	60.4%
No	386	34.3%	The house I live in is rented	445	39.6%
Headship in household	N	%	Household size	N	%
Yes	821	73.1%	Less than 4	159	14.2%
No	302	26.9%	4-6	413	36.8%
			7-10	353	31.4%
			Above 10	198	17.6%

Source: Field Study (2023)

In support of the inference that educational level, current employment status, monthly income amongst others can trigger house ownership, 65.6% of the sample are house owners. Within the population that own houses, 60.4% live in their own houses while the remaining 39.6% live on rented houses even though they are house owners. In terms of household headship, 73.1% of the sample are household heads in their families. For household size of the respondents, 82.4% (14.2% + 36.8% + 31.4% = 82.4%) of the sample have ten or less as number of householders.

4.3 Critical Barriers to House Ownership

Table 5: Evaluation of Barriers to House Ownership using Fussy Set Theory (n = 1,123)

S/N	Barriers	Mean	Std. Dev	Z-Score	M(xi)	Decision
1	High cost of building material	4.34	0.89	0.98	0.85	Critical
2	High construction cost	4.31	0.90	0.99	0.85	Critical
3	High cost of living	4.18	0.97	1.07	0.86	Critical
4	High unemployment rate	4.18	0.96	1.05	0.87	Critical
5	Lack of supplementary income	4.15	0.93	0.93	0.85	Critical
6	Low standard of living/Poverty	4.13	1.00	1.13	0.87	Critical
7	Bad government policies on housing	4.11	1.05	1.24	0.89	Critical
8	Lack of political will and commitment by government on housing provision	4.00	1.12	1.32	0.91	Critical
9	Low profit employment and unfavourable business environment resulting in inadequate disposable income	4.00	0.98	0.95	0.85	Critical

10	Absence of job security and unstable job tenure resulting in lack of pensionable opportunities	3.96	0.92	0.72	0.76	Not critical
11	High loan interest rates with uncomfortable repayment period	3.93	0.96	0.80	0.79	Not critical
12	Difficulty to access housing credit service	3.89	0.90	0.56	0.71	Not critical
13	Rising inflation rate/consumer price index	3.86	0.93	0.65	0.74	Not critical
14	Indebtedness	3.84	0.98	0.77	0.78	Not critical
15	Difficulty in accessing loan	3.80	1.12	1.14	0.87	Critical
16	Poor access to low-cost housing	3.79	0.80	0.02	0.51	Not critical
17	Inadequate financial inclusion	3.79	0.96	0.66	0.74	Not critical
18	Low level of education arising from rising cost of education and poor education facilities	3.77	1.12	1.09	0.86	Critical
19	Non-availability of mortgage facilities	3.75	0.95	0.59	0.72	Not critical
20	High credit interest rate	3.73	0.95	0.59	0.72	Not critical
21	Absence of low-cost housing	3.72	0.98	0.65	0.74	Not critical
22	Inadequate infrastructure provision	3.72	1.06	0.90	0.85	Critical
23	Declining gross domestic product	3.68	0.93	0.45	0.67	Not critical
24	Stringent (inflexible) loan conditions from mortgage banks	3.68	0.95	0.52	0.70	Not critical
25	High cost and difficulty of securing residential building permit	3.66	0.95	0.51	0.69	Not critical
26	Declining health status arising from inadequate health facilities	3.65	1.17	1.09	0.86	Critical
27	Lack of investment in building material manufacturing companies	3.64	0.99	0.61	0.73	Not critical
28	Availability, ease, and affordable cost of land acquisition	3.63	1.19	1.10	0.87	Critical
29	Low rate of urbanization	3.34	1.12	0.67	0.75	Not critical

Source: Field Study (2023)

The study determined the significant barriers to house ownership in Nigeria using 29 variables extracted from literature on the subject matter. The data were ranked using a 5-point Likert scale and the significance of each barrier is based on the critical performance using degree of association of each variable to a set of critical barriers to house ownership. The analysis of barriers to house ownership involved two basic tests, namely: Fussy Set Theory and Test and Factor analysis. Fussy Set Theory (FST) was applied to reduce fussiness in qualitative ranking perceptions of respondents to aggregate the overall level of association of each to the set of critical drivers of house. The critical performance of each barrier is based on the 0.85 cut-off benchmark (Ekung *et al.*, 2020).

The results presented in Table 6 reveal that 14 (48%) out of the 29 theoretical barriers evaluated in the study are significant barriers inhibiting house ownership in Nigeria. Barriers in this category obtained λ-cut (Lambda Cut, M(xi)) values equal or greater than the 0.85 benchmark was adopted in the study. Factors above this benchmark are deemed critical barriers to house ownership including the high cost of building materials, high cost of overall construction, high cost of living, high unemployment rate and lack of supplementary income (λ, 0.85 -0.89 > 0.85).

Other critical barriers to house ownership are low standard of living, bad government policies, poor political will to provide housing, low access to loans, low level of education, inadequate infrastructure provision, declining health status, and low cost and ease of land acquisition. (λ, 0.88 - 0.99 > 0.85). The results imply that reducing the high cost of building materials, overall cost of construction, high cost of living, high unemployment rate and providing supplementary income would improve house ownership in Nigeria.

Conversely, 15 factors (52%) out of the 29 barriers evaluated in the study did not obtain the benchmark for critical barriers in the study. The degree of association of this set of drivers is weak and

less than the benchmark of critical barriers (λ, 0.51 -0.76 < 0.85). The result suggests that this group of factors does not belong to the set of critical barriers hindering house ownership, hence, mitigating them may not significantly improve house ownership. Factors in this category include increasing unstable job security, high interest rates on loans and difficulty in accessing housing credit among others. Others are indebtedness, poor access to low-cost housing, inadequate financial inclusion, high interest of credit, declining gross domestic products, high cost of building permits and low rate of urbanisation.

4.4 The Influence of Human Development Concerns on Barriers to House Ownership

The data for the analysis is mixed. The first group comprises ordinal data obtained from respondents' perceived impacts of the three human development concerns (improved standard of living, life expectancy, level of education) in mitigating barriers to house ownership. The goal was to determine the extent to which these human development concerns can mitigate the barriers inhibiting house ownership. The second group of the data is objective (quantitative or continuous data) obtained from the website of Radboud University, Nijmegen, Netherlands https://globaldatalab.org. Overall, the modelling consists of two parts, namely:

i. Modelling the extent to which human development concerns (improved standard of living, life expectancy, level of education) can improve the barriers to house ownership based on subjective data reflecting the perception of the respondents, and
ii. Modelling the extent to which human development concerns (improved standard of living, life expectancy, level of education) can improve the barriers to house ownership based on subjective and objective data. The subjective data is based on the perceived effects of barriers to house ownership and measured human development indices.

4.5 Descriptive Analysis of the influences of Human Development Concerns on Barrier Mitigation

The analysis in Figure 2 presents the mean item score and standard deviation of three human development concerns: standard of living, life expectancy and education development on the barriers to house development. The top ring towards the boundary of the radar represents the mean item scores, while the lower rings represent the standard deviation. The examination of the mean item scores indicates that the human development concerns could mitigate barriers to house ownership with an overall moderate impact (mean, 3.00 – 3.50). This shows that a greater proportion of the barriers can be mitigated moderately with the mean hovering around 2.80 – 3.5 except six factors, which dilate towards 4.00 (mean < 3.50 and < 4.00). The later emerges the overall most mitigated barriers by human development concerns. The Figure also indicates that the overall mean item score is lower for life expectancy (grey colour, top ring), while educational development generated the most significant mitigation effect on barriers to house ownership. Human development concern with the second most overall significant mitigation effect on the barriers to house ownership is standard of living.

Similarly, the standard deviation aggregates very between 1.00 - 1.50 with educational development producing the least deviation to show consistency with high mean item scores as discussed previously. Life expectancy produced the second least deviation in the level of influence of human development on barriers to house ownership. The deviation in the degree of impact of human development concerns (HDC) on barriers to house ownership is greater for standard of living.

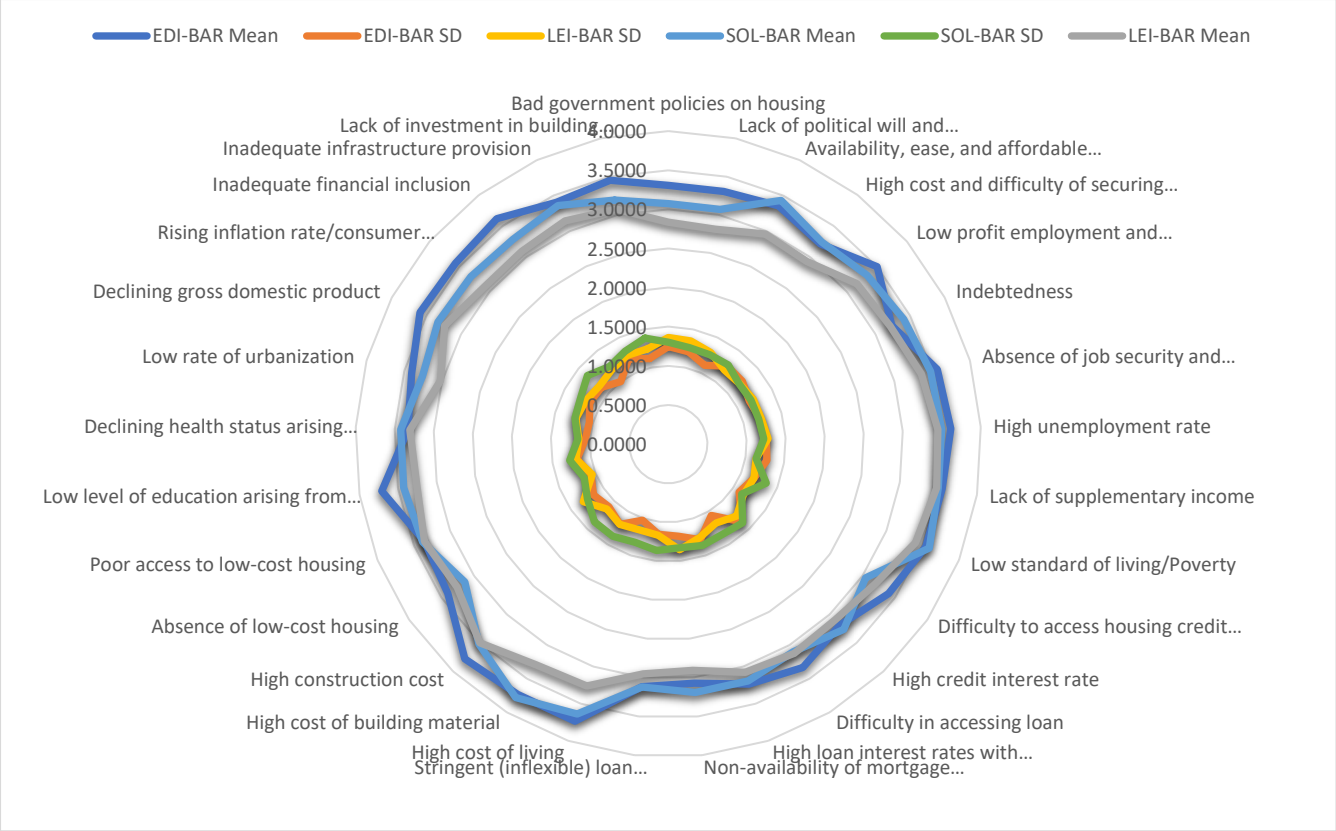

Figure 2: Influence of human development concerns on mitigating barriers to house ownership
Source: Field Study (2023)

4.6 Modelling the Influence of Human Development Concerns on Barriers to House Ownership: Subjective Perspective

Developing from extant theoretical standpoints in the literature, this study argued that improving human development concerns (standard of living, life expectancy, and level of education) can mitigate the influences of pertinent barriers (low standard of living, low access to loans, low level of education, inadequate infrastructure provision, declining health status and low cost and ease of land acquisition) to improving house ownership through a SEM model. This proposition is valid by the extent to which the model parameters fulfil the requirements of acceptable statistics supporting their validity based on their regression coefficients. To establish this relationship, a hypothesis (Ho_1), was formulated. Hypothesis one (Ho_1), states that human development concerns (standard of living, life expectancy and level of education) are not effective parameters for mitigating the barriers to house ownership in Nigeria. Structural equation modelling is adopted to model this postulated relationship based on the involvement of multiple dependent and independent variables as well as ordinal scale of measurement. The resultant model is termed the Human Development Concerns (HDC) - Barriers (Bar) model (HDC-Bar model I).

Analysis of the Structural Model: The (HDC-Bar model I) comprises 39 structural paths in a first-order recursive model, 36 predicts the impacts of HDC on barriers to house ownership that is, direct paths between latent variables (HDCs - Standard of Living, SOL; Life Expectancy Index, LIFEI and Education Development Index, EDI) and manifest variables (barriers to housing ownership). Thirty-six were selected based on their significant regression loadings and based on the need to enhance the simplicity of the HDC-Bar model respectively. This implies that 51 out of 87 manifest variables

(barriers) in this objective did not obtain the stipulated regression loadings objective to retain them in the model. The final structural model (Figure 3) was obtained after the fourth iteration, each iteration involves preliminary analysis, conducting retardant variables elimination and four-time model modifications. Based on the model modification, the validity of the assumptions underpinning the model in the study is extended beyond theoretical standpoints to empirical evidence that is, the data underpinning the model (University of Texas upon Austin, 2012; Bryne, 2016).

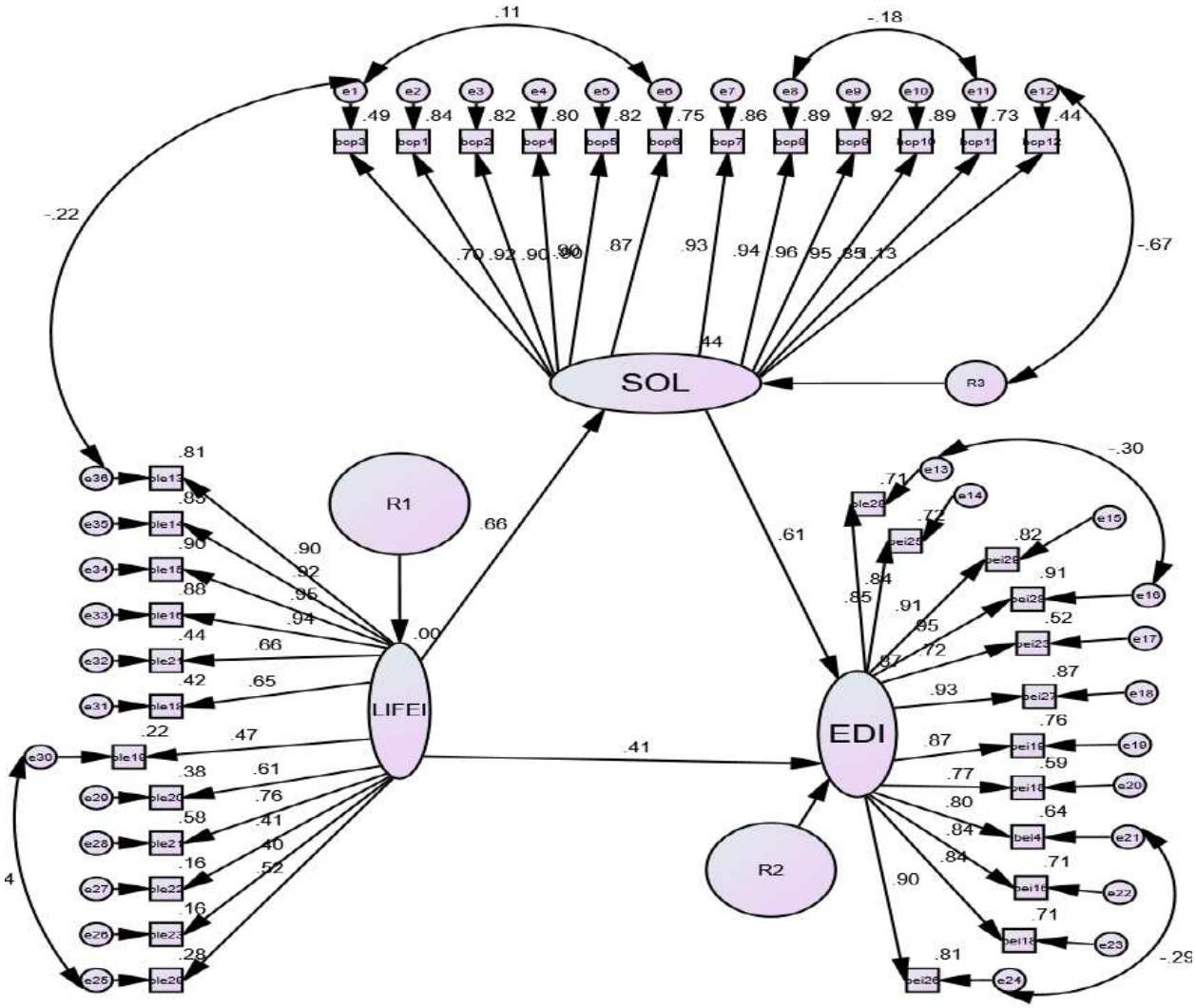

Figure 3: SEM structural model of the influence of human development concerns (standard of living, life expectancy and educational development on barriers to house ownership **(HDC-Bar Model I).**

Source: Field Study (2023)

The overall effects of HDC in mitigating barriers to house owners are significant (regression loading 61% - 95% > 60%; estimates on the arrows, Awang, 2015) for 83% out of 36 parts in the HDC-Bar model for the direct effects of HDC on barriers. However, 17% regression loading is less

than the 60% benchmark (Awang, 2015) and this result infers a considerate impact on the barriers to house ownership which stakeholders should pay attention to mitigating. The paths in this category are related to the effect of the life expectancy index on declining health status and level of education. Therefore, improving health status and level of education will also enhance citizenry life expectancy.

Human development concerns (educational development and standard of living) produced the highest impact on barriers to house ownership regression estimates (70% - 95%) to show that improving the level of education can predict changes or mitigate barriers by 70%-95% directly to enhance house ownership. A unit improvement in the standard of living and level of education will likewise produce a reduction ranging between 49-91% respectively. Improvement in life expectancy would also produce changes in barriers ranging between 17% - 90%. A unit improvement in one human development concern is also significant to improving other human development concerns. In HDC-Bar model I, improving the standard of living could predict a 67% in life expectancy, the standard of living could predict a 61% improvement in educational development, and educational development could improve 40% in life expectancy.

Variance and Covariance Validity: The validity of the variance and covariance is determined using the Critical Ratio (CR; Bryne, 2016). The CR depicts the results of the parameter estimate divided by the standard error (Bryne, 2016) and is valid by the critical p-values greater than ± 1.96. A valid CR is a score greater than 1.96. The results in Table 5 indicate that CR values (11.063 – 36.655 > 1.96) for paths in the structural model show that the covariance and variance indicators are appropriate for the number of barriers predicted by human development concerns.

Test of hypothesis (Ho_1): Hypothesis one (Ho_1) examines the influence of human development concerns on barriers to house ownership. The hypothesis states that human development concerns (standard of living, level of education and life expectancy) have no significant effect on barriers inhibiting house ownership in Nigeria. In other words, the hypothesis is a further validity test for HDC-Bar model I since the hypothesis is determined by the significance of HDC-Bar model I. The results of the significance of parameter estimates are extended by examining their critical p-values in Table 6.

Table 6: Hypothesis test of the effect of HDC on barriers to house ownership based on respondents' perceptions

Structural paths			Estimate	S.E.	C.R.	P	Decision
BPC1	<---	SOL	1.525	.045	33.817	***	Ho_1 rejected
BPC2	<---	SOL	1.451	.044	33.046	***	Ho_1 rejected
BPC4	<---	SOL	1.484	.046	32.521	***	Ho_1 rejected
BPC5	<---	SOL	1.474	.045	32.397	***	Ho_1 rejected
BPC6	<---	SOL	1.331	.044	30.451	***	Ho_1 rejected
BCP7	<---	SOL	1.498	.044	33.998	***	Ho_1 rejected
BCP8	<---	SOL	1.579	.045	35.207	***	Ho_1 rejected
BCP9	<---	SOL	1.648	.045	36.488	***	Ho_1 rejected
BCP10	<---	SOL	1.495	.042	35.564	***	Ho_1 rejected
BCP11	<---	SOL	1.195	.041	29.009	***	Ho_1 rejected
BCP12	<---	SOL	1.262	.054	23.458	***	Ho_1 rejected
BEI25	<---	EDI	.801	.025	32.079	***	Ho_1 rejected
BEI29	<---	EDI	.906	.025	36.655	***	Ho_1 rejected
BEI28	<---	EDI	.978	.023	41.934	***	Ho_1 rejected
BEI23	<---	EDI	.634	.026	24.287	***	Ho_1 rejected
BEI27	<---	EDI	.910	.023	39.861	***	Ho_1 rejected
BEI19	<---	EDI	.788	.024	33.520	***	Ho_1 rejected
BEI8	<---	EDI	.754	.028	26.505	***	Ho_1 rejected
BEI4	<---	EDI	.725	.026	27.898	***	Ho_1 rejected
BEI16	<---	EDI	.778	.025	31.383	***	Ho_1 rejected
BEI18	<---	EDI	.793	.025	31.291	***	Ho_1 rejected
BEI26	<---	EDI	.836	.023	36.365	***	Ho_1 rejected
BLE23	<---	LIFEI	.809	.073	11.063	***	Ho_1 rejected

BLE22	<---	LIFEI	.937	.080	11.658	***	Ho_1 rejected
BLE21	<---	LIFEI	1.491	.068	22.050	***	Ho_1 rejected
BLE20	<---	LIFEI	1.304	.076	17.178	***	Ho_1 rejected
BLE19	<---	LIFEI	1.464	.083	17.644	***	Ho_1 rejected
BLE18	<---	LIFEI	1.569	.082	19.041	***	Ho_1 rejected
BEI21	<---	LIFEI	1.173	.063	18.669	***	Ho_1 rejected
BLE16	<---	LIFEI	2.193	.075	29.333	***	Ho_1 rejected
BLE15	<---	LIFEI	2.164	.073	29.820	***	Ho_1 rejected
BLE14	<---	LIFEI	2.152	.075	28.544	***	Ho_1 rejected
BLE13	<---	LIFEI	2.068	.075	27.712	***	Ho_1 rejected

Source: Field Study (2023)

The results in Table 6 indicate that all the parameter estimates supporting the rejection of the Ho_1 are statistically significant, realistic and appropriate. The null hypothesis (Ho_1) for the 36 paths depicting the effect of human development concerns on barriers to house ownership is rejected (*p*, 0.0000 or *** < 0.05). The inference is a significant predictive effect based on parameter estimates indicated in Figure 3. In other words, human development concerns produce varying degrees of mitigation effects on barriers to house ownership by the extent indicated by the regression estimates.

4.7 Modelling the Influence of Human Development Concerns on Barriers to House Ownership: Mixed Data Perspective

Considering that the HDC-Bar Model I is a recursive model based on perceived unidirectional influences of HDC in the mitigation of barriers to house ownership in which case the barriers to house ownership are exogenous, hence, there is the inability to know the extent to which improving HDC can mitigate the barriers to house ownership generally through the r2 value. Consequently, the study explored a non-recursive SEM model (HDC-Bar II) to evaluate whether improving human development concerns (life expectancy, level of education, and standard of living) can mitigate the influences of pertinent barriers (low standard of living, low access to loans, low level of education, inadequate infrastructure provision, declining health status and low cost and ease of land acquisition) to house ownership, and also whether mitigation of these barriers could imply improvements in human development concerns. The secondary data on the actual measures of human development concerns over the period of the study (19 years) and the perceived strengths of the barriers to house ownership from stakeholders on house ownership were the data utilized for the analysis. The model is further used to determine hypothesis one (Ho1), which states that human development concerns (life expectancy, level of education, and standard of living) are not effective parameters for mitigating the barriers to house ownership in Nigeria. The modelling also applied structural equation modelling based on the involvement of multiple dependent and independent variables. The resulting model is termed Human Development Concerns (HDC) - Barriers (Bar) Model Two (HDC-Bar model II).

Analysis of the Structural Model: HDC-Bar model II comprises 33 structural paths in a second-order recursive model, 28 manifest variables (ble2-ble28) measured the barriers and it refers to the dependent variables in the HDC-Bar Model II. The predictor variables are human development concerns (Standard of Living, SOL; Life Expectancy Index, LEI and Education Development Index, ED). A variable out of the 29 manifest variables of barriers was removed to further enhance the model efficiency. The HDC-Bar Model II was iterated four times before selecting the final structural model (Figure 4). Based on the model modification, the validity of the assumptions underpinning the model in the study is extended beyond the theoretical standpoints of the hypothesised model to empirical evidence, that is the data underpinning the model (University of Texas upon Austin, 2012; Bryne, 2016).

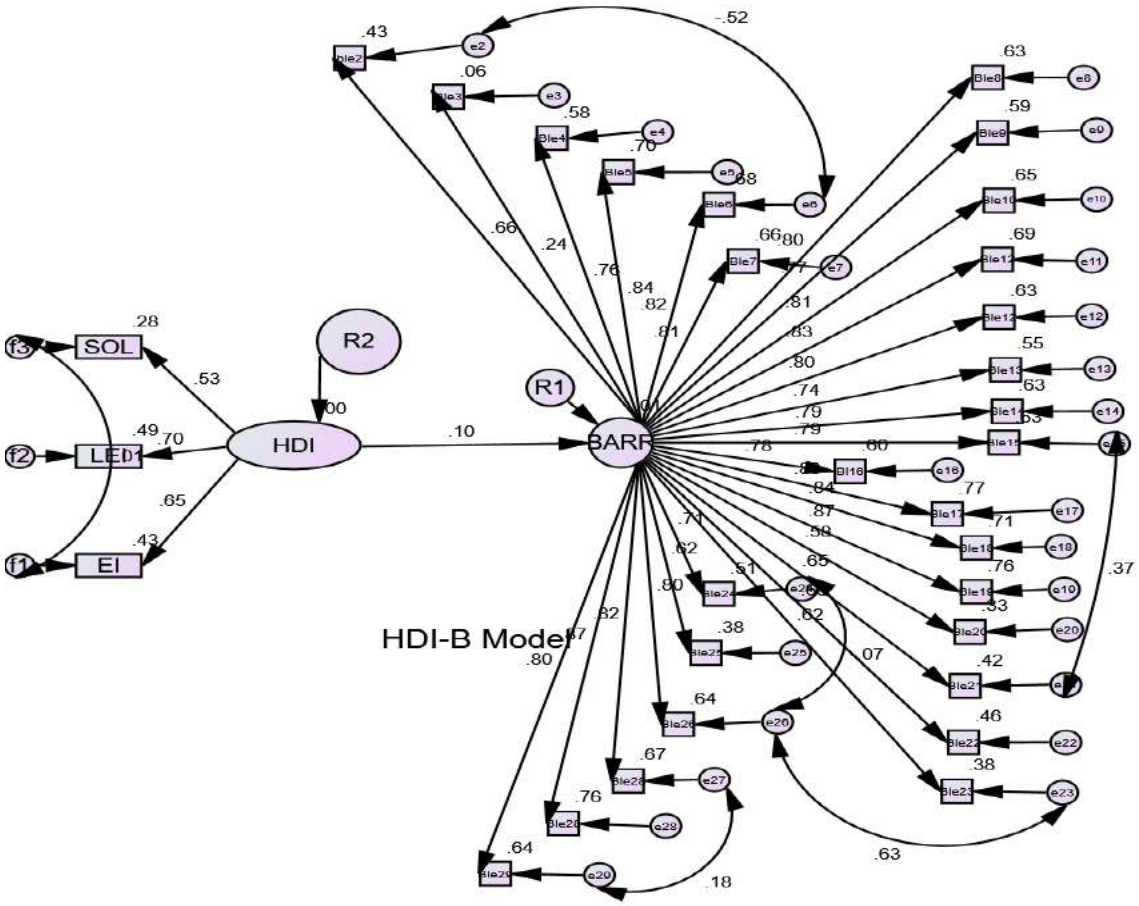

Figure 4: SEM structural model of the influence of human development concerns (standard of living, life expectancy and educational development on barriers to house ownership **(HDC-Bar Model II).**

Source: Field Study (2023)

Based on actual HDC indices collected over 19 years, covered by the study, the overall effects of HDC on barriers to house ownership are correlated and the strength of the correlation is weak (10%). Even though this is considered a weak relationship or degree of effect, further examination of the structural paths indicates that the 10% change can stimulate significant improvement in barriers (regression loading, 23% - 83% > 60%; estimates on the arrows, Awang, 2015) for 100% of the paths in HDC-Bar model II. Human development concerns (educational development and standard of living) produced varying significant direct mitigation ranging between 6% - 78% (estimates on residual estimates e2 - e29) to show that only 10% change in human development concerns is needed to reduce the effects of barriers to house ownership up to 78%. A unit improvement in the standard of

living and level of education will likewise reduce the effects of barriers obstructing house ownership by 6% -78%.

Variance and covariance validity: The CR depicts the results of the parameter estimate divided by the standard error (Bryne, 2016) and is valid by the critical p-values greater than ± 1.96. A valid CR is greater than 1.96 and the results in Table 6 indicate CR values (6.81 – 29.549 > 1.96) for paths in the structural model to show that the covariance and variance indicators are appropriate by the level of improvement in barriers predicted by human development concerns.

Test of hypothesis (Ho_1): Hypothesis one (Ho_1) examines the influence of human development concerns on barriers to house ownership. The hypothesis states that human development concerns (standard of living, level of education and life expectancy) have no significant effect on barriers inhibiting house ownership in Nigeria. HDC-Bar model II (Table 7) is further used to validate Ho_1 using mixed data.

Table 7: Hypothesis test of the effect of HDC on barriers to house ownership based on mixed data

Structural paths			Estimate	S.E.	C.R.	P-values	Decision
BLE2	<---	BARR	.726	.038	19.207	***	Ho_1 rejected
BLE3	<---	BARR	.261	.042	6.281	***	Ho_1 rejected
BLE4	<---	BARR	.851	.036	23.463	***	Ho_1 rejected
BLE5	<---	BARR	.873	.033	26.682	***	Ho_1 rejected
BLE6	<---	BARR	.856	.033	25.705	***	Ho_1 rejected
BLE7	<---	BARR	.844	.034	25.075	***	Ho_1 rejected
BLE8	<---	BARR	.847	.034	24.593	***	Ho_1 rejected
BLE9	<---	BARR	.772	.032	23.812	***	Ho_1 rejected
BLE10	<---	BARR	.945	.038	24.997	***	Ho_1 rejected
BLE11	<---	BARR	.828	.031	26.463	***	Ho_1 rejected
BLE12	<---	BARR	.960	.039	24.642	***	Ho_1 rejected
BLE13	<---	BARR	.879	.039	22.693	***	Ho_1 rejected
BLE14	<---	BARR	.957	.038	24.886	***	Ho_1 rejected
BLE15	<---	BARR	.934	.037	24.952	***	Ho_1 rejected
BLE16	<---	BARR	.938	.039	24.208	***	Ho_1 rejected
BLE17	<---	BARR	.638	.035	29.497	***	Ho_1 rejected
BLE18	<---	BARR	.630	.037	27.586	***	Ho_1 rejected
BLE19	<---	BARR	.669	.036	29.393	***	Ho_1 rejected
BLE20	<---	BARR	.644	.038	16.813	***	Ho_1 rejected
BLE21	<---	BARR	.672	.035	19.458	***	Ho_1 rejected
BLE22	<---	BARR	.782	.038	20.813	***	Ho_1 rejected
BLE23	<---	BARR	.658	.035	18.928	***	Ho_1 rejected
BLE24	<---	BARR	.796	.036	22.206	***	Ho_1 rejected
BLE25	<---	BARR	.715	.038	18.756	***	Ho_1 rejected
BLE26	<---	BARR	.990	.037	26.502	***	Ho_1 rejected
BLE27	<---	BARR	.924	.034	27.272	***	Ho_1 rejected
BLE28	<---	BARR	1.026	.035	29.549	***	Ho_1 rejected

S.E = standard error, C.R = critical ratio

Source: Field Study (2023)

The results in Table 7 indicate that all parameter estimates supporting the rejection of the Ho_1 are statistically significant, realistic and appropriate. The null hypothesis (Ho_1) for the 32 paths depicting the effect of human development concerns on barriers to house ownership is rejected (p-values 0.0000 or *** < 0.05). The inference confirms HDC's capability to improve barriers to house ownership by the extent of the parameter estimates indicated in Figure 4. When this result is

implemented, the implications suggest that improving human development concerns is not a stand-alone requirement for scaling house ownership but an aspect of the overall mitigation strategies contributing only 10%.

Conclusion and Recommendations

This study has provided an insight into the extent to which improving human development indices (life expectancy or health, education, and standard of living of living) have mitigated barriers to house ownership, with a view to enhance house ownership in Nigeria. Result shows that, out of the 29 house ownership barriers appraised by the study, 14 are critical while 15 are non-critical. The implication is that the critical barriers have higher potentials to inhibit house ownership than the non-critical barriers. Also, result shows that, human development indices (life expectancy or health, education, and standard of living of living) can mitigate both the critical and non-critical barriers to house ownership. Furthermore, result shows that, education is the most significant mitigator of the barriers to house ownership. The second most impactful mitigator is standard of living, followed by health, which is the least in impact. Also, the results shows that improvement or progress in one of the indices will lead to progress in the others.

This study has added to housing literature by developing a new approach to tackling the problem of house ownership; via human development indices (life expectancy or health, education, and standard of living of living). Furthermore, the study revealed the nature of the relationship between the human development indices (life expectancy or health, education, and standard of living of living) and the barriers to house ownership. The knowledge of this relationship would be useful to the government, housing, health, education, economic, and monetary policy makers, amongst others, in putting in place appropriate measures and efforts in improving the human development indices (life expectancy or health, education, and standard of living of living) with a view to enhance house ownership.

Based on the findings of the study, it is therefore concluded that, human development has significant influence on the barriers to house ownership. If human development is not improved, barriers to house ownership will not be mitigated, and as a consequence, house ownership will not be promoted. To this end, the study amongst others, recommended that economic policy makers, government officials involved in the economy, government agencies on housing provision and stakeholders on house ownership should prioritise the indices of human development in devising economic policies in order to enhance human development and the consequent mitigation of barriers to house ownership in Nigeria. The human development indices include; Human Development Index, Health, Education, and Standard of living. The more progress is made in these indices, the more the barriers to ownership are mitigated, and house ownership, promoted.

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FACTORS AFFECTING THE ADOPTION OF GREEN INFORMATION SYSTEM AMONG INDIGENOUS AND MULTINATIONALCONSTRUCTION FIRMS IN SOUTH-SOUTH, NIGERIA

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Abstract
Green information system has been identified as a technology capable of improving the sustainability of organizations, however, its adoption in the construction industry has been at a slow pace. The study evaluated the factors affecting the adoption of green information system by indigenous and multinational construction firms in South-South, Nigeria. Purposive sampling technique was used to select the firms that participated in this study. The quantitative research method was adopted in this study in which 60 copies of structured questionnaire were administered to representatives of construction firms operating in the six states of the South-south geopolitical zone of Nigeria. 44 questionnaire with valid responses were returned giving a response rate of 73.3%. which is considered very good and adequate. Data collected from the questionnaire were analyzed using descriptive statistics. Mann-Whitney U-test was used to test the hypotheses of the study. The study identified cost savings as the most important driver, while knowledge barrier such as low level of awareness regarding sustainability and green information system as the most critical barrier to the adoption of green information system by construction firms in the study area. The study concluded that there is a significant difference in the opinions of indigenous and multi-national construction firms regarding the factors affecting the adoption of green information system. The study recommends improving awareness of green information system among construction stakeholders by involving professional bodies in the awareness drive. Green information system solution providers should also embark on targeted advertisements and even distribution of software demos to construction firms. An increased awareness and pressure from the public on environmental issues will push construction companies towards a shift to more sustainable construction practices.
Keywords: Adoption, Green information system; factors; indigenous and multi-national; construction firms; South-South, Nigeria

1.0 INTRODUCTION

While the construction industry is known to play a vital role in the economic growth of developing countries, such as Nigeria, it is also reported as one of the pollution generators that destroy the environment which will lead to undesirable impacts on the economy and social aspects of the country (Tam *et al*, 2007). In 2019, the total CO_2 emissions of global construction enterprises was about 1 billion tons, accounting for 28% of the total global energy-related carbon emissions (Xingwei, *et al*, 2022) also research conducted by Bimhow in 2017, claimed that the construction sector contributes 23% of air pollution, 50% of climate change, 40% of water pollution, and 50% of landfill waste pollution. Different industries including the construction industry have been under enormous pressure to alter their institutional practices with respect to the environment and society. The advocacy has been on creating and supporting a new system that will allow people of the present and future generations to support economic viability, healthy ecosystems, and a more equitable social framework as an alternative (Mitrovic, 2015). This alternative has its origin in the concept of sustainability.

Several environmental and sustainability studies have suggested that the smart use of Information technology (IT) and Information systems (IS) can substantially help green the planet (Melville, 2010; Watson *et al*., 2008). The call by numerous IS scholars to examine the relationship between IS and environmental sustainability (Brocke *et al*., 2012; Pernici *et al*., 2012), resulted in a new sub-field called Green IS (Elliot, 2011; Jenkin *et al*., 2011, Melville, 2010). Recker (2016) defines Green IS as any kind of IS that assists individuals and organizations in making environmentally sustainable decisions and establishing environmentally sustainable work practices rather than environmentally unsustainable ones. This definition is consistent with an older one by Watson *et al*. (2008) who defined Green IS as the design and implementation of IS that contribute to sustainable business

processes. Green IS are expected to create an impact on individual beliefs about environmental sustainability (Melville, 2010), enable more sustainable work practices through virtualization and remote work (Bose and Luo, 2011), enable organizations to meet compliance imperatives and social norms (Butler, 2011), or increase resource efficiency (Watson *et al*., 2008), amongst others.

Green IS has found applications in the construction industry. With Green IS, the objectives of construction firms have moved from remote working beyond telecommuting to include systems that support collaboration, group document management, cooperative knowledge management, and so forth; track environmental information (such as toxicity, energy used, water used, etc.) about the creation of products, their components, and the fulfillment of services; monitor a firm's operational emissions and waste products to manage them more effectively; and provide information to consumers so they can make green choices more conveniently and effectively (Ogunyemi and Aktas, 2013).

While Green IS having been identified as a technology capable of improving the sustainability of organizations, its adoption in the construction industry has been at a slow pace (Brocke *et al*., 2012). Serpel *et al*. (2013), Abidin (2010) and Plessis *et al*. (2003) whose works explored the adoption of sustainable construction practices specifically in developing countries of Chile, Malaysia and South Africa respectively, concluded that they were still at very early stages of adoption with little progress made. Businesses, such as construction firms will have to ensure they have sustainable components to achieve competitive advantage or face suffocation and die a natural death. This threat of extinction of construction firms and the scarce information about Green IS which has slowed the adoption of Green IS in organizations of developing countries, is the premise upon which this study is made.

1.1 Objectives of the Study

The objective of this study is to determine the factors affecting the adoption of Green IS among construction firms in South-south, Nigeria.

1.2 Research Hypothesis

In order to achieve the objective of this study, the study tested the hypothesis which states that there is no significant difference between the opinions of construction firms on factors affecting the adoption of green information system in South-south, Nigeria.

2.0 LITERATURE REVIEW

This section comprises of the factors which affect the adoption of green information system by construction firms. The factors have been divided into drivers which encourage the adoption of Green IS by construction firms and the barriers which inhibit the adoption of Green IS by construction firms

2.1 Drivers for Adoption of Green IS by Construction Firms

In this study "drivers" are motivators that encourage organizations to adopt Green information system. These drivers can be divided into two main categories. They are internal drivers and external drivers.

A. Internal drivers

Internal drivers for the adoption of green information system by an organization are drivers that stem from the organization's goals, values, and operational considerations. Some identified internal drivers are;

1. **Management support** – Management support is considered one of the essential organizational factors that can assist in creating a supportive environment for innovation

through its commitment and providing sufficient resources for the adoption of new technologies in organizations (Low *et al.*, 2011; Lacity *et al.*,2009; Dong *et al.*, 2009; Ramayah *et al.*, 2016). Several studies have shown that management support has been considered a key driver for technology adoption in academic institutions (Huang *et al.*,2011) and the service sector in general (Al-Shamsi and Ajmal, 2018).

2. **Resource commitment** – Resource commitment is defined as the "allocation of tangible and intangible entities available to the firm that enable it to produce efficiently and/or effectively a market offering that has value for some market segment(s)" (Hunt, 2000). Li (2014) has found that more resource allocation will lead to a stronger positive relationship between environmental innovation practices and environmental sustainability. Mao *et al.* (2016) have shown that resource commitment positively influences knowledge management capability. The increased knowledge management capability that Green IS offers is seen as a key driver to its adoption by firms.

3. **Relative advantage –** Relative advantage refers to the characteristic that makes customers perceive a product/service as better than other similar products/services (Rogers, 2003). Organizations tend to adopt new technologies when they recognize that they offer more benefits than other similar technologies (Lee, 2004). The expected benefits Green IS can provide employees with is the incentive required for its adoption because the relative advantage of the new system can include improvement in work efficiency and productivity (Chwelos *et al*., 2001).

4. **Cost Savings** – Čekanavičius *et al*. (2014) found that while shifting to green business practices usually required certain additional costs, however, they can also bring tangible benefits such as lower material costs, and, thus, increased profit. Implementing Green IS can lead to reduced energy consumption and operational costs (Unhelkar, 2015). The cost savings derived from the efficient use of organizational resources could be a driver for organizations to adopt Green IS.

5. **Compatibility –** Compatibility refers to "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 2003). From a business point of view, the adoption of innovation should be consistent with the organizations' standards and technical requirements (Lertwongsatien and Wongpinunwatana, 2003). The ability of an organization to adopt Green IS without disrupting its operation is a driver for its adoption.

6. **Risk Management and Long-Term Sustainability –** Some organizations may decide to adopt green practices such as Green IS as part of their risk management strategy (Bokolo *et al*, 2018). Also, organizations with a focus on long-term sustainability and resilience may see the adoption of green information system as a strategic investment to ensure the continued success of the business in a changing environmental and economic landscape (Lloret, 2016). Anticipating future environmental regulations and market trends, organizations can proactively implement green practices to mitigate potential risks associated with non-compliance or changing consumer preferences. These are factors that could drive the adoption of Green IS in organizations.

B. External drivers

External drivers for the adoption of green information system in an organization are factors originating from outside the organization that influence its decision to implement environmentally sustainable practices. These drivers often arise from changes in the external environment, including market trends, regulatory requirements, and societal expectations. Some key external drivers are:

1. **Regulatory Factors –** These official mechanisms take the form of standards, laws, procedures, and incentives set by regulatory institutions to inspire firms to become environmentally responsible (Hsu and Lin, 2016). Following the laws and regulations are considered among the most influential factors for motivating organizations to adopt green and environmentally friendly practices (Chen *et al*., 2009; Barrieu and Sinclair-Desgagne, 2006). Eiadat *et al.* (2008) have noticed that government environmental regulations can assist organizations in accepting new ideas and devoting more resources to technological enhancements. Shen and Yao (2006) acknowledged that management's decision to implement green practices is related to regulatory pressures. Similarly, Cheah and Chew (2005) determined that enforcing environmental laws is considered an essential factor for adopting measures regarding the reduction of environmental impacts among Chinese construction firms. Qi *et al.* (2010) demonstrated that government environmental regulations have a positive impact on the adoption of green innovation practices such as Green IS.

2. **Industry Standards and Certifications -** Industry-specific standards and certifications related to environmental sustainability may influence organizations to adopt Green IS. Compliance with these standards can enhance the organization's reputation, build trust with stakeholders, and open up new business opportunities for the organization (Harrington *et al*, 2008). For example, organizations that intend to be ISO 14001: 2015 certified would have to adopt practices such as Green IS that would improve their environmental performance. This is identified as a driver for the adoption of Green IS in organizations.

3. **Supplier and Partner Expectations -** Suppliers and business partners may impose requirements or expectations for environmentally sustainable practices as part of their supply chain management strategies (Lee and Klassen, 2008). Organizations may adopt green practices such as Green IS, to meet these expectations and maintain relationships with key stakeholders.

4. **Investor Pressure and Environmental, Social, and Governance (ESG) Criteria –** With the global awareness of the effect of environmental pollution, most investors increasingly consider Environmental, Social, and Governance (ESG) factors when making investment decisions. A global survey by Deloitte, showed that 60% of dealmakers across the world now view ESG as a critical factor in their investment decisions (Omoyele and Owoyokun, 2023). Organizations may adopt green practices such as the use of Green IS to align with ESG criteria, attract responsible investors, and access capital from sustainability-focused investment funds (Stoian and Iorgulescu, 2019). The need to attract capital from investors is a driver for the adoption of Green IS by an organization.

5. **Customer Pressure -** Customers, as major financial stakeholders, can exert considerable pressure and demand goals of sustainability or environmental performance from organizations (Doonan *et al*, 2005; Lin, 2007; Peng and Lin, 2008). Demonstrating a commitment to sustainability can enhance the brand image and differentiate an organization from its competitors. The adoption of green practices such as the use of Green IS in the organization's operation can improve the organization's reputation among customers, investors, and other stakeholders. This is a driver for the adoption of Green IS in organizations.

6. **Competitor Pressure -** Several authors identified competition and competitive advantage as drivers for Green IS (Walker *et al*., 2008). Competitive pressure is the external pressure from other organizations which can lead to losing competitive advantage, thus forcing organizations to adopt new technology (Wang and Cheung, 2004). Competition may motivate companies to adopt innovations to maintain a competitive edge (Zhu *et al.*, 2006) or push organizations toward adopting new technology, although they will not gain any benefit from

it (Lin, 2014). Rao and Holt (2005) state that a policy of environmental sustainability may not be undertaken because of a desire to 'save the world', but because it reflects a way to gain competitive advantage and improve the financial performance of the firm. Following this same line of thought, it is believed that competition can drive companies to adopt Green IS.

7. **Social Pressure -** The deterioration of the environment over recent decades has drastically increased the public's awareness of environmental issues. The public is increasingly influenced by a company's reputation concerning the environment when making purchasing decisions (Aguinis and Glavas, 2012). Many organizations prioritize Corporate Social Responsibility (CSR) initiatives to demonstrate their commitment to environmental sustainability. Adopting Green IS aligns with these values by reducing carbon footprints and promoting eco-friendly practices. In terms of their competition, CSR could be another area where an advantage could be gained, particularly in the area of public perception (Kohli and Hawkins, 2015). This has been identified as a driver for the adoption of Green IS by organizations.

Table 2.1. Drivers for the adoption of Green information system by construction firms

Drivers for the adoption of Green Information Systems by construction firms		
Internal Drivers	1.	Management Support
	2.	Resource Commitment
	3.	Relative advantage
	4.	Cost savings
	5.	Compatibility
	6.	Risk management and long-term sustainability
External Drivers	7.	Regulatory forces
	8.	Industry standards and certifications
	9.	Supplier and partner expectations
	10.	Investor pressure and ESG criteria
	11.	Customer pressure
	12.	Competitive pressure
	13.	Social pressure

Source: Mouakket and Aboelmaged (2021)

2.2 Barriers to Adoption of Green IS by Construction Firms

From the works of Ifeanyichukwu (2019) and Chan *et al* (2017) who identified the barriers to the adoption of new technologies in the construction industry and Amuda-Yusuf *et al* (2020) who identified barriers affecting the adoption of Green building technologies in Nigeria, fifteen barriers which affect the adoption of Green IS by construction firms was identified. These barriers are categorized into seven broad groups. These seven broad groups of barriers affecting the adoption of Green IS are discussed below:

1. **Cost and Risk-Related Barriers** – These are barriers which occurs when the financial expenses related to the usage of technology and the risk of enjoying benefits from such huge investments cause stakeholders to be less prone to using them. This is often the case because of the difference between the costs of normal construction materials, methods, and systems, to the green ones (Yang and Ibuchim., 2013). The fact that the use of Green IS can increase a project's initial costs by two to seven percent, has persuaded many that the use of this

technology is counterproductive (Chan *et al*., 2017). The identified barriers that fall under this category are:

i. The higher costs of green technologies compared to traditional technologies.
ii. The long repayment period for investments in green technologies
iii. The risks and uncertainties involved in adopting new technologies

2. **Knowledge Barriers** – This type of barriers occurs when the resistance to proposed changes in either business processes or project deliverables is due to cognitive limitations. The demand in the construction industry for more research displaying successful results of Green IS implementation is not being met (Ifeanyichukwu, 2019). Findings showed that when stakeholders lack needed information for decision-making in the use of Green IS, they opt for a "safe" alternative due to the quality-driven and risk-averse organizational culture (Chan *et al*., 2017). Findings like these illustrate that until knowledge is effectively diffused amongst most of the professionals in the construction industry, Green IS may continue to be disadvantaged by the barrier of knowledge. The identified barriers that fall under this category are:

i. The low level of awareness regarding sustainability issues
ii. The low level of awareness regarding Green IS among industry practitioners
iii. The lack of information about Green IS models available

3. **Skill-set Barriers** - Due to one's unfamiliarity with working with Green IS hands-on, difficulties can arise on all levels of Green IS implementation, otherwise known as Skill-set barriers. As the application of Green IS infrastructure by construction firms increases, the skills required to operate and maintain it will also increase (Chan *et al*., 2017). The main specialist requirement will be for people with technician-level skills in building information modeling, new software in construction information management, environmental information management, and other related operational management information systems (Ifeanyichukwu, 2019, Chan *et al*., 2017). This invariable alienates other members of the project team who do not possess this skill set and this would be a barrier to the implementation of Green IS especially when the alienated group makes the majority. The identified barriers under this category are;

i. Limited human resources with skill sets required to operate and maintain Green IS infrastructure
ii. Resistance from persons without the skill sets required to operate and maintain Green IS infrastructure.

4. **Bureaucratic Barriers** - A persistent opposition to Green IS, lies within the difficulty of getting acceptance and adoption on an industrial scale. When a company adopts Green IS and cannot relate with other companies on the same level, then, it creates challenges (Ifeanyichukwu, 2019, Chan *et al*., 2017). Take for instance, preparing building documentation using BIM and forwarding same to another project team in another company, only to be informed that they are not compatible with the BIM platform. this raises bureaucratic issues. The only identified barrier under this category is;

i. Bureaucratic challenges relating with other companies or project team members who have not adopted Green IS.

5. **Government-Related Barriers –** This type of barrier occurs whenever the government neglects provisionary actions for green construction projects or when its authority establishes regulations that either slow down or hinder the progress of development (Choi, 2010). The identified barriers under this category are;

i. The lack of government policies and guidelines supporting Green IS
ii. Lack of government incentives for companies adopting Green IS

6. **Bounded Rationality Barrier** - Bounded Rationality is a way of grouping those barriers that arise from the personal and biased perceptions that stakeholders carry, whose decision-making is constrained by limitations in reasoning feasibility concerning project objectives (Hoffman and Bagheri, 2008). On the individual level, stakeholders unacquainted with Green IS can resist implementation due to an organizational bias. Positive allusions give the tendency for groups of individuals to notice their needs more than those of the surrounding environment. The identified barriers under this category are;
   i. The resistance of individuals to voluntarily accept a change to a new system.
   ii. Lack of management Support for the use of Green IS

7. **Market-Related Barriers –** These are barriers arising from market forces, which are the demand and supply of Green IS products (Amuda-Yusuf *et al*., 2020). The adoption of Green IS by organizations could be hampered by the limited Green IS products available in the market and tailored towards the construction industry. Also, when clients of construction firms do not make any specific request for the use of Green IS on their projects, the construction firms are not obliged to adopt Green IS (Amuda-Yusuf *et al*., 2020). The identified barriers under this category are;
   i. Barriers due to the limited Green IS products available in the market for use by construction organizations.
   ii. The lack of interest in Green IS by clients of construction firms results in low demand for Green IS products.

Table 2.2: Barriers for the adoption of Green IS by construction firms

Barriers to the Adoption of Green IS in Construction Firms		
Cost and Risk-related Barriers	1.	The higher costs of green technologies compared to traditional technologies
	2.	The long repayment period for investments in green technologies
	3.	The risks and uncertainties involved in adopting new technologies.
Knowledge Barriers	4.	The low level of awareness regarding sustainability issues
	5.	The low level of awareness regarding Green IS among industry practitioners
	6.	The lack of information about Green IS models available
Skill-set Barriers	7.	Limited human resources with skill sets required to operate and maintain Green IS infrastructure
	8.	Resistance from persons without the skill sets required to operate and maintain Green IS infrastructure.
Bureaucratic Barriers	9.	Bureaucratic challenges relating with other companies or project team members who have not adopted Green IS
Government-related Barriers	10.	The lack of government policies and guidelines supporting Green IS
	11.	Lack of government incentives for companies adopting Green IS
Bounded rationality Barriers	12.	The resistance of individuals to voluntarily accept a change to a new system.
	13.	Lack of Management support for the use of Green IS
Market-related Barriers	14.	Barriers due to the limited Green IS products available in the market for use by construction organizations.
	15.	The lack of interest in Green IS by clients of construction firms results in low demand for Green IS products.

Source: Ifeanyichukwu (2019), Chan *et al* (2017) Amuda-Yusuf *et al* (2020)

Despite the fact that some studies have identified the drivers and barriers of adoption of green information system and green building technologies, the empirical evaluation and prioritization of these factors affecting adoption of green information system by construction firms, especially in

developing countries, such as Nigeria is limited. By prioritizing the most important factors affecting adoption of green information system, construction stakeholders and construction firms can formulate policies that would focus on these important factors. This study therefore filled the gap in literature by evaluating the drivers and barriers of adoption Green information system by construction firms in South-south, Nigeria.

METHODOLOGY

This study assessed the drivers and barriers of adoption Green information system by construction firms in South-south, Nigeria. The population of this study comprised indigenous and multinational construction firms in the South-South region of Nigeria. Purposive sampling technique was used to select the firms that participated in this study. The study adopted a quantitative survey approach. Data was obtained using 44 copies of structured questionnaire. The data collected from the questionnaire was analyzed using simple percentage, Mean score and Mann–Whitney U test. The means and the mean ranks were used to provide the averages of the responses obtained and their corresponding ranking order while Mann–Whitney U test was used to determine whether differences exist in the mean scores of the responses for indigenous and multi-national firms. Using a five point likert scale, the decision rule is that mean scores that fall between 1.0 – 1.8 show a very low level of importance, 1.81 – 2.60 show a low level of importance, 2.61 – 3.40 shows a moderate level of importance, 3.41 – 4.20 shows a high level of importance, while 4.21 – 5.0 is regarded as a very high level of importance.

4.0 RESULTS AND DISCUSSION OF FINDINGS

4.1 Questionnaire Distribution and Response Rate

A total of 60 copies of questionnaire were distributed to construction firms across the six states in South-South, Nigeria, out of which only 44 with valid responses were returned. This a response rate of 73.3%. Grooves (2006) noted that a response rate of at least 50% is considered adequate for analysis, and reporting, a response of 60% is good and a response rate of 70% is very good. Hence the response rate of 73.3% in this study is considered very good and adequate.

The respondents for the survey came from the six states of the south-south part of Nigeria. Table 4.1 showed that Akwa Ibom state accounted for the highest number of respondents (22.7%), followed by Delta state (18.2%). Bayelsa and Cross River States came tied with the lowest number of the respondents (13.6%). This gives a fairly good distribution of construction firms among the south-south states in Nigeria. This implies that the results from this study represents the situation in South-south, Nigeria.

Table 4.1: Respondents states of operation

State of Operation	Frequency	Percent
Akwa Ibom	10	22.7
Bayelsa	6	13.6
Cross River	6	13.6
Delta	8	18.2
Edo	7	15.9
Rivers	7	15.9
Total	**44**	**100.0**

Source: Researcher's field data (2024)

Table 4.2 revealed that Indigenous firms formed a majority of the respondents of the study with a percentage of 70.5%, while multi-national firms only had 29.5% of the respondents. This gives a typical representation of the Nigerian construction industry which has a higher population of Indigenous firms compared to multi-national firms.

Table 4.2: Respondents by Type of firm

Type of Firm	Frequency	Percent
Indigenous	31	70.5
Multi-national	13	29.5
Total	**44**	**100.0**

Source: Researcher's field data (2024)

4.2. Factors affecting the adoption of Green Information System (IS)

The factors affecting the adoption of Green IS was evaluated based on the drivers and barriers affecting the adoption of Green IS. These drivers and barriers were identified in the literature review of this research and listed in Table 2.1 and Table 2.2.

4.2.1 Drivers Facilitating the adoption of Green Information System (IS)

Table 4.3 shows the evaluation of the 13 identified drivers affecting the adoption of green information system among construction firms. It compares the opinions of indigenous firms and multi-national firms using mean scores. The decision rule is that mean scores that fall between 1.0 – 1.8 show a very low level of importance, 1.81 – 2.60 show a low level of importance, 2.61 – 3.40 shows a moderate level of importance, 3.41 – 4.20 shows a high level of importance, while 4.21 – 5.0 is regarded as a very high level of importance.

Table 4.3 shows that cost saving from using green IS (3.64) is the most important driver affecting adoption of green information system by construction firms. The next most important driver is the relative advantage of using Green information system (3.54), followed by the competitive advantage of using green information system (3.51). The use of Green information system as a risk management and long-term sustainability strategy (2.53) is considered the least most important driver that affects the adoption of green information system by construction firms.

While cost saving from using green information system (3.90) is the most important driver affecting the adoption of green information system by indigenous construction firms, compliance with industry standards and certifications (3.62) was found to be the most important driver affecting the adoption of green information system by multi-national construction firms. The competitive advantage of using green information system (3.87) followed by the relative advantage of using green information system (3.77) are the second and third most important drivers affecting the adoption of Green information system by indigenous construction firms. For multi-national construction firms, cost saving from using Green IS (3.38) and the relative advantage of using green information system (3.31) are the second and third most important drivers. The use of green information system as a risk management and long-term sustainability strategy is considered the least most important driver that affects the adoption of Green IS by both indigenous (2.52) and multi-national (2.54) construction firms.

Table 4.3 shows that six of the drivers have a high level of importance on the adoption of green information system by indigenous construction firms. The six drivers are management support (3.61), commitment of resources (3.52), relative advantage of using Green IS (3.77), cost savings from using Green IS (3.90), pressure from customers/ clients to demonstrate a commitment to sustainability (3.45) and competitive advantage derived from using Green IS (3.87). Of the six drivers above, four of them are internal drivers, which shows that indigenous firms are driven by organizational goals and values. Compliance with industry standards and certifications (3.62) is the only driver that has a high level of importance for multi-national construction firms. Using green

information system as a risk management and long-term sustainability strategy is the driver that has low level of importance for both indigenous and multi-national construction firms.

For the combined mean scores, four drivers have been identified to have a high level of importance on the adoption of green information system by construction firms. They are relative advantage of using green information system (3.54), cost savings from using green information system (3.64), compliance with industry standards and certifications (3.505) and competitive advantage derived from using green information system (3.51). Only using green information system as a risk management and long-term sustainability strategy is the driver that has low level of importance for construction firms.

Table 4.3: Drivers affecting adoption of Green IS by indigenous and multi-national construction firms

Drivers affecting the adoption of Green IS by Construction firms	Indigenous			Multi-national			Combined		
	Mean	**Rank**	**Rmk**	**Mean**	**Rank**	**Rmk**	**Mean**	**Rank**	**Rmk**
The organization's management support for the use of Green IS	3.61	4	HLI	3.00	7	MLI	3.305	6	MLI
The commitment of resources for Green IS by the organization	3.52	5	HLI	2.85	9	MLI	3.185	8	MLI
The relative advantage of using Green IS	3.77	3	HLI	3.31	3	MLI	3.540	2	HLI
The cost savings from using Green IS	3.90	1	HLI	3.38	2	MLI	3.640	1	HLI
The compatibility of available Green IS with the operational requirements and standards of the construction firm	2.77	12	MLI	2.54	12	LLI	2.655	12	MLI
Using Green IS as a risk management and long-term sustainability strategy for the construction firm	2.52	13	LLI	2.54	12	LLI	2.530	13	LLI
Regulatory factors such as government regulations or incentives	3.32	10	MLI	2.77	10	MLI	3.045	11	MLI
Compliance with industry standards and certifications	3.39	7	MLI	3.62	1	HLI	3.505	4	HLI
Environmentally sustainable practice requirements from suppliers and business partners	3.32	10	MLI	3.31	3	MLI	3.315	5	MLI
Pressure from Investors who consider Environmental, Social, and Governance (ESG) factors when making investment decisions.	3.35	8	MLI	3.08	6	MLI	3.215	7	MLI
Pressure from customers/clients to demonstrate a commitment to sustainability	3.45	6	HLI	2.92	8	MLI	3.185	8	MLI
The competitive advantage derived from using Green IS	3.87	2	HLI	3.15	5	MLI	3.510	3	HLI
The awareness and pressure from the public on environmental issues	3.35	8	MLI	2.77	10	MLI	3.060	10	MLI
Overall Mean Score	**3.395**			**3.018**			**3.207**		

LLI – Low level of importance, MLI – Moderate level of importance, HLI – High level of importance
Source: Researcher's field data (2024)

4.2.2 Barriers Inhibiting the Adoption of Green Information System (IS) amongst Construction Firms.

Table 4.4 shows the evaluation of the 15 identified barriers affecting the adoption of green information system (IS) amongst construction firms. Table 4.4 shows that the lack of information about green information system models available (3.955) is the most influential barrier affecting the adoption of green information system by construction firms as it also ranked 1st by both indigenous and multi-national construction firms. The low awareness regarding green information system by industry practitioners was the next most influential barrier (3.720), followed by limited green information system products available in the market for use by construction firms (3.625). The least influential barrier affecting adoption of green information system by construction firms is the risk and uncertainties involved in adopting new technologies (2.800).

The lack of information about green information system models available (4.29) is the only barrier that has a very high influence on the adoption of green information system by indigenous construction firms. All the other barriers ranged from high level of influence to moderate level of influence. Apart from lack of information about green information system models available (3.62) which has a high level of influence, and the risk and uncertainties involved in adopting new technologies, (2.54) which has a low level of influence, all the remaining barriers have a moderate level of influence on multi-national construction firms.

For the combined mean scores, eight barriers were identified to have a high level of influence on the adoption of Green IS by construction firms. They are higher costs of using Green IS compared to traditional technologies (3.445), low level of awareness regarding sustainability issues (3.51), low level of awareness regarding Green IS among industry practitioners (3.72), lack of information about Green IS models available (3.955), limited human resources with skill sets required to operate and maintain Green IS infrastructure (3.475), barriers due to limited Green IS products available in the market (3.625), lack of interest in Green IS by clients of construction firms (3.445) and lack of management support (3.46). None of the identified barriers have a low level of influence on the adoption of Green IS by construction firms.

Table 4.4: Barriers affecting adoption of Green IS by indigenous and multi-national construction firms

Barriers affecting the adoption of Green IS by Construction firms	Indigenous			Multi-national			Combined		
	Mean	Rank	Rmk.	Mean	Rank	Rmk.	Mean	Rank	Rmk.
The higher costs of using Green IS compared to traditional technologies	3.81	6	HLI	3.08	8	MLI	3.445	8	HLI
The long repayment period for investments in Green IS	3.06	14	MLI	2.62	14	MLI	2.840	14	MLI
The risks and uncertainties involved in adopting new technologies	3.06	14	MLI	2.54	15	LLI	2.800	15	MLI
The low level of awareness regarding sustainability issues	3.94	3	HLI	3.08	8	MLI	3.510	4	HLI
The low level of awareness regarding Green IS among industry practitioners	4.06	2	HLI	3.38	3	MLI	3.720	2	HLI
The lack of information about Green IS models available	4.29	1	VHLI	3.62	1	HLI	3.955	1	HLI
Limited human resources with skill sets required to operate and maintain Green IS infrastructure	3.87	5	HLI	3.08	8	MLI	3.475	5	HLI
Resistance from persons without the skill sets required to operate and maintain Green IS infrastructure.	3.19	11	MLI	2.77	12	MLI	2.980	12	MLI
Bureaucratic challenges relating with	3.61	8	HLI	3.15	6	MLI	3.380	9	MLI

other companies or project team members who have not adopted Green IS									
The lack of government policies and guidelines supporting Green IS	3.16	12	MLI	2.92	10	MLI	3.040	11	MLI
Lack of government incentives for companies adopting Green IS	3.32	10	MLI	2.85	11	MLI	3.085	10	MLI
The resistance of individuals to voluntarily accept a change to a new system	3.06	14	MLI	2.69	13	MLI	2.875	13	MLI
Barriers due to the limited Green IS products available in the market for use by construction organizations.	3.87	5	HLI	3.38	3	MLI	3.625	3	HLI
The lack of interest in Green IS by clients of construction firms	3.58	9	HLI	3.31	5	MLI	3.445	8	HLI
Lack of organization's management support for the use of Green IS	3.61	8	HLI	3.31	5	MLI	3.460	6	HLI
Overall Mean Score	**3.566**			**3.052**			**3.309**		

LLI – Low level of influence, MLI – Moderate level of influence, HLI – High level of influence, VHI – Very high level of influence
Source: Researcher's field data (2024)

4.3 Mann Whitney U-Test for comparing opinions of factors affecting adoption of Green IS among indigenous and multi-national construction firms.

Mann Whitney U-test was used to test the hypothesis and the decision rule is such that if the p value is less than 0.05, it means the null hypothesis is rejected and the alternative hypothesis is accepted. Otherwise, the null hypothesis is accepted and the alternative hypothesis is rejected.

Table 4.5 shows the result of the Mann-Whitney U test comparing the opinions of drivers affecting adoption of Green IS between indigenous and multinational construction firms. From the table, the P-value is 0.011, which is less than the 0.05 significant level set for the test. This therefore implies that there is a significant difference in the opinion of indigenous and multi-national construction firms about the drivers that affect the adoption of Green IS.

Table 4.5: **Mann Whitney U Test for comparing the opinions of drivers affecting the adoption of Green IS between indigenous and multi-national construction firms**

Drivers affecting the adoption of Green Information Systems by Construction firms	Mean Rank	Sum of Ranks	Decision @ 0.05 significance level
Indigenous firms	17.31	225.00	
Multi-national firms	9.69	126.00	
Mann Whitney U	35.000		
Wilcoxon W	126.000		
Z	-2.542		
P- Value	0.011		**Reject**

Source: Researcher's field data (2024)

4.4 Mann Whitney U Test for comparing the opinions of barriers affecting the adoption of Green IS between indigenous and multi-national construction firms

The result of the Mann-Whitney U test comparing the opinions of barriers affecting the adoption of Green IS between indigenous and multinational construction firms is shown in Table 4.6. From the table, the P-value is 0.004, which is less than the 0.05 significant level set for the test. This therefore implies that there is a significant difference in the opinion of indigenous and multi-national construction firms about the barriers that affect adoption of Green IS.

Table 4.6: Mann Whitney U Test for comparing the opinions of barriers affecting the adoption of Green IS between indigenous and multi-national construction firms

Barriers affecting the adoption of Green Information Systems by Construction firms	Mean Rank	Sum of Ranks	Decision @ 0.05 significance level
Indigenous firms	20.13	302.00	
Multi-national firms	10.87	163.00	
Mann Whitney U	43.000		
Wilcoxon W	163.000		
Z	-2.887		
P- Value	0.004		**Reject**

Source: Researcher's field data (2024)

4.5 Discussion of Findings

The study shows that there is a significant difference in the opinions of the factors affecting adoption of Green IS by construction firms. The study reveals that cost savings, the relative advantage and the competitive advantage from the use of Green IS are the three most critical drivers affecting the adoption of Green IS by construction firms in South-South, Nigeria. These three drivers are primarily aimed at delivering economic gains to the construction companies. Even the pressure from suppliers and business partners to adopt environmentally sustainable practice ranked higher in importance to regulatory factors such as government regulations and incentives. This confirms the statement by Petzer *et al* (2011) who in their exploratory study on the adoption of Green IS in South Africa, stated that the dominant drivers of Green IS adoption appears to be economic rather than environmental or a response to regulatory pressure.

Regulatory factors such as government regulations and incentives ranked low in the drivers affecting the adoption of Green IS by construction firms in South-South, Nigeria. This is in contrast to the works of Chen et al (2009), Barrieu and Sinclair-Desgagne (2006) which considered laws and regulations among the most influential factors for motivating organizations to adopt green and environmentally friendly practices. This difference could be attributed to the weak nature of law enforcement in Nigeria, which make construction firms not to feel any pressure as a result of government regulations. The pressure from suppliers and business partners to adopt environmentally sustainable practice and the pressure from investors who consider Environmental, Social and Governance (ESG) factors when making investment decisions, ranked higher than government regulations and incentives. This confirms the statement from Omoyele and Owoyokun (2023) that pressures from investor preferences and societal expectations are pushing ESG to the forefront of business considerations and driving companies to incorporate these considerations into their strategic planning. It therefore means that a greater pressure from investors, business partners, suppliers and

client/customers will drive the adoption of Green IS by construction firms further than government regulations and incentives.

The study shows that knowledge barriers play a very important role in the adoption of Green IS by construction firms. The low level of awareness regarding sustainability issues, low level of awareness regarding Green IS and the lack of information about Green IS models available, which are knowledge barriers, were among the five most influential barriers affecting Green IS adoption by construction firms. This conforms with the work of Amuda-Yusuf *et al* (2020) who identified the lack of information about green products available and low level of awareness regarding sustainability issues as the second and third most critical barriers affecting adoption of green building technologies in Nigeria. A similar observation was made by Chan et al (2017) who identified knowledge related barriers as among the critical barriers to the adoption of green building technologies in developing countries.

The study reveals that the long repayment period for investments in Green IS and the risks and the uncertainties involved in adopting new technologies were the two least influential factors affecting the adoption of Green IS by construction firms. This shows that cost and risk related barriers ranked very low among the identified drivers. The shifting to green business practices such Green IS usually require additional costs, however the cost savings which construction firms hope to derive from the efficient use of organizational resources, renders these additional costs and other cost barriers less influential to the adoption of Green IS.

CONCLUSION

The study concludes that there is a significant difference in the opinions of construction firms on the factors affecting adoption of Green IS by construction firms. This implies that indigenous construction firms and multi-national construction firms do not have a common opinion on the factors affecting the adoption of Green IS in construction firms. The results of the study show that cost savings from using Green IS, the relative advantage of using Green IS and the competitive advantage of using Green IS as the three most important drivers affecting adoption of Green IS by construction firms, while the lack of information about Green IS models available, low awareness regarding Green IS by industry practitioners and limited Green IS products available in the market for use by construction firms are the three most influential barriers affecting the adoption of Green IS by construction firms.

The study concludes that the advantages the construction firms derive from using Green IS are the major drivers for its adoption, while awareness of Green IS and Green IS products by construction industry practitioners are major barriers which affect the adoption.

Based on the findings of the study, the following recommendations were made.

1. Improving the level of awareness of Green IS among construction stakeholders is required. Professional bodies of construction stakeholders should be involved in the awareness campaign of Green IS, through seminars, workshops and conferences.

2. Green IS solution providers should embark on targeted advertisements for construction stakeholders. They should also distribute Green IS product demos to construction firms and construction stakeholders to use.

3. Increased awareness and pressure from the public on environmental issues will help build pressure on construction companies to shift to more sustainable business practices such as the adoption Green IS. The increased awareness can be achieved through media advocacy and campaigns.

4. Government support through incentives for investors, business partners and suppliers who consider ESG factors and environmentally sustainable practices in their operations will exert pressure on construction firms who depend on them to shift to more sustainable construction practices such as the adoption of Green IS.

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BARRIERS TO GREEN BUILDING IMPLEMENTATION IN NIGERIA

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Abstract
A global shift towards sustainable development and environmentally conscious practices has prompted the urgency of addressing climate change. The construction industry, known for its significant environmental impact, is a major contributor to greenhouse gas emissions. Green building technologies (GBTs) have emerged as effective solutions to mitigate the environmental consequences of construction. However, the adoption of GBTs in developing countries, including Nigeria, faces numerous barriers. This paper investigated critical barriers to the adoption of green building technologies in Nigeria, by incorporating a cross-sectional survey focusing on construction industry professionals within Kano state metropolis. A systematic literature review was conducted and 31 barriers to green building peculiar to developing countries evolved and a questionnaire survey was employed to identify and understand these barriers. Data collected from the survey were analysed to determine the influence of each barrier and identify principal barrier factors. The research tool employs principal component analysis for comprehensive data analysis. Reliability analysis of the questionnaire was conducted using Cronbach's alpha coefficient of the 31 barriers (0.84667) and demonstrated that the assessment was trustworthy, indicating the suitability of the sample for further analysis. Hence Principal Factor Analysis PCA was conducted to understand better, these barriers. The result of the PCA shows that about 90.32% (28 out of 31) of the barriers peculiar to developing countries are common to the Nigerian construction industry. Out of the barriers that are relevant to Nigeria, 57.14% (16 out of 28) are determined to be significant having a Mean Item Score (MIS) score exceeding 3.5
Keywords: Barriers, Green Building, Implementation, Nigeria

1. Introduction

The construction industry makes a substantial contribution to the release of greenhouse gases into the atmosphere, with building operations accounting for 27% of them and building materials and construction for another 20% (Global status report for Building and Construction, 2021). At the moment, the world faces significant problems in lowering emissions of greenhouse gases and coping effectively with the repercussions of climate change. The construction industry in both developed and emerging countries are highly concerned about this.

Sustainable building is one of several practical and viable solutions for lowering greenhouse gas emissions that might be changed to account for human-caused climate change (Climate Change: Synthesis Report, 2023). Sustainability, according to RockstrÖm et al., (2009), is crucial for the future of our planet as it addresses rising concerns of climate change, environmental degradation, and resource depletion. The United Nations recognized the importance of sustainable development and outlined 17 sustainable development goals (SDGs) which are set to be achieved by 2030. Green building practices align with several of these SDGs, including affordable and clean energy, sustainable cities and communities, responsible consumption and production, and climate action.

Green building technologies (GBTs) have emerged as an effective strategy for improving the sustainability of the construction industry and reducing the environmental impact of the built environment (World Green Building Council (WorldGBC), 2017; Chuen Chan et al, 2018). The construction industry may significantly reduce its greenhouse gas emissions by adopting sustainable construction techniques, such as using green building technologies. (Osuizugbo et al., 2020). Green building practices are an essential component of sustainable development. Green buildings may save 20–30% on energy expenses, 10–30% on water costs, and 10–20% on maintenance costs throughout the course of their lifetime, according to research by Green & Allen (Green & Allen Hamilton, 2015). These savings are significant contributors to the economic sustainability of a building. Green

buildings are created with the intention of reducing their negative effects on the environment while increasing their energy effectiveness, water conservation, and interior air quality. According to Choong et al. (2019), green construction techniques may encourage sustainable growth and lessen the environmental effect of buildings.

In Africa the predicted population growth and urbanization make the demand for new buildings even more pressing. Africa is projected to add 1.1 billion people by 2050, accounting for more than 75% of global population growth. There is a substantial demand for new buildings to handle this increase, with 80% of those that will exist in 2050 yet to be completed (Africa manifesto for sustainable cities & the built environment, 2022). This has created an opportunity as well as a challenge to build sustainably. In light of this, The Africa Manifesto for Sustainable Cities and the Built Environment has been released by the World Green Building Council's (WorldGBC) Africa Regional Network. The manifesto outlines specific and practicable initiatives, such as green building code adoption and enforcement to enhance energy efficiency standards and promote access to clean and distributed renewable energy sources.

Green Building Councils (GBCs) in Africa are focusing on the implementation of the priority areas detailed in the Africa Manifesto for Sustainable Cities and the Built Environment (WGBC, 2022.). The Green Building Council Nigeria (GBCN) announced in the early quarter of 2022 that it has obtained membership in the World Green Building Council, enabling it to establish its formal position as a Member of the World GBC (GBCN 2022).

As the most populous country in Africa, Nigeria confronts a substantial infrastructure and housing deficit of approximately 17 million homes within its construction industry. This should not come as a surprise considering the fact that Nigeria, is confronting significant urbanization issues like many other developing countries. Nigeria's urban population will nearly triple by 2050, United Nations Department of Economic and Social Affairs (UN DESA), making it one of the world's ten cities with the fastest rate of growth between 2018 and 2035. This is the most significant urbanization in Africa, driven by high population increase and rural-urban migration. This presents a challenge of housing deficit. it's reported that the housing deficit is estimated to continue to grow by about 2 million annually (UN Population division world urbanization prospect, 2014). There is therefore a need to leverage sustainable construction practices such as green building in order to contribute to the global sustainability requirement. Ahmed et al., (2021a)conducted research on the current state of green building in Nigeria and found that it is not widely adopted. This presents an opportunity to build sustainably, but also a challenge.

There has been a lot of research on the barriers to the adoption of GBTs in other developing nations like Ghana (Lam et al., 2009; Hwang and Tam, 2012), but little has been done to examine the obstacles to the adoption of GBTs in Nigeria. Barriers to GBTs are one area that academics in Nigeria have not studied enough (Ebekozien, Ikuabe, et al., 2022). Green Building Council of Nigeria (GBCN), National Building Efficiency Code, Nigeria Building Code (NBC), and National Adaptation and Plan (NASPA) are the green building policies in Nigeria. Despite the existence of these policies, there is a lack of full implementation of such policies (Abisuga & Okuntade, 2020). In the early third quarter of 2022, the Green Building Council Nigeria (GBCN) announced that it has attained membership of the World Green Building Council and is now officially recognized as a Prospective Member of the World GBC (GBCN 2022).

A number of research on GBTs have been conducted in Nigeria. The barriers to green building adoption need to be first identified and overcome for the promotion of GBTs to be effective and efficient (Mao et al., 2015). Despite extensive research, there remains a noticeable lack of comprehensive coverage of research on green building barriers across all regions in Nigeria. This research aims to fill that gap and provide insights that will inform policies and strategies for

promoting GBT adoption and achieving sustainable urban development in Nigeria. The study will attempt to fill that gap by focusing on a region of Nigeria where research on challenges to green building adoption has not been explored. The outcome of the research is expected to provide insights that will inform policies and strategies for promoting GBT adoption and achieving sustainable urban development in Nigeria.

2. Global and local insight to green building barriers

A number of green building researchers have investigated the primary barriers to GBTs in construction. Earlier studies have shown that the adoption of GBTs barriers exists in both developed and developing countries. (Chan et al., 2018a). This study's background and context have been influenced by a comprehensive review of literature focused on barriers to green building implementation. The review encompasses studies conducted in both developed and developing countries, providing insights into the challenges faced globally. The following summarize the relevant literature that has informed this study:

2.1 Barriers in Developed Countries: Numerous studies have explored barriers to green building adoption in developed countries. Researchers like Bond (2011), Ahn et al. (2013), Williams and Dair (2007), Hwang et al. (2017), Zhang et al. (2012), and Winston (2010) have identified barriers such as high costs, lack of information, resistance to change, limited expertise, and inadequate policies. These barriers are observed in various countries including the United States, Australia, New Zealand, the UK, Singapore, and Canada. Survey data in the US (Darko & Chan, 2017) also highlighted resistance to change, lack of knowledge, high material costs, and inadequate training as significant barriers.

2.2 Barriers in Developing Countries: Apart from China and Malaysia, it was discovered that few studies on the barriers to GBTs in developing nations had been done (Chan et al., 2018). It is crucial to understand the barriers to the adoption of GBTs in different nations because rules and conditions vary from one country to the country (Aktas & Ozorhon, 2015). This will aid in eradicating GBT obstacles. Specific challenges vary, but common barriers include lack of awareness, government support, technical know-how, and high costs. For instance, Malaysia faces issues related to lack of credit resources, risk of investment, and lack of demand (Samari et al., 2015), while China's barriers include lack of government incentives and reliance on traditional construction (Wang et al., 2021).

2.3 Barriers in Nigeria: Green building practices in Nigeria encounter barriers such as lack of awareness, technical know-how, government support, and high costs (Abisuga & Okuntade, 2020; Alohan & Oyetunji, 2021; Ebekozien et al., 2022). For example, **Alohan & Oyetunji, (2021)** looks at stakeholders' awareness and understanding of the barriers and benefits of green building technology in sustainable construction by investigating the perspectives of parties involved in Nigeria's construction and real estate markets, within Benin City and identified; “Lack of awareness by developers”,” non-availability of local materials and standard for structural control of green building”, and “Lack of adequate knowledge and technical know-how by professionals to handle the job” as the four major barriers to green building in Nigeria.

Findings from (Ebekozien, Ikuabe, et al., 2022) identified twelve major barriers to green building implementation in Nigeria five of which are “lack of institutional framework, high-cost upfront, lax of government participation”, “absence of incentives”, and “lack of expertise and absence of locally based rating tool”. **(Abisuga & Okuntade, 2020)** also identified “lack of political will, lack of leadership”, “The absence of demand for green production”, “lack of sustainable norms and practices”, “lack of commitment from the organization's leadership”, “poor stakeholder communication and information sharing” ,“lack of understanding of the effects of the environment”, “Public ignorance about the advantages of green practices”, “lacking a green consciousness”, “Low standards and policies for green buildings”, “Lack of expert knowledge about environmental issues”,

"country's level of poverty", "lack of production knowledge for green construction products", "the financial impact of green products", "Low levels of innovation and design", "lack of client and user interest", "Lack of green technologies", and "ineffective enforcement of policies", as barriers to green building implementation in Nigeria. Similarly, in the North-central region of Nigeria, Wasiu Mayowa et al., (2020)identified "Lack of institutions to formulate policies and set guidelines", "Lack of information about green products and high-performance building systems", "Low level of awareness with regard to sustainability issues", Human resource and client knowledge, and Lack of knowledge about Green Building Technologies are barriers identified.

Limited green building education, absence of local standards for green structures, and lack of political will contribute to these barriers. The review highlights the common barriers and recommends strategies to address them.

a) **Lack of Awareness, Knowledge, and Technical Know-How**

Among the recurring challenges highlighted in the research is a lack of awareness and information of green building practices and their advantages among developers, experts, and the general public. This is due to a scarcity of green building education and training programs in Nigeria. Additionally, there is a lack of technical know-how among professionals to handle green building jobs due to the absence of local standards for structural control of green buildings (Abisuga & Okuntade, 2020; Alohan & Oyetunji, 2021; Ebekozien, Ayo-Odifiri, et al., 2022). As a result, there is a need to design and implement green building education and training programs to raise awareness and understanding among experts and the general public. Furthermore, there is a need to set local standards for structural management of green buildings in order to strengthen professional technical knowledge.

b) **Lack of Government Support**

Green building implementation in Nigeria is also hampered by a lack of government support, lack of political will, and lack of leadership commitment. The Nigerian government has not adopted the necessary regulations and policies to assist green construction practices, and current policies are not being followed or enforced. This is due to the lack of incentives and low demand for green production from both clients and users (Abisuga & Okuntade, 2020; Ebekozien et al., 2022). To overcome this barrier, the Nigerian government needs to implement policies and regulations that support green building practices. Additionally, rewards ought to be given to encourage the demand for green production from both clients and users.

c) **Cost Implications and Lack of Production Knowledge for Green Building Products**

The cost implications of green products and the Lack of Production Knowledge for Green Building Products are also identified as barriers. Green building products are generally expensive and require specialized knowledge and expertise for production, which is lacking in Nigeria (Abisuga & Okuntade, 2020; Ebekozien, Ayo-Odifiri, et al., 2022). To overcome this barrier, there is a need to develop local expertise in green building product production to reduce the cost of green building products. Furthermore, the government and private sector should collaborate to develop affordable green building products.

Green construction practices are being implemented in Nigeria despite a lack of awareness, expertise, technical know-how, government backing, political will, leadership commitment, and financial implications. To overcome these barriers, education and training programs focusing on green construction practices are needed to raise awareness and understanding among professionals and the general public. Furthermore, the Nigerian government should create rules and regulations that promote green construction practices, as well as provide incentives to increase demand for green

products. Furthermore, in order to minimize the cost of green building materials, local competence in green building manufacturing must be developed.

The Nigerian government's efforts to promote green building through policies like the National Policy on Climate Change and initiatives like the Nigerian Energy Support Programme have aimed to address these barriers (Oloyede, 2015).

2.2 Brief History and Status of sustainable Buildings in Nigeria

Nigeria's urbanization in the early 2000s led to increased housing demand and energy use, prompting a need for sustainable development. Government policies like the National Policy on Climate Change were introduced to promote renewable energy and sustainability. Notable initiatives include the Nigerian Energy Support Programme, the National Building Code, and the Green Building Council of Nigeria (GBCN). These initiatives aim to enhance energy efficiency, promote sustainable practices, and create a supportive framework for green building in Nigeria.

3. Methodology

The methodology employed encompasses a systematic literature review to identify major barriers, a questionnaire survey to gauge stakeholders' perceptions, and statistical analyses such (factor analysis) to assess the level of influence of each barrier

3.1 data collection methods, tools, and procedures.

To identify barriers, an extensive literature search was conducted using Scopus journals, focusing on articles published between 2017 and 2022. A total of 66 relevant articles were initially identified, with 31 specifically addressing barriers to green building. This literature review established a foundation for understanding barriers in the context of green building technology.

Principal Component Analysis (PCA) was utilized to uncover underlying trends among responses and identify relationships between barriers. PCA is a dimension reduction method that provides a comprehensive view of interrelated variables.

3.2 data analysis techniques.

The research employed PCA to assess barriers to green building implementation in Nigeria. These techniques included the Mean item score and Principal Component Analysis (PCA) with varimax rotation using SPSS software.

Principal Component Analysis (PCA): PCA, a multivariate statistical method, aimed to discover underlying trends among responses. It's a dimension reduction technique that transforms original variables into orthogonal (uncorrelated) principal components. These components were analyzed

through eigenvalue decomposition, extraction, and interpretation. PCA aimed to uncover latent structures and relationships among the identified barriers.

The study's data collection methods included snowball sampling to select knowledgeable construction industry professionals in Nigeria. The sample size was determined by information saturation, ensuring comprehensive coverage of the topic.

The questionnaire consisted of three sections:

Background and Demographics (Section A): Gathering participants' demographic information, such as age, education level, occupation, industry experience, and organization type.

Barriers to Green Building Implementation in Nigeria (Section B): The core of the questionnaire, assessing the importance of 31 potential barriers using a 5-point scale. Participants ranked each barrier's significance, contributing to the identification and prioritization of barriers.

These data analysis techniques and the structured questionnaire provided a comprehensive approach to understanding barriers to green building implementation in Nigeria, integrating findings from both quantitative and qualitative perspectives.

4 Analysis and Results

4.1 Reliability Analysis -

Cronbach's alpha has been a popular method for measuring the reliability of scales. Cronbach's alpha does this by calculating the average correlation or internal consistency of components in a survey questionnaire to assess its reliability. The Cronbach's alpha coefficient (a) has a value between 0 and 1 and may be used to describe the reliability of components extracted from multi-point and/or dichotomous structured scales or questionnaires (Santos, 1999). The higher the value, the more reliable the scale of measurement. However, the general rule is that the value must be more than 0.70 in order for the scale to be reasonable (Thorndike, 1995).

The computed value for the 31 GBTs barriers could be seen in table 1. The result was obtained using the SPSS 20.0 statistical software, the table shows that he assessment using the five-point Likert scale was trustworthy. As a result, the gathered sample may be considered as a whole and therefore eligible for additional ranking analysis as well as factor analysis (Mao et al., 2015).

Table 1: Reliability test

Chronbachs Alpha	No. of items
0.84667	31

4.2 Factor Analysis

Malhotra and Birks (2006) observed that when conducting factor analysis, researchers often make use of the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity to assess the suitability of the sample for analysis. According to Mane and Nagesha (2014), if Bartlett's test of sphericity yields a significant result (with a p-value of 0.05 or less) and the KMO index is above 0.5, then the dataset is typically considered appropriate for factor analysis. In line with this, in the present study, the KMO test produced a value of 0.595, indicating sample adequacy, and Bartlett's test of sphericity exhibited a statistically significant outcome (chi-square = 972.142, and p=0.000), as displayed in Table 2 Hence, the conditions for applying factor analysis are satisfied.

Table 2 : KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.595
Bartlett's Test of Sphericity	Approx. Chi-Square	972.142
	Df	465
	Sig.	0.000

Table 3: Descriptive statistics (mean item score)

	Mean	Std. Deviation	Analysis N
GB1	3.71	1.170	63
GB2	4.00	1.150	63
GB3	3.83	0.976	63
GB4	3.78	1.170	63
CRB1	3.21	1.124	63
CRB2	3.30	1.227	63
CRB3	3.22	1.408	63
CRB4	3.62	1.224	63
KRB1	3.52	1.134	63
KRB2	3.62	0.941	63
KRB3	3.62	1.038	63
KRB4	3.67	1.122	63
MB1	3.52	1.105	63
MB2	3.90	1.103	63
MB3	3.90	1.088	63
MB4	3.73	1.125	63
MB5	4.10	0.837	63
HB1	3.25	1.204	63
HB2	3.21	1.259	63
HB3	3.00	1.150	63
TCB1	3.30	1.087	63
TCB2	3.46	1.162	63
TCB3	3.59	1.173	63
TCB4	3.21	1.180	63
TCB5	3.48	1.203	63
TCB6	2.79	1.297	63
OB1	2.83	1.225	63
OB2	3.06	1.330	63
OB3	3.00	1.283	63
OB4	3.49	1.256	63
OB5	3.56	1.133	63

State what GB1 to GB4 represent under this table. Also state what CRB1 to CRB4 represent. Ditto others.

Explanation of Eigenvalue variance

In Table 4, the analysis revealed nine components having eigenvalues greater than one. Only Items having a factor loading of 0.5 or more were included in each factor. This nine-factor solution managed to account for the complete variability within the 31 barriers to green building implementation in Nigeria. These variables accounted for 71.546% of the total variance. Meyers et al. (2006) supported that a suitable threshold for cumulative variation is not to go below 50%, whereas Malhotra and Birks (2017) proposed a higher limit of 60% variability. As a result, the model's reliability may be considered adequate.

The distribution of variance across the nine barrier factors is presented in Table 4. The first component comprised five items and explained 21.548% of the variance, the second, third fourth and fifth barrier factors contributed 9.815%, 8.677%, 6.512%, and 6.233%, respectively. The sixth factor with two items contributed 6.024%, the seventh factor with one item contributed 4.875%, the eighth component with one item contributed 4.270% and the ninth with 2 factors 3.593%.

To validate the outcomes of the factor analysis, the scree plot was considered, as recommended by Nunayon et al. (2020). The scree plot displays eigenvalues for each barrier, with the initial eigenvalue explaining the most substantial variance and the final eigenvalue explaining the least. The analysis focused on identifying a breakpoint where the slope of the scree plot, as depicted in Figure 1, began to level off. The number of variables retained corresponded to the count of data points above this line of breakpoint, as depicted in Figure 1. Any data value that is precisely on the breakpoint was excluded. While challenging cases sometimes occur with clustered data points, such an issue did not arise in the current study (Malhotra and Birks, 2006; Hair et al., 2010).

In this study, eigenvalues were primarily utilized for factor extraction due to their widespread applicability. K'Akumu et al. (2013) emphasized their utility in establishing criteria for selecting crucial elements in factor analysis, using an eigenvalue greater than one as an indicator of significant factors.

Table 4: Total Variance Explanation

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.680	21.548	21.548	6.680	21.548	21.548	3.116	10.051	10.051
2	3.043	9.815	31.363	3.043	9.815	31.363	3.085	9.953	20.004
3	2.690	8.677	40.040	2.690	8.677	40.040	2.914	9.400	29.404
4	2.019	6.512	46.551	2.019	6.512	46.551	2.868	9.253	38.657
5	1.932	6.233	52.785	1.932	6.233	52.785	2.802	9.040	47.697
6	1.867	6.024	58.809	1.867	6.024	58.809	2.027	6.537	54.235
7	1.511	4.875	63.684	1.511	4.875	63.684	1.951	6.293	60.527
8	1.324	4.270	67.953	1.324	4.270	67.953	1.774	5.724	66.251
9	1.114	3.593	71.546	1.114	3.593	71.546	1.641	5.295	71.546
10	0.964	3.108	74.654						
11	0.899	2.901	77.555						
12	0.841	2.713	80.268						
13	0.715	2.307	82.575						
14	0.661	2.133	84.708						
15	0.552	1.779	86.487						
16	0.511	1.648	88.134						
17	0.461	1.487	89.621						
18	0.422	1.362	90.983						
19	0.414	1.336	92.319						
20	0.369	1.192	93.511						
21	0.337	1.088	94.599						
22	0.267	0.863	95.461						
23	0.255	0.821	96.283						
24	0.225	0.726	97.009						
25	0.206	0.665	97.674						
26	0.185	0.597	98.271						
27	0.169	0.547	98.818						
28	0.133	0.430	99.248						
29	0.100	0.321	99.569						
30	0.077	0.249	99.818						
31	0.056	0.182	100.000						

Extraction Method: Principal Component Analysis.

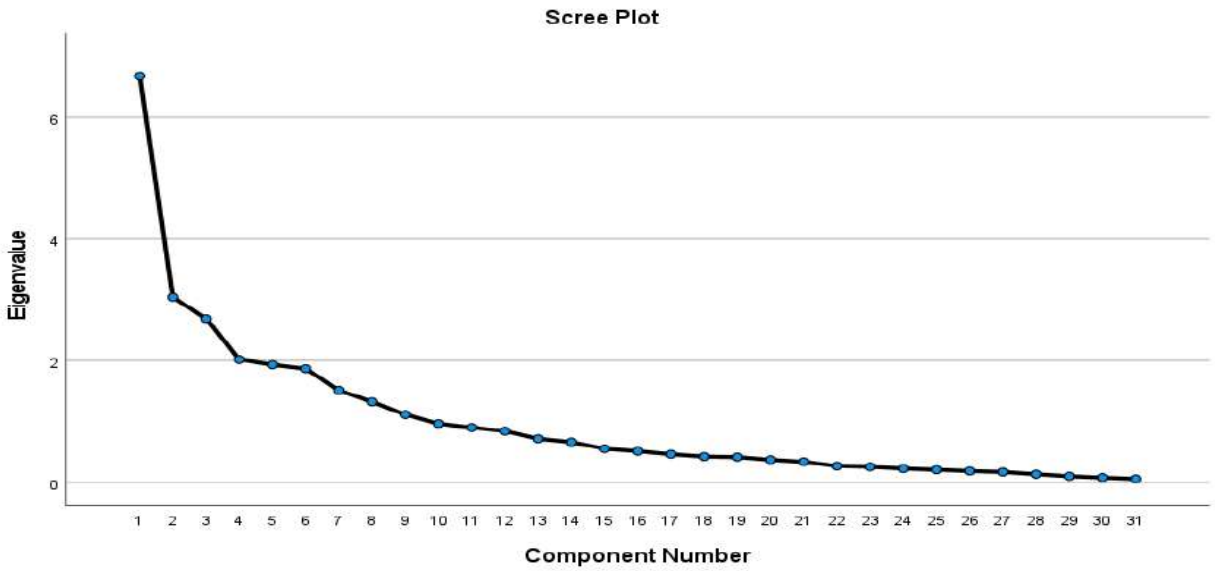

Figure 1: scree plot

4.3 Component matrix.

As stated by Yong and Pearce (2013), examining a correlation matrix offers insight into whether there exists a structured association among the 31 barriers. The analysis is suitable with confidence if the correlations range above 0.3 and none exceed 0.9, as advised by Tabachnick and Fidell (2007) and Field (2009).

For this study, a thorough examination of the matrix of correlation for the 31 barriers, as presented in Table 5, confirms that the correlation coefficients among these variables adhere to this specified criterion. The correlation matrix reveals that each variable has a correlation coefficient with other variables that is greater than 0.3. This, in turn, emphasizes that the barriers to Green building implementation are truly interrelated, demonstrating strong correlations between a number of these factors. The insights gleaned from the correlation matrix illustrate that each variable maintains a correlation coefficient exceeding 0.3 with other variables. This, in turn, underscores that the barriers to BIM adoption are indeed interconnected, showcasing pronounced relationships among a number of these variables

Table 5: Component matrix

	Component								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
TCB5	0.647	-0.334	0.046	-0.377	0.080	-0.125	-0.092	-0.078	0.180
HB2	0.645	0.059	-0.130	0.220	-0.088	-0.234	-0.188	-0.319	-0.097
MB4	0.637	0.161	-0.079	-0.286	-0.143	-0.079	0.204	-0.075	0.151
HB1	0.622	0.268	-0.337	0.189	-0.059	-0.321	-0.209	-0.068	0.134
OB3	0.616	-0.127	0.336	-0.064	-0.269	0.040	0.154	0.182	-0.286
KRB4	0.593	-0.075	-0.192	-0.249	-0.368	0.214	-0.079	-0.118	0.114
OB2	0.592	-0.265	0.258	-0.270	-0.276	0.055	0.311	0.163	-0.046
TCB4	0.584	-0.121	0.244	0.129	0.068	-0.184	-0.146	0.104	-0.120
HB3	0.577	-0.084	0.066	0.081	0.152	-0.497	-0.350	-0.171	-0.005
TCB2	0.569	-0.301	-0.079	0.094	0.390	0.274	-0.274	0.212	0.132
KRB2	0.563	0.148	-0.369	-0.080	0.052	0.234	-0.078	-0.306	-0.129
KRB3	0.562	0.051	-0.216	-0.153	0.131	0.187	-0.085	0.093	-0.545
TCB1	0.555	-0.322	0.079	-0.161	0.259	0.351	-0.069	0.130	0.191
TCB3	0.498	-0.313	0.123	0.073	0.401	0.123	-0.022	-0.011	0.298
CRB4	0.457	0.074	0.292	0.039	-0.375	0.374	-0.406	0.220	0.057
OB5	0.413	0.155	0.141	-0.349	0.409	-0.026	0.379	-0.128	-0.324
GB4	0.124	0.753	0.145	-0.127	-0.034	-0.157	-0.071	0.080	0.176
GB2	0.150	0.714	0.322	0.023	0.157	-0.058	-0.015	0.197	0.128
GB3	0.140	0.679	0.153	-0.233	-0.004	0.031	0.076	0.278	-0.014
GB1	0.209	0.664	0.317	0.033	0.123	0.251	-0.156	-0.161	0.230
MB5	0.372	0.012	-0.670	-0.123	-0.322	-0.138	0.080	0.218	0.134
MB3	0.381	0.207	-0.623	0.148	-0.039	-0.116	0.371	-0.009	0.024
MB2	0.334	0.296	-0.431	0.181	0.016	-0.170	0.157	0.375	0.032
MB1	0.318	0.059	0.016	0.538	0.513	-0.035	0.179	0.071	-0.028
CRB3	0.469	0.089	0.189	0.512	-0.346	0.183	-0.160	0.214	-0.296
CRB2	0.288	0.006	0.420	0.488	0.053	0.039	0.442	-0.010	0.006
OB4	0.398	0.066	0.372	-0.482	0.207	-0.273	0.127	-0.114	-0.015
TCB6	0.347	-0.299	0.237	0.274	-0.084	-0.568	0.014	-0.012	0.019
KRB1	0.295	0.110	-0.410	0.202	0.256	0.522	0.186	-0.167	0.045
OB1	0.322	-0.253	0.239	0.213	-0.369	0.102	0.448	-0.060	0.373
CRB1	0.182	0.282	0.226	0.173	-0.301	0.206	0.034	-0.657	-0.077

Extraction Method: Principal Component Analysis.

a. 9 components extracted.

Table 5 looks into the discussion and analysis of the extracted factors using the varimax rotation method. The connection strength between the factor score and each variable is termed factor loading, as outlined by Nunayon et al. (2020). This factor loading aids in calculating eigenvalues for each element and their similarities to individual variables, as indicated by Mane and Nagesha (2014).

Enshassi et al. (2018) proposed a crucial step in the interpretation process—rotating the factor loading matrix via the varimax method. The objective is to minimize smaller loadings towards zero while maximizing larger loadings towards unity. Pallant (2005) observed that when a variable's factor loading is substantial (loading > 0.5) on only one component, it often signifies a clear component structure. Enshassi et al. (2018) reinforced this, adopting a loading threshold > 0.5 for items allocated to each factor using a sample of 76. Brown's study in 2009 emphasized that drivers with factor loadings nearing 1 are pivotal for factor interpretation, while those near 0 hold less significance. However, variables boasting loadings of 0.5 or higher were chosen and employed to appropriately label the factor they contribute to.

Table 6: **Rotated component matrix**

	Component								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
OB2	**0.827**	0.073	0.180	-0.059	0.075	0.178	0.036	-0.020	0.039
OB3	**0.675**	0.007	0.071	0.016	0.195	0.401	0.149	0.009	0.208
OB1	**0.529**	0.109	0.112	-0.141	-0.026	0.134	0.314	0.210	-0.524
OB4	**0.521**	-0.181	0.130	0.311	0.325	-0.337	-0.041	-0.003	0.206
MB4	**0.521**	0.398	0.172	0.242	0.192	-0.077	-0.095	0.214	0.042
KRB4	0.421	0.339	0.281	-0.039	0.083	0.230	-0.345	0.345	0.010
MB3	0.053	**0.821**	-0.026	-0.015	0.030	-0.120	0.173	0.138	0.098
MB5	0.165	**0.810**	0.030	-0.102	0.059	0.068	-0.295	-0.079	-0.032
MB2	-0.028	**0.689**	0.016	0.207	0.077	0.097	0.161	-0.213	0.086
HB1	-0.047	**0.587**	0.138	0.221	0.563	0.120	-0.036	0.181	0.019
TCB2	0.002	0.113	**0.813**	-0.079	0.171	0.212	0.077	-0.086	0.165
TCB1	0.309	0.003	**0.759**	-0.045	0.017	0.096	0.001	-0.001	0.094
TCB3	0.150	-0.017	**0.708**	-0.049	0.218	-0.065	0.223	0.027	-0.049
TCB5	0.488	0.078	**0.506**	-0.067	0.411	-0.121	-0.227	0.037	0.058
KRB1	-0.143	0.403	0.414	-0.038	-0.309	-0.006	0.244	0.399	0.202
GB2	-0.020	-0.007	-0.025	**0.823**	0.049	0.056	0.182	-0.040	0.020
GB4	-0.007	0.128	-0.154	**0.793**	0.091	-0.010	-0.079	0.052	-0.035
GB1	-0.087	-0.112	0.172	**0.744**	-0.019	0.093	0.074	0.386	-0.027
GB3	0.151	0.119	-0.115	**0.731**	-0.139	0.064	-0.026	-0.081	0.166
HB3	0.055	0.071	0.219	0.049	**0.836**	0.003	-0.010	0.055	0.107
TCB6	0.239	0.000	-0.048	-0.172	**0.677**	0.058	0.260	-0.132	-0.191
HB2	0.075	0.311	0.102	-0.002	**0.616**	0.164	0.055	0.389	0.141
TCB4	0.260	-0.005	0.250	0.055	**0.509**	0.257	0.180	-0.054	0.151
CRB3	0.114	0.106	-0.003	0.055	0.192	**0.813**	0.293	0.130	0.099
CRB4	0.233	-0.075	0.294	0.245	0.063	**0.727**	-0.192	0.137	-0.062
CRB2	0.267	-0.062	0.038	0.072	0.074	0.143	**0.744**	0.129	-0.141

MB1	-0.180	0.162	0.299	0.077	0.200	-0.010	**0.695**	-0.030	0.138
CRB1	0.098	-0.125	-0.187	0.129	0.073	0.135	0.103	**0.808**	-0.036
KRB2	0.065	0.397	0.294	0.029	0.104	0.046	-0.108	0.487	0.380
KRB3	0.194	0.254	0.213	-0.007	0.094	0.236	-0.030	0.077	**0.731**
OB5	0.427	0.000	0.127	0.221	0.056	-0.360	0.238	0.096	**0.568**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 12 iterations.

Furthermore, Table 6 presents the interpretation derived from the data outlined in Table 5. The outcomes in Table 6 underscore that out of the 31 identified barriers, 28 were specific to the Nigerian construction industry. These barriers encompass various categories, with six falling under Technical and capacity barriers (TCB), five each under other barriers (OB) and Market-related barriers (MB), four each under Government barriers, (GB), and Cost and risk-related barriers (CRB), three under human barriers (HB), and one under Knowledge training and education-based barriers (KRB). The 28 barriers that are specific to Nigeria according to the analysis are outlined in table 7 below

SN	FACTOR NAMING	BARRIER	BARRIER CODE	FACTOR LOADING
1	Technical and capacity barriers	Insufficient technology to support the execution of sustainable building initiatives in Nigeria	TCB2	**0.813**
2		Lack of technology for the delivery of sustainable building projects in Nigeria	TCB1	**0.759**
3		Insufficient experience of contractors in the construction and implementation of green constructions in Nigeria	TCB3	**0.708**
4		Lack of green building technologies database and information in Nigeria	TCB5	**0.506**
5		Non-availability of local green materials in Nigeria	TCB6	**0.677**
6		Difficulties in providing green building technical training for project staff in Nigeria	TCB4	**0.509**
7	Other barriers	The high expense of preparing documents for certification in Nigeria	OB2	**0.827**
8		Developers fear of requirements in the approval checklist in Nigeria	OB3	**0.675**
9		Long payback period as a barrier to green building implementation in Nigeria	OB1	**0.529**
10		Lack of legal backing for green building implementation in Nigeria	OB4	**0.521**
11		Lack of Standards for managing the structural aspects of GBT in Nigeria	OB5	**0.568**
12	Market-related barriers	Lack of databases and information on green building technologies in Nigeria	MB4	**0.521**
13		Lack of information and awareness about existing green buildings and the benefits of green building in Nigeria	MB3	**0.821**
14		Low awareness among clients and society in general about the importance of sustainability in Nigeria	MB5	**0.810**
15		Lack of interest from clients and market demand in Nigeria	MB2	**0.689**
16		Unavailability of GBTs in the local market in Nigeria	MB1	**0.695**
17	Government barriers	Lack/poor Green Building Policy and Regulation in Nigeria	GB2	**0.823**
18		Fewer green building codes and Regulations in Nigeria	GB4	**0.793**
19		Lack of government support and Incentives for green building implementation in Nigeria	GB1	**0.744**
20		Inadequate support and recognition of green building technologies by authorities/governments in Nigeria	GB3	**0.731**
21	Cost and risk-related barriers	Poverty level in Nigeria as a barrier to green building implementation	CRB3	**0.813**
22		Obstacles in acquiring financial support from banks to back sustainable projects in Nigeria	CRB4	**0.727**
23		Risk and Uncertainty of adopting new technology in Nigeria	CRB2	**0.744**
24		High cost associated with GBT in Nigeria	CRB1	**0.808**
25	Human barriers	Resistance to change as a cultural barrier to green building implementation in Nigeria	HB1	**0.587**
26		Unavailability of GBT suppliers in Nigeria	HB3	**0.836**
27		Lack of skilled and competent labour for green building implementation in Nigeria	HB2	**0.616**
28	Knowledge training and education-based barriers	Lack of reliable green building technologies research and education in Nigeria	KRB3	**0.731**

Rotated component factor interpretation of 28 peculiar barriers

5. Conclusion

This study has undertaken a comprehensive assessment of the barriers to green building implementation in Nigeria, drawing from a systematic literature review and questionnaire survey results. The study has identified various barriers, including government-related barriers, cost and risk-related barriers, knowledge and education-based barriers, market-related barriers, human barriers, technical capacity barriers, and other barriers. The result of the PCA shows that about 90.32% (28 out of 31) of the barriers peculiar to developing countries are common to the Nigerian construction industry. Out of the barriers that are relevant to Nigeria, 57.14% (16 out of 28) are determined to be significant having a Mean Item Score MIS score exceeding 3.5. five of which were evaluated as the most important barriers using the MIS, three of which are, low awareness, inadequate policies, and lack of interest from clients. The significance of this study lies in its potential to deepen the understanding of challenges hindering GBT adoption in Nigeria while offering valuable insights for government, private sector, researchers, and policymakers, aiding the development of effective programs and policies to support green building practices in Nigeria. The research contributes to achieving sustainable urban development and addressing climate change.

It is critical to understand the limitations of the study, which include the study focusing on a state i.e., Kano state of Nigeria and the small sample size of participants. To strengthen the generalizability of the findings, future research should conduct comparative studies in other locations and increase the sample size. Incorporating qualitative research approaches, such as interviews and case studies, might also give deeper insights into the barriers and a more in-depth exploration of potential solutions.

Finally, this study adds to the body of knowledge on the barriers to green building adoption in Nigeria. The results and suggestions lay the foundation for policymakers, industry practitioners, and other stakeholders to create and execute successful strategies and policies to encourage sustainable building practices and urbanization. Nigeria can set the way for a greener, improved built environment that is more sustainable for both present and future generations by eliminating these barriers and encouraging collaboration.

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FACTORS INFLUENCING THE IMPLEMENTATION OF PUBLIC PROCUREMENT REGULATIONS AND APPLICATION OF SUSTAINABLE CONTRACT ADMINISTRATION PRACTICES IN TERTIARY INSTITUTION PROJECTS IN NIGERIA

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Abstract
The aim of this study is to assess the critical factors affecting the implementation of public procurement regulations and application of sustainable contract administration practices with a view to achieving sustainable infrastructural development in the tertiary education sector in Nigeria. The study assessed the drivers facilitating the implementation of public procurement regulations and application of sustainable contract administration and evaluated the barriers inhibiting the implementation of public procurement regulations and application of sustainable contract administration in tertiary education projects in Nigeria. Survey design was adopted where data were obtained from 635 valid structured questionnaire. The methods of data analysis were simple percentage, mean score, Kruskal – Wallis test, and Bonferron- Dunn test. The results of the study showed that the three critical bottlenecks to the implementation of public procurement regulations and administration of construction contract are lack of capacity, dearth of committed leadership, and inadequate legal framework. While the critical drivers are top management support, corporate governance, and professionalism. The study indicated that there is a significant difference in the opinion of the respondents on drivers facilitating the implementation of public procurement regulation and administration of construction contract in Tertiary Education Sector in Nigeria, hence the hypothesis was rejected. The result of the post Hoc test conducted showed that the opinion of institutions on drivers influencing public procurement regulation and administration of construction contract in Tertiary Education Sector in South –South, and North – Central is significantly different from other zones in Nigeria. This study showed that there is a significant difference in the opinion of institutions on bottlenecks/challenges affecting public procurement regulation and administration of construction contract in Tertiary Education Sector in Nigeria, hence the hypothesis was rejected. The result of the post Hoc test conducted showed that the opinion of institutions on bottlenecks/challenges affecting public procurement regulation and administration of construction contract in Tertiary Education Sector in South – South, and North – East is significantly different from other zones in Nigeria. This study recommended that Tertiary Education Sector in Nigeria should develop their capacity, ensure committed and sustainable leadership, ensure adequate legal framework, reduce cost of tendering, and carry out effective project planning so as to achieve successful and sustainable project outcomes.

Keywords: Application; Education sector; Factors; Implementation; Nigeria; Public Procurement Regulations; Sustainable Contract Practices; Tertiary Institution Projects

1 Introduction

Public procurement has been defined as the process that generates, manages, and achieve contract relating to the provision of goods, services and construction works or disposal or a combination of these elements (Davies, 2019). Focusing on the procurement of construction goods, Cartlidge (2015) defined public procurement as the acquisition of the spectrum of goods, materials and services needed to design, construct and commission buildings that meets the optimal values of the clients. Public procurement has become an important part of the governance system in Nigeria, particularly in its tertiary education institutions. The history and trends of public procurement in Nigerian universities have been documented by several researchers and scholars (Aluko and Arogundade, 2020). Procurement of construction projects in the tertiary education sector in Nigeria has been a topic of concern due to the challenges faced in the process of administering construction contracts. Sustainable contract administration in construction refers to the integration of sustainability principles into the procurement and management of construction contracts. This approach aims to promote environmental, social, and economic sustainability throughout the construction process, from the design stage to the end of the contract (Tetteh *et al*., 2019).

The implementation of public procurement regulations (PPR) to leverage the objectives of the tertiary education sector in infrastructure delivery has overtime remains a daunting task due to inherent challenges (Yahaya *et al*., 2019). Compliance with the requirements of the public procurement regulations (PPR) is facing continuous barriers (Zadawa *et al*., 2015; 2017). Varying arrays of challenges obstructs the efficiencies of the public procurement practice (PPP) and overall performance of the projects (Yahaya *et al*., 2019). Studies have corroborated one another with issues of ineffective implementation, inadequate knowledge, research and monitoring, elongated period of service delivery and political issues inhibiting the constitution of National Council and Public Procurement, insufficient and inefficient procurement personnel (Zadawa *et al*., 2017; Yahaya *et al*., 2019). Yahaya *et al*. (2019) opined that the time-related to advertisement, processing, and award to waiting for budgetary cycles are wasteful. Jubrin *et al*. (2015) stated that the key challenges with the (PPR) is never the adequacy of the legal framework but ineffective implementation. Shwarka (2019) and Bamidele (2020a) also showed that public project processes notably bidding are enshrined in secrecy.

Furthermore Adedokun *et al*. (2022) observed that there is growing evidence of cost and time overruns in public tertiary education in Nigeria. The implementation of PPR in Nigeria and most developing countries is affecting cost performance of construction projects (Zadawa *et al*., 2017). Bamidele *et al*. (2019) found that the projects initiated in public tertiary institutions using the PPR are bedevilled by time overrun. The rate of project abandonment in the TES is also significant (Aghimien and Aigbavboa, 2018). Alao and Jagboro (2017) maintained that the project abandonment in Nigeria is on the increase with over $47.9billion needed for completion.

A significant proportion of TES projects suffered cost and time overruns, which resulted in change of project specifications to meet approved budget (Mangvwat *et al*., 2020). TESP continue to record abysmal delay despite benefiting from a significant level of funding through the TETFUND (Ogbeifun and Pretorious, 2022). Contributing to the debate on the abysmal performance of TES building projects, Adedokun and Egbelakin (2022) characterised the capital outlay in this sector as huge yet failed to meet performance objectives in cost, time, and quality. Obieye (2019) posited that projects initiated using the Nigerian PPR failed to provide value for money.

Despite the appreciable level of awareness and implementation of the PPR, critical issues, which bedeviled the pre-PPR era are yet inherent in the Nigeria including widespread corruption, inattention to fiscal responsibilities, poor value for money, absence of financial planning and control and dearth of capacities (Yahaya *et al*., 2019; Buba *et al*., 2020). In the TES (universities), Abdullahi *et al*. (2019) observed that the procurement of construction projects is plagued with unethical procurement practices. These failures have berated the socio-economic performance of the country because inherent benchmarks of sustainable development are unruly unimpressive. Corruption and mismanagement of public resources in the public sector procurement is alarming, with implications such as hardship and poor economic development (Akinradewo *et al*., 2022).

The dimensions of challenges in PPR in the Nigeria public sector space have been extensively examined overtime, existing studies are laden with inconsistencies in results, approaches and empirical evidence provided. With the increasing infrastructure deficits in the tertiary education sector (TES) in Nigeria, it is important to understand the geopolitical spread of the factors facing the implementation of PPR and effective contract administration in tertiary education sector projects (TESP). This will position the government and other funding agencies to develop strategies to strengthening extant laws, improve practices, enhance construction public procurement processes and overall project performance as well as grow the implementation of public policies (Yahaya *et al*., 2019.

There is need to assess the critical factors that affect successful implementation of PPR and sustainable contract administration practices in construction project delivery in the tertiary education sector in the geopolitical zones in Nigeria. Hence the aim of this study is to assess the critical factors

affecting the implementation of public procurement regulations and application of sustainable contract administration practices with a view to achieve sustainable infrastructural development in the tertiary education sector of the geopolitical zones in Nigeria. To achieve this aim, the following objectives were set for the study:

i Assess the drivers facilitating the implementation of public procurement regulations and application of sustainable contract administration in tertiary education projects of the geopolitical zones in Nigeria

ii Evaluate the barriers inhibiting the implementation of public procurement regulations and application of sustainable contract administration in tertiary education projects of the geopolitical zones in Nigeria

The following hypotheses were postulated in the study:

i There is no significant difference in the opinion of respondents on the drivers facilitating the implementation of public procurement regulations and application of sustainable contract administration in tertiary education projects of the geopolitical zones in Nigeria

ii There is no significant difference in the opinion of respondents on the barriers inhibiting the implementation of public procurement regulations and application of sustainable contract administration in tertiary education projects of the geopolitical zones in Nigeria. The results of these test will help to ascertain if common solutions and control strategies can be provided to the institutions in the various geopolitical zones.

2 Empirical Review of Related Literature

This section provides insight into the various factors and the literature sources where they were selected for use in this study.

2.1 Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

The drivers are the factors that promote Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria. One of the drivers is the media. The media play significant roles in Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria. The media helps the corporate community to be aware of the regulatory outcomes. Wide publication of tenders in the media such as newspapers and websites could help reduce corruption by increasing transparency and participation, thereby enhancing public procurement compliance. Media exposure reduces the incidence of wrongdoing through press coverage that highlights instances of wrongdoing. More to that, in an environment of heightened and effective press coverage of misconduct, others contemplating misconduct may be discouraged (Zubcic and Sims, 2011; Jubrin, Ejura and Nwaorgu , 2014; Omagbon, 2016). Another driver is the level of enforcement of the rule of law. Enforcement could be broadly viewed as any actions taken by regulators to ensure compliance. Enforcement action and increased penalties lead to greater levels of compliance with rule of law. In addition, an effective record management has been identified as a good driver of enhances the public procurement regulation and administration of construction contract in tertiary education sector. In any contemporary industry, the data and reports showing compliance to regulatory needs must be robust and come from a reliable source. Many developing countries lack a systematic approach to managing records. It is argued that accurate and readily accessible records of judicial rulings reduce the potential for illicit manipulation resulting from delays, corruption, and inaccuracies.

Organizational culture influences public procurement regulation and administration of construction contract in tertiary education sector. Due to regulatory reforms and changing community expectations, the role of culture in organizational compliance has gained momentum. Basing on the

competing values model (hierarchical culture), which involves enforcement of rules, conformity and attention to technical matters, individual conformity and compliance are achieved through enforcement of formerly stated rules and procedures . Although there is no single definition of culture, one can define it as,, the structure of behaviours, ideas, attitudes, values, habits, beliefs, customs, language, rituals, ceremonies and practices of a particular group of people that provides them with a general design for living and patterns for interpreting behavior (Gyamfi *et al.,* 2021).

Professionalism in public procurement relates not only to the levels of education and qualifications of the workforce but also to the professional approach in the conduct of business activities. If the workforce is not adequately educated in procurement matters, serious consequences; including, breaches of codes of conduct occur. Lack of a high degree of professionalism in public procurement to corruption, which ultimately impedes compliance. The procurement officers must be trained and aware about all regulations in relation to procurement and related procedures. Thus, professionalism increases public procurement compliance (Oyebode, 2019).

The willingness to comply because of moral obligation and social influence is based, among others on the perceived legitimacy of the authorities charged with implementing the regulations. Hui *et al.* (2011) stipulated that legitimacy theory provides a sufficient and superior lens for understanding government procurement system. Voluntary compliance is the result of personal or corporate ethics, motivation schemes and in most cases the result of corporate interest alignment with the legal provisions behaviour. Moral obligation, may be a significant motivation explaining much of the evidence on compliance behaviour. We therefore make the following proposition that; Perceived rule legitimacy improves moral obligation; Moral obligation improves public procurement compliance and Social influence affects public procurement compliance.

Stakeholders' familiarity with the rules is another driver of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector. Compliance with the formal elements gives an indication of knowledge of the rules. Lack of familiarity with procurement rules results into poor compliance levels. They also found out that in the Nigerian context, familiarity with procurement regulations significantly predicted compliance with procurement regulations. Thus increasing knowledge of the law can improve compliance .The following proposition is therefore advanced that; Familiarity with the procurement rules increases public procurement compliance (Sandada and Kambarami, 2016). The level of compliance to Public Procurement Regulation and successful Administration of Construction Contract in Tertiary Education Sector is also influenced by top management support. Hui *et al.* (2011) stipulated that efficient management is one of the most effective preventive mechanisms for it promotes transparency and accountability, facilitates oversight and provides a good basis to prevent corruption. Formal controls must first be defined, agreed, and applied top-down internally within an organization if they are to be effective. An organization with a genuine commitment to legal compliance is evidenced by top management's dedication to ethical corporate behaviour (Sarawa and Mas'ud, 2020).

Corporate governance also plays key roles in successful contract administration. Corporate ownership and governance structures depend on corporate conventions and rules of behaviour. Corporate compliance equates to corporate governance and refers to the mechanisms by which corporations are directed and controlled, and by which those who direct and control corporations are monitored and supervised and made accountable for their actions. Other drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector include the of concept of transparency in procurement process is the information is available to all the players including contractors, suppliers, and the public at large, effective risk management, control activities, information and communication and active monitoring (Rae and Sands, 2017; Ismail *et al*., 2018), enhancing integrity in public procurement systems, promoting actions to integrate risk-management strategies for mapping, detection and mitigation throughout the public procurement cycle; applying oversight and control mechanisms to support accountability throughout the public procurement cycle, including appropriate complaint and sanctions processes; encouraging transparent and effective stakeholder participation; and preserving the integrity of the public procurement system through general standards and procurement-specific safeguards. Others are public accountability,

transparency, best value for money, open competition, fair dealing, and integrity (Abebe, 2014; Tajarlou and Ghorbany, 2017; Abul Hassan *et al.,* 2020; Kristensen *et al.,* 2021).

Rahimi (2019) posited that critical success factors of contract administration include; managers experience and familiarity with project, clear conditions of final project acceptance and closeout, good and effective communication and collaboration among construction team members, client's financial stability, on time response to enquiry and effective feedback mechanism as well as competency of project manager among other ten factors in North east Asia.

Yahaya *et al* (2020) stated that improving the knowledge based or level of awareness of procurement personnel and effective monitoring significantly influence the level of compliance to regulations. The study assessed the influence of knowledge and monitoring on compliance with public sector procurement law in North –West region of Nigeria. A questionnaire survey comprising one hundred and forty three (143) public sector procurement professionals in North-West Zone of Nigeria was used to assess the influence of monitoring and knowledge related factors on compliance with public-sector procurement regulations. The data collected were analyzed using partial least square-structural equation modeling (PLS-SEM). The PLS- SEM results indicated that monitoring and knowledge positively influenced the level or extent of compliance or adherence to public procurement Act. Based on the results of the study, improving monitoring and knowledge level of personnel by the bureau of public procurement (BPP) can lead to total and effective compliance/adherence to the public procurement act (PPA).Therefore, only well trained and professionally certified procurement personnel should manage procurement process in all public sector organization.

2.2 Bottlenecks to Public Procurement Regulation and Effective Contract Administration

Compliance with PPR laws and procedures in tertiary education construction projects in Nigeria has been a major challenge, leading to various issues such as corruption, delays, and poor project outcomes. Afolayan and Rotimi (2017) also identified some challenges to procurement compliance, including inadequate monitoring and control mechanisms, lack of transparency in the procurement process, and political interference. Adeyemi and Opawole (2015) identified challenges to procurement compliance, such as a lack of awareness and training among procurement officials and contractors, inadequate monitoring and evaluation mechanisms, and political interference. Furthermore, a report by the Nigerian Institute of Quantity Surveyors (NIQS) (2016) revealed that corruption is a major challenge in public procurement processes in Nigeria, including those in the tertiary education sector. The report identified various forms of corruption, including bid rigging, kickbacks, and inflated contract costs, which are often facilitated by non-compliance with procurement laws and procedures.

Ekung *et al*. (2015) found the requirements of PPR cumbersome through verification of evidence, appraisal of submissions, document management, continuous pre-qualification and treatment request for information. Shwarka and Anibogu (2012) found that PPR performance in Nigeria is inhibited by weak monitoring and enforcement, insufficient project planning, dearth of committed leadership, resistance to change defaulting contractor, dearth of project management competencies, low ethical practices, non-prosecution of defaulters and application of ICT. Zadawa *et al*. (2018) found that fraudulent practices were most critical drivers of ineffective cost performance in public procurement in Nigeria. Adeboyejo and Ogunlana (2019) observed that weak institutional capacity and corruption were major hindrances to effective implementation of public procurement guidelines in Nigeria. The causes of these issues vary, but inadequate budgeting, poor project planning and scheduling, poor workmanship, the use of substandard materials, inadequate supervision, and inadequate maintenance have been identified as major contributing factors.

Studies have corroborated one another with issues of ineffective implementation, inadequate knowledge, research and monitoring, elongated period of service delivery and political issues inhibiting the constitution of National Council and Public Procurement, insufficient procurement personnel (Jubrin *et al*., 2014; Yahaya *et al*., 2019). Late passage of appropriation laws is deemed to

truncate the procurement cycles and operation of the PPR in the Nigerian public sector (Shakirat and Kabir, 2014). Before this decade, the issues of resistantance to change to the adoption of the PPR, political interference, contract splitting, low awareness, and poor capacity. Ineffective implementation, low media publicity and public knowledge of ongoing bidding, poor record management and poor service delivery due to the rule of competitive bidding (Jubrin *et al*., 2014). High cost of tendering (transaction costs) are also important issues posed by PPA, which affects compliance with requirements by contractors, namely: sourcing eligibility documents, contract administration costs and securing related documents (Yahaya *et al*., 2020).

The structure of the public service and the dearth of training, lengthy time frame, high cost of tendering were also prevalent issues in this era. Yahaya *et al*. (2019) re-appraised these early occurring issues, using three major themes, namely: implementation challenges, monitoring and knowledge and research issues. The results revealed that the dearth of enforcement of guidelines by bureau of public procurement (BPP), poor constitution of procurement units, reliance on manual tendering against E-Tendering, long timeframe at the MDA and approval bodies and rigidity of the PPR are current issues affecting compliance with PPR. In addition, monitoring challenges are multiples of issues arising from poor monitoring by Civil Societies and media, project management by procuring entities, infrequent review and revocation of contract, apathy from supervisory agents such as Directorate of Physical Planning due to institutional issues and the dearth of clearly benchmarked quality control processes (Yahaya *et al*., 2019). Knowledge and research challenges include dearth of awareness with the provisions of extant regulation, long timeframe, dearth of experience, insufficient training and dearth of personnel (Yahaya *et al*., 2019). Despite a significant awareness and understanding of the tenets of PPR in North-Central, Nigeria, synergy between stakeholders, poor monitoring and unethical behaviors are prevalent issues for the implementation of the Act in the region (Akinradewo *et al*., 2022). Through delayed completion, cost escalation, variations, poor maintainability ineffective project implementation process and quality standard, Obieye (2019) showed that public project initiated using the PPR failed to achieve value for money.

Corruption, inadequate funding, poor planning, bureaucracy, incompetent contractors, lack of skilled labour, security challenges, unstable political environment, environmental factors, and inadequate monitoring are pertinent bottleneck in public procurement contract administration in Nigeria (Aderonke, 2015; Oluwole, 2015; Babalola, 2016). Shwarka (2019) reinforced this practice is prevalent due to the poor rating of public sector PPR processes and project performance and transparency of bidding. In internationally funded projects, Babalola and Itodo (2019) found that governance interference, conflicts of interests, bias among civil servants, experience, manipulation of processes and altering reports are some important challenges faced in the procurement processes.

Nwokoye (2017) identified issues such as lack of planning, inadequate budgeting, and poor project management as key factors contributing to non-compliance with procurement laws and procedures in tertiary education construction projects in Nigeria. Aliyu and Aliyu (2018) identified corruption, political interference, inadequate procurement planning, and insufficient monitoring and evaluation mechanisms as the main factors limiting procurement compliance in Nigeria's tertiary institutions. Ogbuozobe and In the context of universities, Muhammad and Agarwal (2018) note that public procurement is critical to maintaining quality and value for money in the procurement of goods and services. However, universities in Nigeria have faced several challenges in this area, including lack of capacity, inadequate legal framework, and corruption. Adenuga *et al*. (2019) examined the challenges of implementing public procurement policies in the tertiary education sector in Nigeria. The research identified factors such as lack of transparency, inadequate monitoring and evaluation, and weak regulatory frameworks as key challenges to the effective implementation of public procurement policies in the sector.

Owoeye and Komolafe (2018) investigated the factors influencing procurement compliance in Nigerian public universities. Their findings indicate that factors such as corruption, inadequate government funding, and lack of awareness among procurement officials and contractors are among the key challenges that hinder procurement compliance in the Nigerian education sector. Maduekeh and Obinwa (2022) highlighted that corruption, high cost of tendering, less involvement of

professionals, disputes are some prevalent inherent in the current procurement reforms in Nigeria. Ogunsanmi and Ogunsemi (2012) investigated the factors influencing the procurement of construction projects in Nigerian universities. The study identified factors such as lack of transparency, corruption, and inadequate funding as major challenges to the procurement process. The study recommended that there should be greater transparency in the procurement process and the provision of adequate funding for construction projects. Adedokun *et al.* (2019a) placed the bulk of the challenges in TESBP to contractor-related issues including supply-related and financial issues are more prominent.

Olusegun *et al*. (2016) in a study of factors inhibiting compliance with PPR among federal tertiary institutions in Lagos, revealed that the dearth of professionalism, ethical issues and low-familiarity with Act as most important barriers affecting compliance with PPR 2007. Odeyinka *et al*. (2012) examined the procurement process for construction projects in Nigerian universities from the perspective of contractors. The study found that delayed payment and lack of transparency were major challenges faced by contractors in the procurement process. Ogbeifun and Pretorious (2022) linked delayed problems to weak project management post-contract evidenced in the form of weak monitoring and delayed certification and evaluation of projects for payment.

Nmecha, *et al*. (2023) found the major impact factors that affect the effectiveness of PPR in contract awarding in public sectors in some cities of south-south to include; Communication challenges, corruption, delay in project implementation, financial challenge (lack of adequate resources) and inadequate PPA implementation. It was also recommended that efforts such as improving the justice system, adequate planning and implementation and end corruption system in Nigeria should be made to surmount the most significant constraints/challenges by all stakeholders involved in the implementation of the PPR 2007.

Overall, the administration and procurement of tertiary education construction projects in Nigeria are faced with several challenges. These challenges range from inadequate funding to poor project management, corruption, and lack of skilled personnel. Others include delayed payment to poor quality control, inadequate planning, and lack of infrastructure. In addition, Inadequate monitoring of public construction projects is another challenge faced in the administration of public construction projects in Nigeria. Lack of monitoring allows contractors to deliver poor quality work, manipulate costs, and delay project completions are other pertinent issues in public work contract administration in Nigeria.

3 Methodology

This study assessed the factors affecting the implementation of public procurement regulation and application of sustainable contract administration practices in tertiary education sector projects (TESP) in Nigeria. This study focused on public tertiary education institutions in Nigeria. The following geopolitical Zones were chosen for the study namely South-west, North-West, North-Central, South-South, South-East and North-East geopolitical zones in Nigeria. A survey design was adopted in the study, and random sampling techniques was used to obtain the sample for this study. One thousand and twenty eight (1028) copies of questionnaire were randomly distributed by the researchers and research assistants among construction professionals, procurement officers, consultants, and contractors, Low-operational/field staff, Middle level-policy implementers, and top management level (formulation of policy) in the Tertiary institutions in Nigeria. The criteria for selection of the professionals were years of experience, educational qualification, and professional development. The questionnaire has two sections. The first section comprises information about the respondents. The second section comprises variables used to assess the factors influencing the implementation of public procurement regulations and application of sustainable contract administration practices in tertiary education sector projects (TESP) in Nigeria. The data used in the study were collected using a five-point scale of 1 to 5 (Anyanwu, 2018). Scale 1 represents a very low level of influence, while scale 5 represents a very high level of influence. Methods of data analysis

include simple percentage, mean score, Kruskal – Wallis test, and Bonferron- Dunn test. The simple percentage was used to analyze the respondents' characteristics; the mean score was used to assess the drivers, and barriers influencing level of compliance of public procurement regulations, and application of sustainable contract administration practices. Kruskal – Wallis test was used to test the hypotheses, while Bonferron- Dunn test was used to carry out posthoc test so as to determine the source of variation. Using a 5-point scale, the decision rule in this study is that any driver or barrier with an overall mean score of 1.0-1.49, 1.5-2.49, 2.5-3.49, 3.5-4.49, and 4.5-5.0 is considered to have a very low level of influence, low level of influence, moderate level of influence, high level of influence, and very high level of influence respectively (Ogenma 2018**).**

4.0 Results and Discussion of Findings

This section presets and discusses results concerning the respondents' characteristics, the factors influencing the implementation of public procurement regulations and the application of sustainable contract administration in the institutions of the geo-political zones.

4.1 Questionnaire Distribution and Response Rate

The research instrument used in this study was structured questionnaire. The copies of questionnaire were administered among the Tertiary Institutions in Nigeria.

The study showed that the number of questionnaire administered to Tertiary Institutions in Nigeria were 164, 215, 128, 159, 202, and 160 in South- South, South West, North Central, North East, North West, and South East respectively. The response rate ranges between 18.3% and 90%. North Central received the highest response rate of 90% while North West got the least response rate of 18.3 %. In all, an overall response rate of 62**%** was achieved. According to Ijosiga Odubuker (2016), a response rate above fifty percent (50%) is considered good and adequate.

4.2 Respondents' Characteristics

Table 1 shows the results of the analysis of respondents' characteristics. It shows that 15.1%, 22.2%, 18.1%, 21.4%, 5.8%, and 17.3% of the respondents were from the South-South, South West, North Central, North East, North West, and South East region of Nigeria respectively. Table 1 also shows that the category of the respondents. These include the construction professionals, procurement officers, consultants, and contractors. These categories of the respondents are responsible for contract administration within the tertiary education sector in Nigeria. The results revealed that 36.7%, 27.6%, 24.3%, and 11.5% of the respondents were construction professionals, procurement officers, consultants, and contractors respectively. Table 1 shows that 26.3%, 56.9%, and 16.9% were Low-operational/field staff, Middle level-policy implementers, and Top management level (formulation of policy) respectively. The level of educational qualification of the respondents was also analysed. The result presented in Table 1 also shows that 63.5% of the respondents have First Degree, while 31.3% of the respondents have Postgraduate degree. In addition, 5.2 % of the respondents obtained College level and other relevant qualification. This shows that the respondents that participated in this study are well educated and knowledgeable. Therefore, data obtained from them are valid and reliable. Furthermore, the overall years of experience of the respondents with the organisation was analysed, the result indicated that 0.8%, 35.1%, 43.8%, and 20.3% of the respondents have years of experience with the organizations in the range of 1– 5years, 6 – 10years, 10-20years, and above 20years respectively. Moreso, the results in Table 4.3 shows that 0.5%, 28.0%, 50.2%, and 21.3% of the respondents have 1– 5years, 6 – 10years, 10-20years, and above 20years overall years of experience in the industry respectively. It implies that majority of the respondents considered in this study have worked more 10 years with their respective organizations and in the industry. And therefore have the prerequisite experience for reliable information on the study

The extent of professional development of the respondents was analysed, the results revealed that 77.3% of the respondents are professionally registered with their respective professional bodies while 22.7% of them are yet to be professionally registered. This revealed a high level of professional commitment and development on the part of the respondents which can make them authorities in matters of construction industry.

Table 1: Respondents Characteristics

Respondents Characteristics	Frequency	Percent
Location of organisation		
South- South	96	15.1
South West	141	22.2
North Central	115	18.1
North East	136	21.4
North West	37	5.8
South East	110	17.3
Total	635	100.0
Category of respondents		
Construction professional	233	36.7
Procurement officer	175	27.6
Consultant	154	24.3
Contractor	73	11.5
Total	635	100.0
Level in organization		
Low-operational/field staff	167	26.3
Middle level-policy implementers	361	56.9
Top management level (formulation of policy)	107	16.9
Total	635	100.0
Educational qualification		
First Degree	403	63.5
First degree + Postgraduate degree	199	31.3
College level and others	33	5.2
Total	635	100.0
Overall years of experience with organization		
1– 5	5	.8
6 – 10	223	35.1
10-20years	278	43.8
20years and above	129	20.3
Total	635	100.0
Overall years of experience in the industry organization		
1– 5	3	.5
6 – 10	178	28.0
10-20years	319	50.2
20years and above	135	21.3
Total	635	100.0
Professional Qualification		
Registered	491	77.3
Not registered	144	22.7
Total	635	100.0

4.3 Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

The drivers influencing the implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria were evaluated. The results are presented in Table 2. The results showed that top management support (MS=4.1193), corporate governance (MS=4.1011), professionalism in public procurement (MS=4.0701), effective stakeholder participation (MS=4.0508), and organizational culture (MS=4.0263**)** are the top five factors that enhance implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria. Other drivers that critically determine successful administration of construction contract in Tertiary Education sector in Nigeria include promoting actions to integrate risk-management strategies for mapping, detection and mitigation throughout the public procurement cycle (MS=3.9943), level of enforcement of the rule of law (MS=3.9914), appropriate complaint and sanctions processes (MS=3.9798), applying oversight and control mechanisms to support accountability throughout the public procurement cycle (MS=3.9715), and the media (MS=3.9620). Furthermore, enhancing integrity in public procurement systems (MS=3.9599), willingness to comply because of moral obligation and social influence (MS=3.9584), information, communication and active monitoring (MS=3.9552), stakeholders' familiarity with the rules (MS=3.9464), and transparency in procurement process(MS=3.8913) highly influenced the extent of implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria . In addition, the participants in this study opined that effective records management (MS=3.8688), Open competition (MS=3.8397), and Public accountability(MS=3.7631) facilitate successful implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria. The three drivers/facilitators that were least rated by the participants in this study include Preserving the integrity of the public procurement system through general standards and procurement-specific safeguards(MS=3.7594), Best value for money(MS=3.7076), and Effective risk management(MS=3.5817). However, the mean scores of 3.7594, 3.7076, and 3.5817 indicated that these factors also facilitates successful contract administration in the tertiary education sector in Nigeria.

Table 2: Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

Code	Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria	South-South Mean	South West Mean	North Central Mean	North East Mean	North West Mean	South East Mean	Group Mean	Rank
DPPRACCTE8	Top management support	3.8396	4.1915	3.8957	4.2647	4.3514	4.1727	4.1193	1
DPPRACCTE9	Corporate governance	3.8750	4.1773	3.9652	4.2279	4.2973	4.0636	4.1011	2
DPPRACCTE5	Professionalism in public procurement	3.8229	4.1631	3.9130	4.2059	4.2703	4.0455	4.0701	3
DPPRACCTE17	Effective stakeholder participation	3.9479	4.0993	3.9217	4.1103	4.1892	4.0364	4.0508	4
DPPRACCTE4	Organizational culture	3.5958	4.1206	3.9478	4.1324	4.2432	4.1182	4.0263	5

Code	Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria	South-South Mean	South West Mean	North Central Mean	North East Mean	North West Mean	South East Mean	Group Mean	Rank
DPPRACCTE14	Promoting actions to integrate risk-management strategies for mapping, detection and mitigation throughout the public procurement cycle	3.5104	4.1064	3.9478	4.1397	4.2162	4.0455	3.9943	6
DPPRACCTE2	Level of enforcement of the rule of law	3.6479	4.0780	3.8609	4.0809	4.1622	4.1182	3.9914	7
DPPRACCTE16	Appropriate complaint and sanctions processes	3.5000	4.0709	3.9478	4.1250	4.1622	4.0727	3.9798	8
DPPRACCTE15	Applying oversight and control mechanisms to support accountability throughout the public procurement cycle	3.5312	4.0780	3.9130	4.0809	4.1892	4.0364	3.9715	9
DPPRACCTE1	The media	3.7958	4.0142	3.8609	4.0662	4.1351	3.9000	3.9620	10
DPPRACCTE13	Enhancing integrity in public procurement systems,	3.5625	4.0213	3.8870	4.0441	4.1351	4.1091	3.9599	11
DPPRACCTE6	Willingness to comply because of moral obligation and social influence	3.5479	4.0780	3.8609	4.1471	4.1622	3.9545	3.9584	12
DPPRACCTE12	Information, communication and active monitoring	3.5104	4.0426	3.8957	4.0662	4.1892	4.0273	3.9552	13
DPPRACCTE7	Stakeholders' familiarity with the rules	3.6542	4.0355	3.8609	4.0294	4.1622	3.9364	3.9464	14
DPPRACCTE10	Transparency in procurement process	3.5312	3.9574	3.8000	3.9779	4.0541	4.0273	3.8913	15
DPPRACCTE3	Effective records management	3.7438	3.8794	3.7217	3.9044	4.0000	3.9636	3.8688	16
DPPRACCTE21	Open competition	3.7083	3.8582	3.8957	3.8750	3.9189	3.7818	3.8397	17
DPPRACCTE19	Public accountability	3.6458	3.6809	3.8261	3.6397	3.9676	3.8182	3.7631	18
DPPRACCTE18	Preserving the integrity of the public procurement system through general standards and procurement-specific safeguards	3.8583	3.8255	3.6391	3.7456	3.8243	3.6636	3.7594	19
DPPRACCTE20	Best value for money	3.6700	3.5957	3.7217	3.5809	3.8865	3.7909	3.7076	20
DPPRACCTE11	Effective risk management	3.5313	3.4823	3.4870	3.5221	3.5676	3.9000	3.5817	21

4.4 Kruskal Wallis Test for Comparing the Opinion of Institutions on Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

Table 3 shows the result of Kruskal Wallis test that was conducted to test the hypothesis which states that there is no significant difference in the opinion of respondents on drivers influencing the implementation of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria. The P-value of 0.001 is less than 0.05 significance level, hence the hypothesis was rejected. This indicates that there is a significant difference in the opinion of the respondents on drivers facilitating the implementation of public procurement regulation and administration of construction contract in Tertiary Education Sector in Nigeria.

Table 3: Kruskal Wallis Test for Comparing the Opinion of Respondents on Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

Drivers influencing the implementation of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria	Mean Rank	Decision @ 0.05 Sig. level.
South- South	21.64	
South West	72.62	
North Central	44.57	
North East	77.64	
North West	94.71	
South East	69.81	
Chi- Square	66.167	
D.F	5	
P-Value	0.001	Reject

4.5 Post Hoc Test on the Opinion of Respondents on Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

The result of post hoc test on the opinion of respondents on drivers facilitating the implementation of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria is shown in Table 4. Because of the significant difference the opinion of respondents on drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria, a post hoc test was conducted using Bonferroni and Dunnest test (Bonferroni-Dunn test) to determine the source(s) of the difference. The result of Bonferroni's multiple comparisons and Dunnest test show that South – South, and North –North- Central are the sources of the variation/ difference. This was validated by Dunnest test result which showed that the other four zones have P-values greater than 0.05 significant level, except South –South, and North – Central which have the P-values of 0.001 and 0.044 respectively. These values are less than 0.05 significance level.

Table 4: Post Hoc Test the Opinion of Respondents on Drivers of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

	(I) Political Zones In Nigeria	(J) Political Zones In Nigeria	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
		South West	-.31076*	.05150	.000	-.4650	-.1565
	South- South	**North Central**	-.17807*	.05150	.011	-.3323	-.0238
		North East	-.33029*	.05150	.000	-.4845	-.1761
		North West	-.43113*	.05150	.000	-.5854	-.2769
		South East	-.31199*	.05150	.000	-.4662	-.1577
		South- South	.31076*	.05150	.000	.1565	.4650
	South West	**North Central**	.13269	.05150	.168	-.0215	.2869
		North East	-.01953	.05150	1.000	-.1738	.1347
		North West	-.12038	.05150	.316	-.2746	.0339
		South East	-.00123	.05150	1.000	-.1555	.1530
	North Central	**South- South**	.17807*	.05150	.011	.0238	.3323
		South West	-.13269	.05150	.168	-.2869	.0215
		North East	-.15222	.05150	.056	-.3065	.0020
		North West	-.25307*	.05150	.000	-.4073	-.0988
		South East	-.13392	.05150	.157	-.2882	.0203
	North East	**South- South**	.33029*	.05150	.000	.1761	.4845
		South West	.01953	.05150	1.000	-.1347	.1738
		North Central	.15222	.05150	.056	-.0020	.3065
		North West	-.10084	.05150	.788	-.2551	.0534
		South East	.01830	.05150	1.000	-.1359	.1725
	North West	**South- South**	.43113*	.05150	.000	.2769	.5854
		South West	.12038	.05150	.316	-.0339	.2746
		North Central	.25307*	.05150	.000	.0988	.4073
		North East	.10084	.05150	.788	-.0534	.2551
		South East	.11915	.05150	.336	-.0351	.2734
	South East	**South- South**	.31199*	.05150	.000	.1577	.4662
		South West	.00123	.05150	1.000	-.1530	.1555
		North Central	.13392	.05150	.157	-.0203	.2882
		North East	-.01830	.05150	1.000	-.1725	.1359
		North West	-.11915	.05150	.336	-.2734	.0351
Dunnett t (2-sided)[b]							
	South- South	**South East**	-.31199*	.05150	.001	-.4431	-.1808
	South West	**South East**	-.00123	.05150	1.000	-.1324	.1299
	North Central	**South East**	-.13392*	.05150	.044	-.2651	-.0028
	North East	**South East**	.01830	.05150	.996	-.1128	.1494
	North West	**South East**	.11915	.05150	.088	-.0120	.2503

*. The mean difference is significant at the 0.05 level

4.6 Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

The result in Table 5 revealed that the top five bottlenecks inhibiting the Implementation of Public Procurement Regulations and administration of Construction Contract in Tertiary Education Sector in Nigeria are lack of capacity(MS=4.1375), dearth of committed leadership (MS=4.1127), inadequate legal framework(MS=4.0666), high cost of tendering (MS=4.0629), and insufficient project planning (MS=4.0610). Other challenges that were considered to have high influence on the extent of implementation of public procurement regulations among tertiary institutions include non-involvement of stakeholders notably construction professionals (MS =4.0445), resistance to change defaulting contractor(MS =4.0295), poor project management (MS =4.0082), lack of awareness and training(MS =3.9590), and inadequate monitoring and control mechanisms(MS =3.9582). Furthermore, dearth of project management competencies, lack of transparency, risks (inaccurate estimate, poor experiences, unclear specification), low ethical practices, and Late passage of appropriation were also critical challenges affecting the implementation of Public Procurement Regulations with mean scores of 3.9547, 3.9368, 3.9320, 3.9291, and 3.9253 respectively. In addition, the participants in this study revealed that the following factors inhibit the extent of implementation of Public Procurement Regulations among tertiary institutions. These include non-prosecution of defaulters(MS=3.9210), lengthened approval processes by regulatory agencies (MS=3.9187), lack of transparency in the procurement process(MS=3.9175), dearth of personnel(MS=3.8995), and none utilisation of ICT(MS=3.8926). The five bottlenecks/challenges that were least rated by the participants in this study include conflict of interests(MS=3.8824), cumbersome requirements through verification, appraisal, management, and information(MS=3.8733), inadequate budgeting(3.8698), political interference(MS=3.8294), and corruption (bid rigging, kickbacks and inflated contract costs)(MS=3.7981). However, the mean scores of 3.8824, 3.8733, 3.8698, 3.8294, and 3.7981 implied that these factors also influence the extent of implementation of Public Procurement Regulations among Tertiary institutions in Nigeria.

Table 5: Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

Code	Bottlenecks/Challenges	South-South Mean	South West Mean	North Central Mean	North East Mean	North West Mean	South East Mean	Group Mean	Rank
BC19	Lack of capacity	3.6458	4.2695	4.2609	4.2059	4.2703	4.1727	4.1375	1
BC8	Dearth of committed leadership	3.8125	4.2766	4.1130	4.0221	4.2703	4.1818	4.1127	2
BC20	Inadequate legal framework	3.8333	4.1489	4.1913	4.0000	4.1081	4.1182	4.0666	3
BC22	High cost of tendering	3.6146	4.3121	3.9913	4.0441	4.2973	4.1182	4.0629	4
BC7	Insufficient project planning	3.8646	4.1348	3.8870	4.3088	4.2162	3.9545	4.0610	5
BC23	Non-involvement of stakeholders notably construction professionals	3.7604	4.1844	3.9478	4.1397	4.1892	4.0455	4.0445	6
BC9	Resistance to change defaulting contractor	3.8958	4.0426	3.8522	4.3235	4.1081	3.9545	4.0295	7
BC18	Poor project management	3.6979	4.1915	3.9913	3.9706	4.2162	3.9818	4.0082	8
BC4	Lack of awareness and training	3.8333	3.9858	4.0696	3.9559	3.9730	3.9364	3.9590	9

Code	Bottlenecks/Challenges	South-South Mean	South West Mean	North Central Mean	North East Mean	North West Mean	South East Mean	Group Mean	Rank
BC1	Inadequate monitoring and control mechanisms	3.6146	3.8723	4.1739	4.2426	3.9459	3.9000	3.9582	10
BC10	Dearth of project management competencies	3.7188	4.0638	3.9217	3.8971	4.0811	4.0455	3.9547	11
BC21	Lack of transparency	3.6250	4.0284	3.9913	3.9853	4.0270	3.9636	3.9368	12
BC25	Risks (inaccurate estimate, poor experiences, unclear specification	3.6417	4.1986	3.8174	3.8088	4.1892	3.9364	3.9320	13
BC11	Low ethical practices	3.7708	3.9433	3.9565	4.0221	3.9730	3.9091	3.9291	14
BC14	Late passage of appropriation	3.4792	3.9858	3.7130	4.3382	4.1081	3.9273	3.9253	15
BC12	Non-prosecution of defaulters	3.6250	4.0922	3.7565	3.9265	4.1351	3.9909	3.9210	16
BC24	Lengthened approval processes by regulatory agencies	3.8021	4.0567	3.8609	3.8382	4.0000	3.9545	3.9187	17
BC2	Lack of transparency in the procurement process	3.6146	3.8794	3.8783	4.3235	3.9730	3.8364	3.9175	18
BC15	Dearth of personnel	3.7396	3.8652	3.6870	4.2500	3.9459	3.9091	3.8995	19
BC13	None utilisation of ICT	3.5937	3.9220	3.6783	4.3162	4.0000	3.8455	3.8926	20
BC16	Conflict of interests	3.6875	3.8865	3.7130	4.2794	3.9189	3.8091	3.8824	21
BC6	Cumbersome requirements through verification, appraisal, management, and information	3.7083	3.9362	3.7043	3.9632	3.9459	3.9818	3.8733	22
BC17	Inadequate budgeting	3.8021	3.8936	3.6957	4.0809	3.8649	3.8818	3.8698	23
BC3	Political interference	3.6250	3.8298	3.9478	4.0000	3.8649	3.7091	3.8294	24
BC5	Corruption (bid rigging, kickbacks and inflated contract costs)	3.5833	3.6950	3.8435	4.2279	3.7297	3.7091	3.7981	25

4.7 Kruskal Wallis Test for Comparing the Opinion of Institutions on Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

Table 6 shows the result of Kruskal Wallis test that was conducted to test the hypothesis which states that there is no significant difference in the opinion of Tertiary Institutions on Bottlenecks/Challenges affecting Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria. The P-value of 0.001 is less than 0.05 significance level, hence the hypothesis was rejected. This indicates that there is a significant difference in the opinion of institutions on bottlenecks/challenges affecting public procurement regulation and administration of construction contract in Tertiary Education Sector in Nigeria

Table 6: Kruskal Wallis Test for Comparing the Opinion of Respondents on Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria	Mean Rank	Decision @ 0.05 Sig. level.
South- South	19.76	
South West	90.84	
North Central	63.24	
North East	106.80	
North West	98.32	
South East	74.04	
Chi- Square	66.167	
D.F	5	
P-Value	0.001	Reject

4.8 Post Hoc Test on the Opinion of Respondents on Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

The result of post hoc test on the Opinion of respondents on Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria is shown in Table 4.11. Because of the significant difference the opinion of Institutions on Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria, a post hoc test was conducted on the geopolitical zones using Bonferroni and Dunnest test (Bonferroni-Dunn test) to determine the source(s) of the difference. The result of Bonferroni's multiple comparisons and Dunnest test show that South – South, and North –East are the sources of the variation/ difference. This was validated by Dunnest test result which showed that the other four zones have P-values greater than 0.05 significant level, except South –South, and North – East which have the P-values of 0.001 and 0.002 respectively. These values are less than 0.05 significance level.

Table 7: Post Hoc Test the Opinion of Institutions on Bottlenecks/Challenges of Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria

	(I) Political Zones In Nigeria	(J) Political Zones In Nigeria	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
	South-South	South West	-.32422*	.04145	.001	-.4480	-.2005
		North Central	-.20216*	.04145	.001	-.3259	-.0784
		North East	-.39524*	.04145	.001	-.5190	-.2715
		North West	-.35047*	.04145	.001	-.4742	-.2267
		South East	-.24733*	.04145	.001	-.3711	-.1236

		South- South	.32422*	.04145	.001	.2005	.4480
	South West	**North Central**	.12206	.04145	.057	-.0017	.2458
		North East	-.07102	.04145	1.000	-.1948	.0527
		North West	-.02625	.04145	1.000	-.1500	.0975
		South East	.07689	.04145	.985	-.0469	.2006
	North Central	**South- South**	.20216*	.04145	.001	.0784	.3259
		South West	-.12206	.04145	.057	-.2458	.0017
		North East	-.19308*	.04145	.001	-.3168	-.0693
		North West	-.14831*	.04145	.007	-.2721	-.0246
		South East	-.04517	.04145	1.000	-.1689	.0786
	North East	**South- South**	.39524*	.04145	.001	.2715	.5190
		South West	.07102	.04145	1.000	-.0527	.1948
		North Central	.19308*	.04145	.001	.0693	.3168
		North West	.04477	.04145	1.000	-.0790	.1685
		South East	.14791*	.04145	.007	.0242	.2716
	North West	**South- South**	.35047*	.04145	.001	.2267	.4742
		South West	.02625	.04145	1.000	-.0975	.1500
		North Central	.14831*	.04145	.007	.0246	.2721
		North East	-.04477	.04145	1.000	-.1685	.0790
		South East	.10314	.04145	.210	-.0206	.2269
	South East	**South- South**	.24733*	.04145	.001	.1236	.3711
		South West	-.07689	.04145	.985	-.2006	.0469
		North Central	.04517	.04145	1.000	-.0786	.1689
		North East	-.14791*	.04145	.007	-.2716	-.0242
		North West	-.10314	.04145	.210	-.2269	.0206
Dunnett t (2-sided)[b]							
	South-South	**South East**	-.24733*	.04145	.001	-.3527	-.1420
	South West	**South East**	.07689	.04145	.231	-.0284	.1822
	North Central	**South East**	-.04517	.04145	.713	-.1505	.0602
	North East	**South East**	.14791*	.04145	.002	.0426	.2532
	North West	**South East**	.10314	.04145	.057	-.0022	.2085

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

4.9 Discussion of Findings

4.9.1 Drivers facilitating the Implementation of Public Procurement Regulations and administration of Construction Contract in Tertiary Education Sector: The drivers influencing the implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria were evaluated. The results showed that top management support, corporate governance, professionalism in public procurement, effective stakeholder participation, and organizational culture are the top five factors that enhance implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria. Other drivers that critically determine successful administration of construction contract in Tertiary Education sector in Nigeria include promoting actions to integrate risk-management

strategies for mapping, detection and mitigation throughout the public procurement cycle, level of enforcement of the rule of law, appropriate complaint and sanctions processes, applying oversight and control mechanisms to support accountability throughout the public procurement cycle, and the media. Furthermore, enhancing integrity in public procurement systems, willingness to comply because of moral obligation and social influence, information, communication and active monitoring, stakeholders' familiarity with the rules, and transparency in procurement process highly influenced the extent of implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria . In addition, the participants in this study opined that effective records management, open competition, and public accountability facilitate successful implementation of public procurement regulation and administration of construction contract in Tertiary Education sector in Nigeria. The last three drivers/facilitators that were rated by the participants in this study include preserving the integrity of the public procurement system through general standards and procurement-specific safeguards, best value for money, and effective risk management. The result is an indication that stakeholders should not go with the illusion that the effectiveness and efficiency of construction contracts will always occur by chance without some major facilitators. The result of this study partly aligns with the findings of Rahimi (2019), which identified critical success factors of contract administration to include; managers experience and familiarity with project, clear conditions of final project acceptance and closeout, good communication and collaboration among team members. Others include client's financial stability, on time response to enquiry and competency of project manager among other ten factors in North east Asia.

The study also somehow supports the findings by Gunduz and Elsherbeny (2020) which found that change control, financial, and claims and disputes resolution management were the top three factors affecting the performance of construction contract administration of design-bid-build contracts in Qatar. While, Nmecha, *et al*. (2023) similarly, found the major factors that drive the effectiveness of PPA in contract awarding in public sectors to include; full implementation and enforcement of procurement act, improving the justice system, eliminating corruption and indiscriminate biding system and adequate monitoring, planning and implementation.

This study is in agreement with Omagbon, (2016) who posited that the media helps the corporate community to be aware of the regulatory outcomes, an indication of ignorance and lack of awareness. Wide publication of tenders in the media such as newspapers and websites could help reduce corruption by increasing transparency and participation, thereby enhancing public procurement compliance. Media exposure reduces the incidence of wrongdoing through press coverage that highlights instances of wrongdoing. This study also aligns with Oyebode (2019) who stated that professionalism in public procurement relates not only to the levels of education and qualifications of the workforce but also to the professional approach in the conduct of business activities. If the workforce is not adequately educated in procurement matters, serious consequences; including, breaches of codes of conduct occur. Lack of a high degree of professionalism in public procurement will lead to corruption, which ultimately impedes compliance. The procurement officers must be trained and aware about all regulations in relation to procurement and related procedures. Thus, professionalism increases public procurement compliance. This study is also in consonance with Rae and Sands (2017), and Ismail *et al(* 2018) who revealed that enhancing integrity in public procurement systems, promoting actions to integrate risk-management strategies for mapping, detection and mitigation throughout the public procurement cycle, applying oversight and control mechanisms to support accountability throughout the public procurement cycle, encouraging transparent and effective stakeholder participation are drivers facilitating the implementation of public procurement regulations and administration of construction contract in tertiary education sector.

The result of the hypothesis which states that there is no significant difference in the opinion of Tertiary Institutions on drivers affecting Public Procurement Regulation and administration of Construction Contract in Tertiary Education Sector in Nigeria showed that there is a significant

difference in the opinion of institutions on drivers affecting public procurement regulation and administration of construction contract in Tertiary Education Sector in Nigeria (P-value = 0.001), hence the hypothesis was rejected. The result of Bonferroni's multiple comparisons and Dunnest test showed that South – South, and North –Central are the sources of the variation/ difference. This implied that the opinion of Tertiary institutions in South – South, and North – Central significantly differ from Tertiary institutions in other zones. The difference may be attributable to the result of some factors like; enhancing integrity in public procurement systems, willingness to comply because of moral obligation and social influence, information, communication and active monitoring, stakeholders' familiarity with the rules and transparency in procurement process which all ranked least in the two zones.

4.9.2 Bottlenecks inhibiting the Implementation of Public Procurement Regulations and administration of Construction Contract in Tertiary Education Sector: The result of the study revealed that the top five bottlenecks inhibiting the Implementation of Public Procurement Regulations and administration of Construction Contract in Tertiary Education Sector in Nigeria are lack of capacity, dearth of committed leadership, inadequate legal framework, high cost of tendering, and insufficient project planning. Other challenges that were considered to have high influence on the extent of implementation of public procurement regulations among tertiary institutions include non-involvement of stakeholders notably construction professionals, resistance to change defaulting contractor, poor project management, lack of awareness and training, and inadequate monitoring and control mechanisms. Furthermore, dearth of project management competencies, lack of transparency, risks (inaccurate estimate, poor experiences, unclear specification), low ethical practices, and Late passage of appropriation were also critical challenges affecting the implementation of Public Procurement Regulations. In addition, the participants in this study revealed that the following factors inhibit the extent of implementation of Public Procurement Regulations among tertiary institutions. These include non-prosecution of defaulters, lengthened approval processes by regulatory agencies, lack of transparency in the procurement process, dearth of personnel, and none utilisation of ICT. The last five bottlenecks/challenges that were rated by the participants in this study include conflict of interests, cumbersome requirements through verification, appraisal, management, and information, inadequate budgeting, political interference, and corruption (bid rigging, kickbacks and inflated contract costs). The result is an indication that stakeholders should bear in mind that construction contracts may not always be successfully implemented, as several factors will mitigate the effective and efficient implementation of construction project in line with the observation of Mugabe *et al*. (2019).

This study is in agreement with Afolayan and Rotimi (2017) who identified some challenges to procurement compliance as lack of transparency in the procurement process, and political interference. It is also in consonance with Nigerian Institute of Quantity Surveyors (NIQS) (2016) which revealed that various forms of corruption, including bid rigging, kickbacks, and inflated contract costs. This study is also in alignment with Adeboyejo and Ogunlana (2019) who observed that weak institutional capacity and corruption were major hindrances to effective implementation of public procurement guidelines in Nigeria. The findings partly support the study by Pooworakulchai *et al*. (2017) which concluded that the factors affecting the government's project contract management are both public and private sectors internal influences., noting that the problem is caused by personnel, documentation, and the work processes related issues.

The result of the hypothesis which states that there is no significant difference in the opinion of Tertiary Institutions on Bottlenecks/Challenges affecting Public Procurement Regulation and Administration of Construction Contract in Tertiary Education Sector in Nigeria showed that there is a significant difference in the opinion of institutions on bottlenecks/challenges affecting public procurement regulation and administration of construction contract in Tertiary Education Sector in Nigeria (P-value = 0.001), hence the hypothesis was rejected. The result of Bonferroni's multiple comparisons and Dunnest test showed that South – South, and North –East are the sources of the

variation/ difference. This implied that the opinion of Tertiary institutions in South – South, and North –East significantly differ from Tertiary institutions in other zones. The zonal difference in the perception of the bottlenecks/challenges affecting public procurement regulation and administration of construction contract in Tertiary Education Sector in Nigeria may be attributable to political interference and corruption (bid rigging, kickbacks and inflated contract costs) which were ranked least in the two zone as against the other zones. This is somehow at variance with the findings of Moneke (2020) which revealed that the attainment of the desired impact of public procurement Act on construction projects performance, is being significantly hindered by some constraints/challenges in the Federal Institutions in the South East by some factors like political interference by the executives, complexity procurement regulation and size; and complexity of procurement. While, Nmecha, *et al*. (2023) found the major impact factors that affect the effectiveness of PPA in contract awarding in public sectors in some cities of south-south to include; Communication challenges, corruption, delay in project implementation, financial challenge (lack of adequate resources) and inadequate PPA implementation.

5 Conclusion and recommendations

This study determined the factors affecting the administration of tertiary education sector construction projects under public procurement regulation in Nigeria and found that the top five bottlenecks inhibiting the Implementation of Public Procurement Regulations and administration of Construction Contract in Tertiary Education Sector in Nigeria are lack of capacity, dearth of committed leadership, inadequate legal framework, high cost of tendering, and insufficient project planning. It also found that the top five drivers facilitating the Implementation of Public Procurement Regulations and administration of Construction Contract in Tertiary Education Sector in Nigeria are top management support, corporate governance, professionalism in public procurement, effective stakeholder participation, and organizational culture. It is therefore concluded that stakeholders should not be oblivious of the fact that construction contracts may not always be successfully implemented, as several factors will mitigate or drive the effective and efficient implementation of construction project. Consequent on the findings and conclusion of this study it is recommended that; Stakeholders should bear in mind that construction contracts may not always be successfully implemented, therefore adequate consideration should be given to several factors that can mitigate or drive the effective and efficient implementation of construction projects. For public procurement regulations to optimally support and influence sustainable contract administration in tertiary education sector projects, government should ensure adequate enforcement of existing public procurement regulations and encourage satisfactory framework for the enforcement.

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EVALUATION OF THE FACTORS AFFECTING THE IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN THE NIGERIAN CONSTRUCTION INDUSTRY

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Abstract
This study evaluated the factors influencing the implementation of blockchain technology (BT) in project delivery in the Nigerian construction industry. Survey design was adopted for the study. Data were obtained using 721 copies of structured questionnaire. The methods of data analysis were descriptive and inferential statistics. The study found that payment processing, efficiency, and transparency are the critical drivers facilitating the implementation/adoption of blockchain technology among construction firms operating in the Nigerian construction industry. The study concluded that there is no significant difference in the opinion of the firms on driver facilitating the implementation of blockchain technology among construction firms. The study also found that lack of knowledge, inadequate technical expertise, absence of construction ICT driven policy via an institutional framework, lack of training, and lack of incentives are the critical barriers inhibiting the implementation of blockchain technology in the study area. It is also concluded that there is no significant difference in the opinion of construction firms on inhibitors/barriers influencing the implementation of blockchain technology among Construction Firms in the Nigerian Construction Industry. The study recommended that construction firms should train/educate construction professionals on blockchain technology for effective and sustainable project delivery in the Nigerian construction industry.

Keywords: Blockchain Technology, Evaluation, Factors, Implementation, Nigerian Construction Industry

1.0 Introduction

The Present construction project management is confronted with several problems which include the dearth of trust, poor management of information, poor contract award processes, and process automation (Liu *et al*, 2023; Hamma-adama *et al.,* 2020). These problems have persisted due to inability to embrace contemporary technologies such as Blockchain Technology in the construction sector (Tezel *et al.,* 2020). The issues ranging from little confidence and transparency among the important members in the construction process, weak systems of transaction recording and documentation, delayed project delivery, abandonment of projects, complex process structure and massive corruption are some critical issues Blockchain Technology (BT) is designed to resolved (Umbenhauer and Younger 2018; Dwivedi and Carvalho 2022; El Baz *et al.,* 2022).

A study by Aibinu and Jagboro (2002) posited that the main criticism confronting Nigerian construction sector is the increase rate of delays in construction project delivery. Also, Abisuga *et al.*, (2014) opined that the Nigerian construction sector outputs in term of quality, time and cost have not been satisfactory. This has resulted in time and cost overrun factors which are directly and indirectly linked to construction delays. Hence, if blockchain technology was implemented during the project initiation all parties involved could have keyed into the network and drawings, specification clearly outlined and uploaded into the network for all to assess.

Likewise, construction projects are confronted with other sorts of challenges such as mistakes, project delays, and accident at various levels (Fashina *et al.,* 2021). Another challenge identified is the lack of accountability in the construction sector (Boadu *et al.,* 2020). The effects of which has squeezed profits margins and have left projects suffer setback in terms of delays and abandonment. Hence, organisation is determined to seek for ways to reduce cost and deflect blame from the resulting failures. Payment and project management issues have affected project delivery. Delayed payments and relating cash flow issues have been a headlong hindrance in the construction sector.

In addition, the challenge of diversion of funds paid to contractors for project execution has been common trend in the Nigerian construction sectors. This common problem will be eliminated if blockchain system is setup to aid monitoring of smart contracting process. To monitor the smart contracting process, a thorough blueprint is required in terms of the smart contracts (reflecting the monitoring capabilities), the oracles (identifying the data sources), and the monitoring data (balancing between on-chain and off-chain data) (Zheng *et al,* 2020). The blockchain uses smart contracts (chaincode) to ensure a correct execution of predefined business rules (Kostal *et al.,* 2019). Whereby work progress is monitored and followed by the various agencies responsible. With this they can confirm the level of work attained and payments issued according to percentage of work executed. The disaggregated structure of the construction industry makes it suitable for the application of the BT and smart contracting (Shojaei, 2019), despite this loose structure being a disadvantage in the implementation of innovation and new technologies (Shojael, 2019). In view of the above identified issues, the traditional method of contract award has been found faulty, awkward, inefficient and have been identified with many irregularities which has affected project timely project delivery.

Several Studies have revealed that the level of digitalization in the construction industry is still below expectation and it is in infancy stage when compared to other industries that have long embraced the digital form of operation (Perera *et al.,* 2017; Lamb, 2018; Leviäkangas *et al,* 2017; Mason and Escott, 2018). Also, report from McKinsey Global Institute (2016) showed that the level of digitalization index for the construction industry is classified as the lowest out of 22 industries. Past studies have focused on finding the key enablers and challenges to implementation of Blockchain Technology in a more generalised context rather than at the construction firm level. Some studies focussed on the barriers responsible for poor implementation of blockchain technology in the construction sector, while others solely focussed on the drivers facilitating blockchain adoption. In order to unearth the critical factors influencing BT implementation in the Nigerian construction industry and contribute to studies on blockchain technology, this study evaluated the level of influence of both the drivers, and the inhibitors influencing the implementation of BT in the Nigerian construction industry. This will provide valuable insights and help the firms to take better decisions.

2.0 LITERATURE REVIEW

2.1 What is blockchain Technology?

Blockchain is a ledger-based tamper-resistant technology that enables various use cases across a wide range of applications and represents a continuously maintained and controlled database considering growing factors and collected data sample sets (Kumara and Mallick, 2018). Started with the popular cryptocurrency Bitcoin makes it possible to spread digital information without copying or altering it. In the classic construction industry, data is stored in a central database that can be accessed from various locations. Transactions are aggregated into blocks over a period and then added to a persistent chain. These blocks cannot be modified once added to the chain, making the transaction chain publicly auditable and completely un-hackable (Taylor, 2017). Trust is the main feature of blockchain technology. When the construction business or activities are carried out on a blockchain system, the participants involved do not need to have an established trust relationship if they trust the blockchain itself. In addition, blockchain technology ensures information sharing by making each project participant a custodian of all information flowing through the project lifecycle (Wang *et al.,* 2017). unlike internet information exchange, where information is passed from point to point, in blockchain the same information is passed to the entire system. Therefore, no person, including the sender, has more information than others (Wang *et al.,* 2017).

2.2 Barriers Hindering Blockchain Technology implementation in the construction industry

There are various barriers to BT Implementation in the construction sector which have been identified in literature such as lack of validity or authorisation issues (which as result of insufficient testing of the new technology hinders the adoption of the technology) (Akinradewo *et al.,* 2022), absence of required regulations, laws and other legal issues is also a major barrier (Biswas and Gupta, 2019). Others include Authorisation issues, Vulnerability of smart contract(Human error and poorly coded contracts could have a terrible effect), high Energy consumption, transactional uncertainties, interoperability(When various applications need to link, data transfer challenges arise, which is a major task for BIM in construction), reluctance to adopt, lack of infrastructure, security issues, resistance to change, skills (insufficient blockchain technology skills among employees and management will have an effect on how blockchain is planned to be implemented and used in the construction sector), technological state of the industry(due to the delayed digitalization, the construction industry's output has basically, lagged behind that of other sectors), and Poor digitalisation of the construction sector(Hamma-adama et al., 2020; Risius and Spohrer, 2017; Hawlitschek et al., 2018; Vidan and Lehdonvirta, 2019; Akinradewo et al.,2022; Mahmudnia et al.. 2022; Yildizbasi,2020; Rana et al..2021; Singh and Kim, 2019; Rana et al., 2021; Wang et al., 2020; Nofer et al., 2017; Rejeb et al., 2022; Biswas and Gupta, 2019; Gurgun et al., 2022, and Okanlawon *et al.,* 2023).

2.3 Drivers Facilitating the Implementation of BT in the Nigeria Construction Industry

The drivers facilitating the implementation of blockchain technology in the Nigeria construction industry are payment processing, efficiency, Transparency, incentives and support by various agencies, capacity building and development, stakeholders" awareness, smart contract,organizational readiness, management commitment and support, and information sharing (Wang *et al.*,2019b; Wang *et al.*2019c, and Okanlawon *et al.,* 2023). Others are Inter-organizational trust, Relational governance, Data transparency, and Data Immutability (Chen *et al.* 2017; Wang *et al.,* 2019). Blockchains can also improve efficiency, effectiveness as well enhance the performance of project delivery in the construction sector by automating many transaction processes using smart contracts, reducing complexity, and improving accuracy. For example, bank transfers, which normally take several business days and can incur more transactional costs, can be made free and instantaneously with blockchain.(Smith and Orourke, 2019).

3.0 Methodology

The aim of this research is to evaluate the factors influencing the implementation of blockchain technology(BT) in project in the Nigerian construction industry. Data were obtained using 721 copies of structured questionnaire. The methods of data analysis were simple percentage, mean score, and Kruskal-Wallis test. Using a 5-point scale, the decision rule in this study is that any driver/barrier of Blockchain technology with an overall mean score of 1.0-1.49, 1.5-2.49, 2.5-3.49, 3.5-4.49, and 4.5-5.0 is considered to have a very low level of influence; low level of influence, moderate level of influence, high level of influence ; and very high level of influence respectively (Ogenma 2018). Kruskal-Wallis test was used to test the hypothesis which states that there is no significant difference in the opinion of construction firms on drivers and barriers influencing the level of implementation of BT in the Nigerian construction industry.

4.0 Results and Discuss

This section contains the results of the analysis of data collected for the study. It contains the descriptive results of the questionnaire distributed and returned, and firm characteristics. This section also contains the result of evaluation of critical factors affecting the implementation of BT among construction firms in the Nigerian construction industry. The results of the hypothesis were also presented in this section.

4.1 Location of the firms

Figure 1 shows the results of the analysis of location of the firms. It shows that 64.1%, 66.1%, 72.2%, 58.7%, 64.7%, 57.0%, 71.4%, 52.1%, and 51.9% of the respondents were from the Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo, and Rivers region of Nigeria respectively.

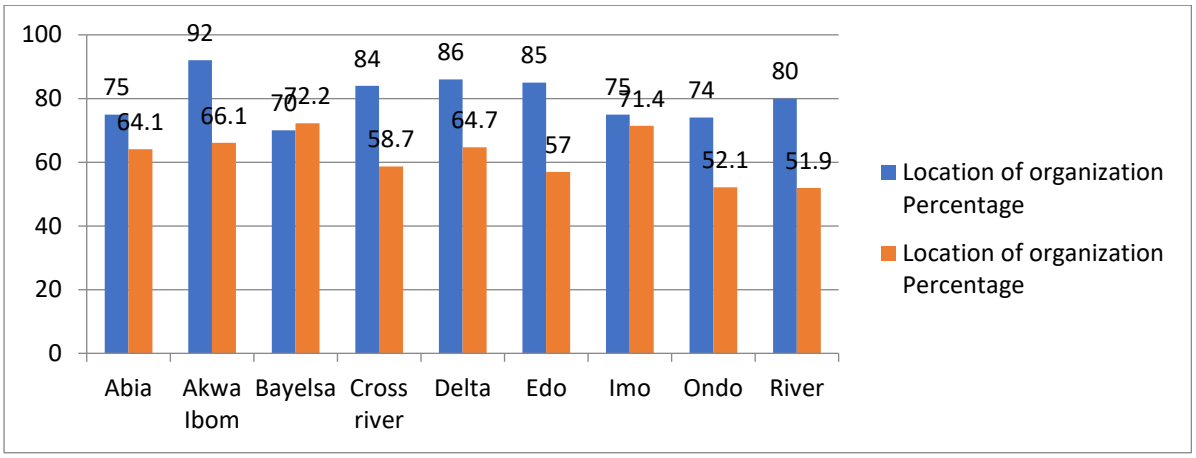

Figure 1**: Location of Construction Firms**

4.2 Educational Qualification of Respondents

The level of educational qualification of the respondents was also examined. The result presented in table 1 also shows that 39.0% of the respondents have Doctorate Degree, while 50.9% of the respondents have Masters' degree, also 8.3% hold Bachelor's degree, while 1.8% and have Higher Diploma degree and related qualification. This infers that the respondents that partook in this study are well educated and knowledgeable. Hence, data gotten from them are valid and dependable.

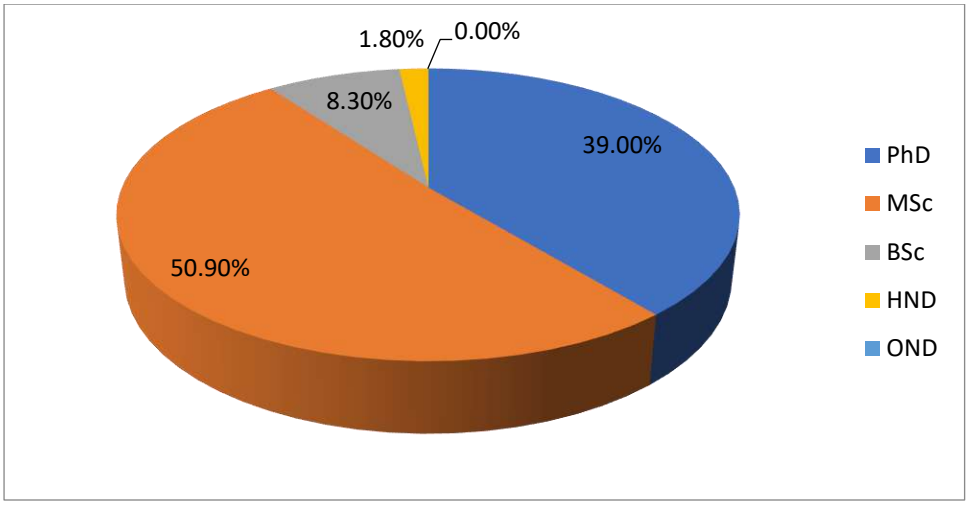

Figure 2: Educational qualification of the respondents

4.3 Years of Experience

Moreso, the results in Figure 3 shows that 23.3%, 34.3%, 29.0%, and 13.4% of the respondents have 1– 10years, 11 – 20years, 21-30years, and 30years and above overall years of experience in the construction sector respectively. It infers that majority of the respondents considered in this study have worked more 20 years with their respective organizations and in the industry. Therefore, the information gotten from them are reliable.

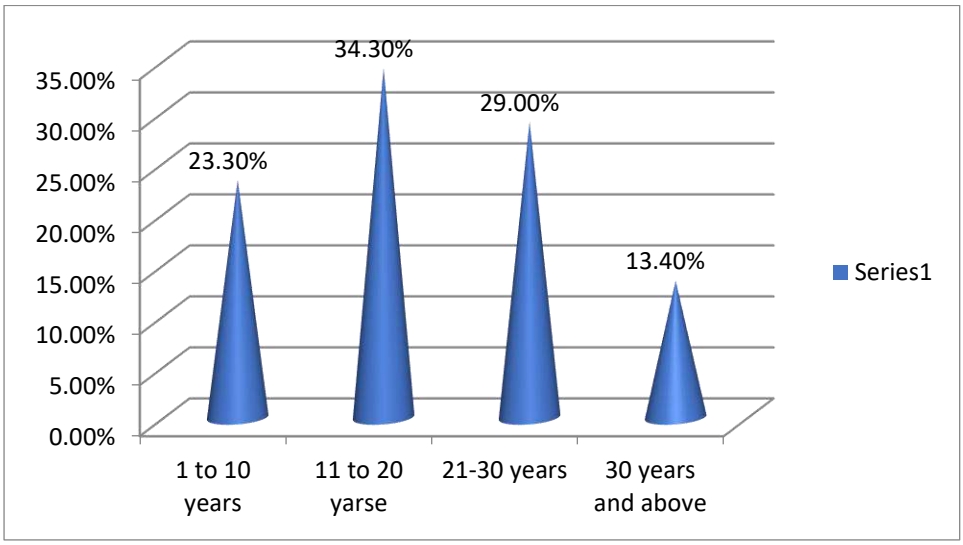

Figure 3: Years of experience

4.4 Professional Affiliation

The level of professional qualification of the respondents was analysed, the results in figure 4 revealed that 14.7%, 10.7%, 10.1%, 17.6%, 4.3%, and 42.6% of the respondents are Project Managers, Quantity Surveyor, Builder, Construction Manager, Procurement personnel/officer, and Engineering (Civil, Mechanical, Electrical) respectively.

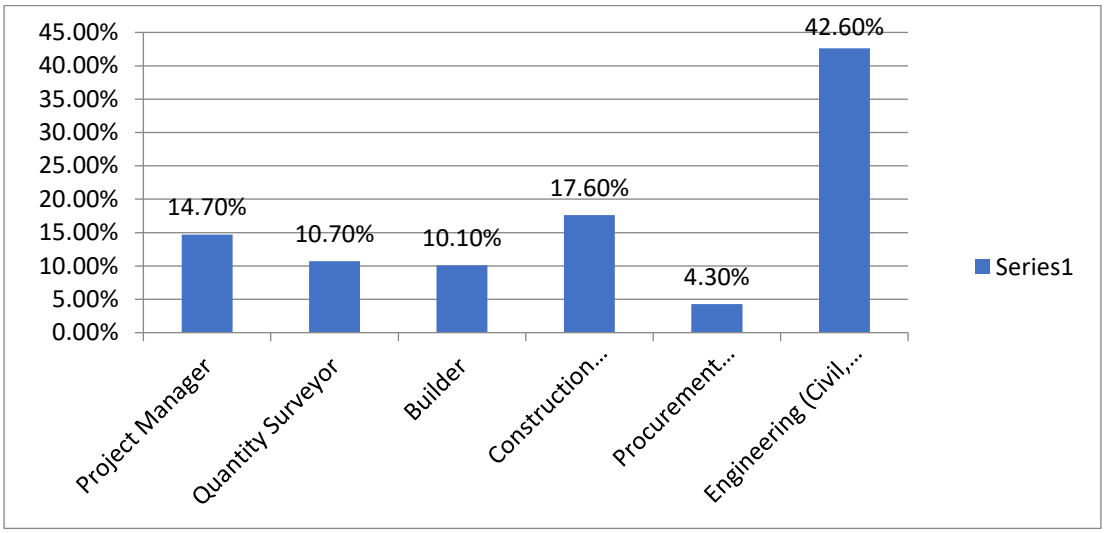

Figure 4: Professional qualification

4.5 Membership of Professional Bodies

Finally, figure 5 shows the percentage of the respondents who are members of professional bodies. The results reveal 97.8% are registered members of one or more profession, while 2.2% are not members of any professional body.

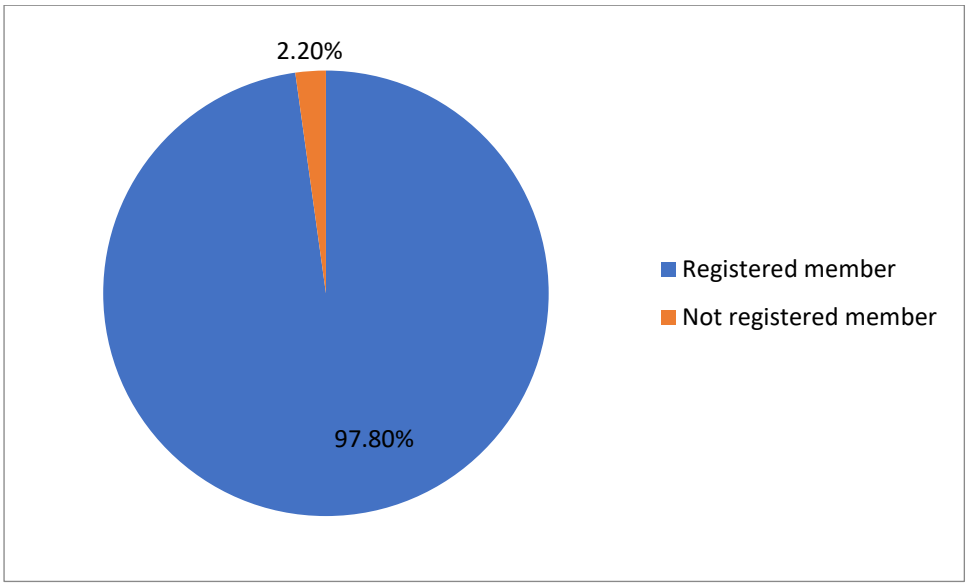

Figure 5: Membership of Professional Bodies

4.6 Drivers Affecting the Implementation of Blockchain Technology in the Nigerian Construction Industry

The result in table 1 reveals the critical drivers that have high influence on the level of implementation of blockchain technology among small firms. These include capacity building and development (MS=4.4800), Payment processing (MS=4.4367), transparency (MS=4.4333), stakeholders' awareness (MS= 4.4300), Incentives and support by various agencies (MS=4.4167), efficiency (MS=4.3667), smart contract (MS=4.3133), organizational readiness (MS=4.2767), information sharing (MS=4.2233), and management commitment and support (MS=4.2200). However, the following drivers were considered to have moderate influence on the extent of implementation of blockchain technology among small firms in the study area. These factors include research and development (MS=3.3633), supply chain management (MS=3.3333), organizations' structure and systems(MS=3.1300), demand of customer and other stakeholders (MS=3.0267), trust and commitment among partners(MS=2.9700), organizational cultural values (MS=2.9267), technology readiness(MS=2.9067), external pressure (MS=2.9033), Monitoring and auditing supply chain partners(MS=2.8667), competitive and marketing advantage (MS=2.7833), awareness (MS=2.7833), Sharing resources (MS=2.7033), Cost reduction (MS=2.6700), and Joint effort and planning (MS=2.4433).

The result in table 1 also revealed the critical drivers that highly influenced the extent of implementation/adoption of blockchain technology among medium construction firms. These factors include transparency(MS=4.4746), Payment processing (MS=4.4542), Efficiency(MS=4.4169), Incentives and support by various agencies (MS=4.4034), Capacity building and development(MS=4.4000), Smart contract(MS=4.3119), Organizational readiness(MS=4.3085), Organizational readiness (MS=4.3085), Information sharing(MS=4.2983), Stakeholders" awareness(MS=4.2949), and Management commitment and support(MS=4.1627). However, some of the drivers had moderate influence on the extent of implementation/adoption of blockchain technology among medium construction firms in the Nigerian construction industry. These factors include, organizations' structure and systems (MS=3.2644), research and development (MS=3.2000), demand of customer and other stakeholders (MS=2.9831), supply chain management (MS=2.9661), competitive and marketing advantage (MS=2.8983), organizational cultural values(MS=2.7763), trust and commitment among partners(MS=2.7661), Technology readiness(MS=2.7220), Sharing resources(MS=2.6305), monitoring and auditing supply chain partners(MS=2.5593), and External pressure(MS=2.5661). Moreso, cost reduction (MS=2.3864), joint effort and planning (MS=2.2983), and level of awareness (MS=2.1831) were considered to have low influence on the extent of implementation/adoption of blockchain technology among medium construction firms in the Nigerian construction industry.

The result in table 1 revealed that efficiency (MS=4.5873), and Payment processing (MS=4.5317) are the two critical drivers/facilitators that have very high influence on the extent of implementation of blockchain technology among large construction firms. Other drivers that have high influence as rated by large constructions firms include transparency(MS=4.4444), stakeholders" awareness (MS=4.3730), incentives and support by various agencies(MS=4.3730), organizational readiness (MS=4.3651), smart contract (MS=4.3492),Management commitment and support (MS=4.3016), Capacity building and development(MS=4.2778), information sharing (MS=4.1508), and organizations' structure and systems (MS=3.5794). However, some of the drivers were considered to have moderate influence on the extent of implementation of blockchain technology among large construction firms in the study area. These drivers/facilitators include supply chain management (MS=3.4683), trust and commitment among partners (MS=3.3413), technology readiness(MS=3.2460), demand of customer and other stakeholders (MS=3.2222), Research and development (MS=3.1270), monitoring and auditing supply chain partners (MS=3.0556), competitive and marketing advantage (MS=3.0317), organizational cultural values(MS=2.9921),

cost reduction(MS=2.9683), external pressure (MS=2.8413), Awareness(MS=2.8413), and sharing resources (MS=2.8254). Furthermore joint effort and planning (MS=2.3810) was considered to have low level of influence on the extent of implementation of blockchain technology among large construction firms in the study area.

The combined mean scores in table 1 showed that the ten (10) critical drivers that facilitate the implementation/adoption of blockchain technology among construction firms operating in the Nigerian construction industry are payment processing (MS=4.4742), efficiency (MS=4.4570), Transparency (MS=4.4508), Incentives and support by various agencies(MS=4.3977), capacity building and development (MS=4.3859), stakeholders" awareness (MS=4.3660), smart contract(MS=4.3248), organizational readiness (MS=4.3168), management commitment and support (MS=4.2281), and information sharing(MS=4.2241). The outcome of study is in consonance with Okanlawon *et al.,* (2023) who opined that transparency and information sharing drivers' area critical drivers of BT implementation in the Nigerian construction sector. This study is also in alignment with Seebacher and Schuritz (2017), Galvez *et al.* (2018), Lo *et al*. (2018), Wang *et al.,* (2019b), and Wang *et al.* (2019c) who stated that data transparency is a critical driver influencing the implementation of blockchain technology in the construction sector. Blockchain technology brings transparency to everyone on the network as transactions are visible to all connected computers without being monitored by any third party. Therefore, the blockchain-based system offers great improvements in transparency compared with existing centralized ledgers. Blockchains can also improve efficiency by automating many transaction processes using smart contracts, reducing complexity, and improving accuracy (Smith and Orourke, 2019).

Table 1: Drivers Affecting the Implementation of Blockchain Technology in the Nigerian Construction Industry

Factors Affecting BT Implementation in the NCI	**Small Firm**	**Medium Firm**	**Large Firm**	**Combined**	**Combined**
	Mean score	**Mean score**	**Mean score**	**Mean score**	**Rank**
Management commitment and support	4.2200	4.1627	4.3016	4.2281	9
Research and development	3.3633	3.2000	3.1270	3.2301	13
Stakeholders" awareness	4.4300	4.2949	4.3730	4.3660	6
Organizational readiness	4.2767	4.3085	4.3651	4.3168	8
Technology readiness	2.9067	2.7220	3.2460	2.9582	16
External pressure	2.9033	2.5661	2.8413	2.7702	20
Incentives and support by various agencies	4.4167	4.4034	4.3730	4.3977	4
Demand of customer and other stakeholders	3.0267	2.9831	3.2222	3.0773	14
Awareness	2.7833	2.1831	2.8413	2.6026	23
Sharing resources	2.7033	2.6305	2.8254	2.7197	21
Capacity building and development	4.4800	4.4000	4.2778	4.3859	5
Joint effort and planning	2.4433	2.2983	2.3810	2.3742	24
Monitoring and auditing supply chain partners	2.8667	2.5593	3.0556	2.8272	19
Competitive and marketing advantage	2.7833	2.8983	3.0317	2.9044	17
Information sharing	4.2233	4.2983	4.1508	4.2241	10
Trust and commitment among partners	2.9700	2.7661	3.3413	3.0258	15
Cost reduction	2.6700	2.3864	2.9683	2.6749	22

Organizational cultural values	2.9267	2.7763	2.9921	2.8984	18
Organizations' structure and systems	3.1300	3.2644	3.5794	3.3246	11
Transparency	4.4333	4.4746	4.4444	4.4508	3
Efficiency	4.3667	4.4169	4.5873	4.4570	2
Payment processing	4.4367	4.4542	4.5317	4.4742	1
Supply chain management	3.3333	2.9661	3.4683	3.2559	12
Smart contract	4.3133	4.3119	4.3492	4.3248	7

Source: Researcher's Field Data (2023)

4.7 **Difference in the opinion of Construction Firms on Drivers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry**

Table 2 shows the result of Kruskal Wallis test that was used to test the hypothesis which states that there is no significant difference in the opinion of construction Firms on drivers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry. The P-value of 0.393 is greater than 0.05 significance level, hence the hypothesis was accepted. This indicates that there is no significant difference in the opinion of Construction Firms on drivers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry**.** This is because they have similar opinion, knowledge and understanding of the drivers.

Table 2: Kruskal Wallis Test for Comparing the opinion of Construction Firms on Drivers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry

Drivers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry	**Mean Rank**	**Decision @ 0.05 Sig. level.**
Small Firm	36.67	
Medium Firm	32.29	
Large firm	40.54	
Chi- Square	1.867	
D.F	2	
P-Value	0.393	Accepted

Source: Researcher's Field Data (2023)

4.8 Inhibitors of Blockchain Technology Implementation in Nigerian Construction Industry

The result in table 3 revealed the factors inhibiting the implementation of Blockchain Technology in construction projects delivery among small , medium and large construction firms in the in Nigerian Construction Industry. The results showed that the following critical barriers or inhibitors have high influence on the extent of implementation of blockchain technology among

small construction firms. These include lack of education (MS=4.4033), inadequate technical expertise (MS=4.3733), absence of construction ICT driven policy via an institutional framework (MS=4.3633), lack of knowledge (MS=4.3300), Perception of low economic return(MS=4.3100), lack of awareness and understanding is preventing the spread of this technology(MS=4.3067), reluctance to adopt (MS=4.3033), and lack of top management commitment (MS=4.2833). Others are lack of infrastructure (MS=4.2667), incentives are insufficient for distributed crowd collaboration(MS=4.2633), lack of training(MS=4.2633), data protection and cybersecurity issues (MS=4.1900), high implementation cost (MS=4.1800), poor digitalization of the construction industry (MS=4.1500), resistance to change from various stakeholders (MS=4.1133), technological limitations of many construction companies (MS=4.1000), security issues(MS=4.0567), energy concerns and usability(MS= 3.6200), and lack of resources (MS=3.5400).

Table 3 also showed the critical barriers that inhibit the implementation of blockchain technology among medium construction firms in the study area. The factors include lack of knowledge(MS=4.4542), incentives are insufficient for distributed crowd collaboration (MS=4.3763), inadequate technical expertise(MS=4.3525), lack of training(MS=4.3525), lack of education (MS=4.3017), lack of awareness and understanding is preventing the spread of this technology (MS=4.2983), perception of low economic return (MS=4.2983), reluctance to adopt (MS=4.2712), absence of construction ICT driven policy via an institutional framework(MS=4.2475), and lack of top management commitment(MS=4.2373). In addition, other inhibitors that were considered critical by medium construction firms are lack of infrastructure (MS=4.2203), resistance to change from various stakeholders (MS=4.1864), poor digitalization of the Construction industry (MS=4.1559), data protection and cybersecurity issues (MS=4.1305), high implementation cost (MS=4.1051), security issues (MS=4.0746), technological limitations of many construction companies(MS=4.0407), energy concerns and usability(MS=3.9458), data malleability issues: data integrity is a key issue in the blockchain environment(MS=3.8576), high operation cost (MS=3.6305), and lack of resources(MS=3.5627).

Furthermore, large construction firms in the study area opined or posited that the following critical factors highly inhibit the extent of implementation of blockchain technology in construction project delivery. These factors include absence of construction ICT driven policy via an institutional framework (MS=4.3730), lack of knowledge (MS=4.3651), lack of infrastructure (MS=4.3492), lack of training (MS=4.3016), reluctance to adopt (MS=4.3016), lack of awareness and understanding is preventing the spread of this technology (MS=4.2937), perception of low economic return (MS=4.2857), and inadequate technical expertise (MS=4.2619). Other inhibitors that were considered to be critical to implementation of blockchain technology among large construction firms are incentives are insufficient for distributed crowd collaboration(MS=4.2619), technological limitations of many construction companies(MS=4.2619), energy concerns and usability (MS=4.2143), lack of top management commitment (MS=4.1984), resistance to change from various stakeholders (MS=4.1746), security issues (MS=4.1270), lack of education (MS=4.0794), data protection and cybersecurity issues (MS=4.0714), data malleability issues: data integrity is a key issue in the blockchain environment(MS=4.0317), high implementation cost (MS=4.0159), and technical challenges (MS=4.0000). Moreso, lack of resources(MS=4.0000), digitalization of the construction industry (MS=3.9762), supply chain complexity(MS=3.8730), high operation cost (MS=3.6984), market uncertainty (MS=3.5476), poor, and inadequate skills among stakeholders (MS=3.5238), authorization issues (MS=3.5159), and security standardization and compatibility(MS=3.5000) were also rated by the large construction firms as critical factors that highly influenced the level of implementation of blockchain technology in construction project delivery in the Nigerian construction sector.

The combined mean scores in table 3 showed that the critical barriers that inhibit the implementation/adoption of blockchain technology among construction firms operating in the Nigerian construction industry are lack of knowledge(MS=4.3831), inadequate technical

expertise(MS=4.3292), absence of construction ICT driven policy via an institutional framework(MS=4.3279), lack of training(MS=4.3058), incentives are insufficient for distributed crowd collaboration(MS=4.3005), and lack of awareness and understanding is preventing the spread of blockchain technology(MS=4.2996). In addition, perception of low economic return(MS=4.2980), reluctance to adopt a new technology(MS=4.2920), lack of infrastructure (MS=4.2787), lack of education(MS=4.2615), lack of top management commitment(MS=4.2397), data protection and cybersecurity issues(MS=4.1640), resistance to change from various stakeholders(MS=4.1581), high implementation cost(MS=4.1479), and technological limitations of many construction companies (MS=4.1342) were also considered to be critical and have high influence on the extent of implementation of blockchain technology in the Nigerian construction industry. Moreso, Poor digitalization of the Construction industry(MS=4.0940), security issues(MS=4.0861), energy concerns and usability(MS=3.9267), data malleability issues: data integrity is a key issue in the blockchain environment(MS=3.7731), lack of resources(MS=3.7009), high operation cost (MS=3.5963), and supply chain complexity(MS=3.5411) also hindered/inhibited the level of implementation of blockchain technology in the Nigerian construction industry. This study is agreement with Okanlawon *et al.*, (2023), who opined that authorization issue, legal issues, energy consumption and security issues are critical factors inhibiting blockchain technology implementation in the developed and developing countries. This study is in consonance with Rana et al. (2021), and Wang *et al*. (2020) who posited that reluctance of organizations adopt blockchain technology is a critical barrier that affects its implementation. The finding of this study also aligns with Hamma-adama *et al.* (2020) who stated that despite technological advancement in many other industries, the construction sector has been among the slowest to adopt digital technology in its operations.

Table 3: Inhibitors of BT Implementation

Inhibitors of BT Implementation	Small Firm	Medium Firm	Large Firm	Combined
	Mean score	Mean score	Mean score	Mean score
High implementation cost	4.0967	4.0475	4.0159	4.0534
Supply chain complexity	3.3267	3.4237	3.8730	3.5411
Government and industry policies	3.0700	3.0271	3.3333	3.1435
Market and customer pressures	3.0800	2.7356	3.1111	2.9756
Market uncertainty	2.9167	3.0610	3.5476	3.1751
Security standardization and compatibility	3.0900	3.0746	3.5000	3.2215
Cultural disparity between supply chain partners	3.3700	3.1627	3.3571	3.2966

High operation cost	3.4600	3.6305	3.6984	3.5963
Energy concerns and usability	3.6200	3.9458	4.2143	3.9267
Technological limitations of many construction companies.	4.1000	4.0407	4.2619	4.1342
Data malleability issues: Data integrity is a key issue in the blockchain environment	3.4300	3.8576	4.0317	3.7731
Wasted Resources: Mining Blockchain requires a large amount of energy to securely calculate and verify transactions	2.9200	3.0271	3.2143	3.0538
Absence of construction ICT driven policy via an institutional framework	4.3633	4.2475	4.3730	4.3279
The energy consumed is not sustainable	2.3400	2.2983	2.7540	2.4641
Powerful holders of old paradigms will usurp it	2.1867	2.5864	2.6270	2.4667
Incentives are insufficient for distributed crowd collaboration	4.2633	4.3763	4.2619	4.3005
Technical Challenges: Blockchain technology is still in its early stages of development and faces several technical limitations	3.0867	3.1085	4.0000	3.3984
Human Challenges: A lack of awareness and understanding is preventing the spread of this technology.	4.3067	4.2983	4.2937	4.2996
Perception of low economic return	4.3100	4.2983	4.2857	4.2980
Unclear benefits and gains to stakeholders	3.1033	3.4881	3.8651	3.4855
Lack of integration	2.6367	3.2339	3.4524	3.1077
No support from government	2.9033	3.0373	3.2619	3.0675
Resistance from suppliers	2.1100	2.0678	2.3571	2.1783
Poor supplier commitment	1.9800	2.3220	2.4206	2.2409
Lack of partner trust	2.0867	2.6475	2.0794	2.2712
Lack of top management commitment	4.2833	4.2373	4.1984	4.2397

Lack of training	4.2633	4.3525	4.3016	4.3058
Lack of education	4.4033	4.3017	4.0794	4.2615
Lack of human resources capability	3.2233	3.2339	3.3889	3.2820
Lack of knowledge	4.3300	4.4542	4.3651	4.3831
Lack of resources	3.5400	3.5627	4.0000	3.7009
Authorization issues	2.8167	3.2983	3.5159	3.2103
Legal issues	2.6100	2.7763	2.9921	2.7928
Reluctance to adopt	4.3033	4.2712	4.3016	4.2920
Transactional uncertainties	2.7033	2.7729	3.0476	2.8413
Energy consumption	2.5100	2.6271	2.7222	2.6198
Lack of infrastructure	4.2667	4.2203	4.3492	4.2787
Security issues	4.0567	4.0746	4.1270	4.0861
Skills: Inadequate skills among stakeholders	2.9600	2.7288	3.5238	3.0709
Technological state of the industry	3.2300	3.0305	3.0079	3.0895
Poor Digitalization of the Construction industry	4.1500	4.1559	3.9762	4.0940
Fragmented and project-based nature of the sector	2.4500	2.6407	2.6190	2.5699
Weak stakeholders' satisfaction	2.6767	2.8475	3.4365	2.9869
High implementation cost	4.1800	4.1051	4.1587	4.1479
Lax 2x-long term partnership	2.7367	3.2847	3.3413	3.1209
Lax blockchain technology policy	2.7167	2.8814	3.0238	2.8740
Absence of Standardisation	2.9800	3.3763	3.1270	3.1611

Data protection and cybersecurity issues	4.1900	4.1305	4.0714	4.1640
Resistance to change from various stakeholders	4.1133	4.1864	4.1746	4.1581
High energy usability	2.9467	3.2983	2.9127	3.0526
Inadequate technical expertise	4.3733	4.3525	4.2619	4.3292

Source: Researcher's Field Data (2023)

4.9 Difference in the Opinion of Construction Firms on Inhibitors Influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry

Table 4 shows the result of Kruskal Wallis test that was used to test the hypothesis which states that there is no significant difference in the opinion of Construction Firms on inhibitors/barriers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry. The P-value of 0.338 is greater than 0.05 significance level, hence the hypothesis was accepted. This indicates that there is no significant difference in the opinion of Construction Firms on inhibitors/barriers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry**.** It showed that the opinions of the firms on the barriers are the same. This can be attributed to their level knowledge on the critical factors affecting the implementation of blockchain technology in the Nigerian construction industry.

Table 4: Kruskal Wallis Test for Comparing the opinion of Construction Firms on Inhibitors/Barriers influencing the Implementation of BT among Construction Firms in the Nigerian Construction Industry

Inhibitors/Barriers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry	Mean Rank	Decision @ 0.05 Sig. level.
Small Firm	71.04	
Medium Firm	76.10	
Large firm	83.86	
Chi- Square	2.167	
D.F	2	
P-Value	0.338	Accepted

Source: Researcher's Field work (2023)

5.0 Conclusion and Recommendation

The study assessed that the critical drivers that facilitate the implementation/adoption of blockchain technology among construction firms operating in the Nigerian construction industry. The study found that payment processing, efficiency, transparency, incentives and support by various agencies, capacity building and development, stakeholders' awareness, smart contract, organizational readiness, management commitment and support, and information sharing are the critical drivers facilitating the implementation/adoption of blockchain technology among construction firms operating in the Nigerian construction industry. The study concluded that there is no significant

difference in the opinion of the firms on driver facilitating the implementation of blockchain technology among construction firms operating in the Nigerian construction industry.

The study found that the critical barriers inhibiting the implementation/adoption of blockchain technology among construction firms operating in the Nigerian construction industry are lack of knowledge, inadequate technical expertise, absence of construction ICT driven policy via an institutional framework, lack of training, incentives are insufficient for distributed crowd collaboration, and lack of awareness and understanding of blockchain technology. In addition, perception of low economic return, reluctance to adopt a new technology, lack of infrastructure, lack of education, lack of top management commitment, data protection and cybersecurity issues, resistance to change from various stakeholders, high implementation cost, and technological limitations of many construction companies were also considered to be critical and have high influence on the extent of implementation of blockchain technology in the Nigerian construction industry. The study concluded that lack of knowledge, inadequate technical expertise, absence of construction ICT driven policy via an institutional framework, lack of training, and lack of incentives are for distributed crowd collaboration are the top five barriers inhibiting the implementation of blockchain technology in the study area. It is also concluded that there is no significant difference in the opinion of Construction Firms on inhibitors/barriers influencing the Implementation of Blockchain Technology among Construction Firms in the Nigerian Construction Industry.

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LEVEL OF ADOPTION OF LEAN CONSTRUCTION PRACTICES AMONG INDIGENOUS AND MULTINATIONAL CONSTRUCTION FIRMS IN NIGER DELTA REGION OF NIGERIA

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Abstract
The quest to enhance the of level of sustainability performance among construction firms in Niger Delta, Nigeria with a view to promoting sustainable project delivery have been advocated by many stakeholders and cannot be overemphasized. Hence this study was aimed at investigating the level of Lean Construction Practices (LCP) implementation among Indigenous and multinational construction firms in the Niger Delta region of Nigeria. Quantitative approach was adopted for this study. Data for the study were obtained using 1174 copies of structured questionnaire administered through random sampling technique. The method of data analysis used included simple percentage, mean score, and Mann-Whitney test. The study revealed that both the indigenous and multinational construction firms recorded moderate level of LCP adoption. However, it was observed that multinational firms have a significant higher level of adoption. The study recommended that construction industry stakeholders should improve on the level of implementation of LCP so as to achieve sustainable project delivery. Construction firms should create or support Lean research groups and initiatives, adopt a Lean culture, carry out lean training, adopt Lean as a firm strategy, and ensure adequate management commitment.
Keywords: *Adoption, lean construction practices, Indigenous and Multinational firms, Niger- Delta, Nigeria*

1.0 INTRODUCTION

Niger Delta region of Nigeria is severely affected by environmental degeneration because of economic activities and oil exploration over the years. According to Kadafa (2012), oil exploration and exploitation which has been on- going for several decades in the Niger Delta, has had disastrous impacts on the environment in the region and has adversely affected people inhabiting that region. It is noted in the study that the region has been rendered one of the five most severely petroleum damaged ecosystems in the world. Similarly, Ite *et al*. (2013) observed that the bulk proven oil reserves of the region have encouraged the influx of visitors and multinational oil corporations whose operations have created serious threats to the livelihood of several communities in the Niger Delta region.

Destruction of habitats, loss of biodiversity, destruction of ecosystem, destruction of farmlands to access onshore sites and marine resource areas, and water pollution all have extensive implications on the people's livelihoods in the region. Apart from the environmental degeneration suffered due to oil exploration, the fact that several construction activities which have been on to accommodate the activities and growing population, also add to the degeneration of the environment. Asad and Khalfan (2007) reported that construction has a significant effect on people's quality of life; construction outputs affect the nature, function and appearance of the towns and countryside in which people live and work. Construction practices in Nigeria, however, is characterised by many problems, such as waste generation, poor environmental and social sustainability, poor performances in terms of cost overruns in projects, poor project planning and control, poor project completion times and compliance with deadlines, and an increase in rework and defects (Oyewobi *et al.*, 2011; Oke and Ogunsemi, 2011; Afolabi, 2016; Otali *et al.*, 2021). Several studies proposed efficient construction management and project execution techniques. For example, Lean Construction Practices when implemented could proffer solution to some of these problems (Amade *et al.*, 2019; Mohammed *et al.*, 2020).

Lean construction has been defined in several ways by different authors. The most popular definition by Koskela *et al.* (2002) stated that lean construction is a way to design production systems to minimize waste of materials, time, and effort to generate the maximum possible amount of value. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements. Reducing the time from start to delivery by eliminating the source of waste in the workflow is one of the basic concepts of Lean enterprise. In construction, lean practices are used to reduce waste and increase productivity. Lean Construction Practices enhance the achievement of owner expectations using the absolute minimum amount of man, machine, and material. This is achieved by continuous pursuit, identification, and elimination of waste through a systematic approach that relies on team-integration and effective communication (Odomirok, 2015).

Sustainable development is therefore obligatory even in the traditional construction project delivery organisations. This is based on the growing needs to save cost, optimised performance and meet external stakeholders needs (Dangana *et al.,* 2012). The concept of sustainable construction is widely interpreted as the application of the principles of sustainable development to construction. According to Brundtland definition, sustainable development is development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). However, sustainable development requires balancing environmental, economic, and social pillars of sustainability (Otali *et al.,* 2021). The concept of sustainability refers to development without harming the environment, and it has now been applied to concerns about the future viability of ecosystems in developing countries. Lean Construction Practices can contribute to sustainability by prioritization of resources. This happens because one of the priorities of sustainable development or sustainable construction is reducing the demand for resources that impact the environment throughout the entire life cycle of a facility (Koranda *et al.,* 2012). Womack and Jones (1996) identified the principles of Lean production as value identification, value stream mapping, making value flow, achieving customer pull, and striving for perfection and continuous improvement. Elimination of waste, flow obstacles and other non-value adding activities are the core principles of Lean Construction (Dania, 2016).

Lean construction has the potential to eliminate wastes and improve customer (value), which invariably enhances the sustainability of the construction industry (Dania, 2016). This is because one of the cardinal objectives of sustainability is to eliminate wastes and improve value for money (Johnsen and Drevland, 2016). Value in this context encompasses social, economic, and environmental benefits associated with the delivery of construction projects to the client and end users (Khodeir and Othman, 2016). This explains the nexus between Lean Construction and Sustainability as both have mutual influence over the other.

Notably, lean construction is designed to make projects sustainable, achieving sustainability in construction projects delivery is possible by making the projects leaner (Johnsen and Drevland, 2016). From the foregoing, it could be seen that a relationship exists between lean construction and sustainability (Koranda *et al.,* 2012); meaning that the construction industry has a role to play in the attainment of the sustainability goal. In fact, studies have shown that lean construction can be applied to achieve sustainability in different areas and dimensions (Ogunbiyi and Goulding, 2013).

Despite this, there is insufficient/ limited evidence in the research literature to establish the level of adoption of Lean Construction Practices (LCPs) among indigenous and multinational construction firms in Nigeria, and the Niger Delta region of Nigeria in particular. Therefore, this research aims at filling in this gap by investigating the level of adoption of Lean Construction Practices among construction firms with a view to enhancing sustainability performance among indigenous and multinational construction firms in the Niger Delta region of Nigeria. This study also tested the hypothesis which states that there is no significant difference in the level of adoption of Lean Construction Practices among construction firms in Niger Delta region of Nigeria.

2.0 REVIEW OF RELEVANT LITERATURE

The construction industry in comparison to the manufacturing industry has lagged well behind in terms of productivity improvements. It is estimated that the construction industry lags some ten (10) years behind in productivity improvement measures (Sarhan *et al.,* 2018). Construction activities in most countries accounts for about 10% of the Gross National Product (GNP). In some European countries, such as Denmark, it is as high as 25% (Pearce *et al.,* 2012).

In the past decade, projects in the construction industry have been experiencing delays, wasteful spending, and inefficiency (Otali 2018, Koskela *et al.,* 2002). As a result, several approaches aimed at improving the performances of these projects have been developed. One of the approaches currently finding its way into the industry is Lean construction and its applicability in the construction sector. Lean construction integrates Lean principles developed mainly for the manufacturing industry with management systems within the construction industry to provide a new way for project management.

Furthermore, lean construction is argued to be a new philosophy of production, representing the adaptation of the concept of Lean manufacturing with the peculiarities of the construction industry. (Bajjou *et al.,* 2017). Lean construction has the potential of bringing innovative changes in the construction industry (Laisha *et al.,* 2019). Unlike current approaches to managing construction and programmatic improvement efforts, Lean construction provides the foundation for an operation-based project delivery system.

Olamilokun *et al.* (2014) suggested that Lean construction is a holistic facility design and delivery philosophy where the over-reaching aim is to maximize value to all stakeholders, through systematic, synergistic, and continuous improvements to contractual arrangements, product design, the construction process design and methods selection, the supply chain, and the workflow reliability of site operations. Sarhan (2018) opined that Lean construction as a management-based process that places emphasis on the reliability and speedy delivery of value to the customer. Its goal is to accomplish the project goals while minimizing waste, maximizing value, and pursuing perfection. Basically, lean construction's major objective is to eliminate waste from all the processes involved in construction industry(Viana *et al.,* 2017). Lean construction is a method of construction used in pursuing non-waste productivity and assuring significant quality through best practices. These practices include production levelling, waste reduction, and multi-process operations. Further to that, Lean is a philosophy that eliminates waste of various kinds in the production functions of a typical organization. It is a system that uses fewer inputs to produce the same output as those produced by the conventional mass production system, while at the same time delivering the required value and improved customer satisfaction. Lean construction is a production management philosophy focused on the execution of projects, the new means of design and construction, with a view to improving the previous construction methods.

Impacts of the application of lean construction to reduce the generation of waste and improve processes in construction was explored by Viana *et al.* (2017) in Brazil. The study was about the implementation of lean construction techniques in a construction work to reduce waste generation and improve the efficiency of the construction processes. The study found that the implementation of the concept of Lean Construction promoted a significant reduction (27%) of waste generation. Furthermore, it provided a reduction in the final cost of the project and increased the efficiency of processes.

Awareness, use and benefits of Lean technologies on construction projects in Nigeria was explored by Amade *et al.* (2021). The result indicated that the level of awareness of Lean Construction is still at a moderate level. Adamu and Abduhamid (2015), evaluated suitability of lean construction approach in Nigerian Project Delivery. The study revealed that lean construction approach adoption has shown significant success in addressing waste generation and non-value adding activities in

project delivery process in some developed countries. Lean construction is yet to be adopted in most of the developing countries, as is still new concept developed from Toyota.

Lean construction as a panacea for poor construction projects performance was investigated by Nwaki and Eze (2020). The study assessed construction professionals' perception of the awareness, adoption and benefits of lean construction in remedying poor construction project performance in the south-south region of Nigeria. A well-structure questionnaire distributed by hand and electronically using the snowball sampling technique were used to gather data from the participants from both the private and public organisations. Frequency, percentage, and factor analysis were used to analyse the collected data. It was found that the level of awareness of lean construction is high, but its adoption is low. Lean construction is a panacea for poor construction project performance because of its cost related benefits, value and relationship benefits, environmental benefits, quality improvement benefits, motivation and productivity benefits, profitability and market benefits, time and workflow benefits, waste reduction benefits, and rework reduction benefits. The creation of dedicated department/team for driving the lean initiative was recommended.

Adamu and Abdulhamid (2016) carried out a research on lean construction techniques for transforming Nigeria project delivery process. The aim of the study was to present a case where lean construction technique was adopted and to highlight on the benefits realised in the implementation process. The study established that LCP are used to optimize value in construction sites by extending planning to downstream to achieve reliable workflow. It makes the project participants to employ their commitment for success of the project in the project planning. Benefits of adopting lean construction technique in the South African construction industry was assessed by Akinradewo *et al.* (2018). Result of the analysed data revealed that clients, consultants, and contractors agreed that the most significant benefits of adopting LC technique are waste reduction, efficient administration of materials and improved whole-life cost of construction projects. Mohamed *et al.* (2019) evaluated in a study "Assessment of Readiness of Nigerian Construction Firms on Adoption of Lean Construction Principles. The result showed that the level of awareness of the lean construction principles was still at the lowest level among the construction firms. It was also established that the construction firm's readiness on the adoption of lean construction principles was still at the lowest level.

An appraisal of the readiness of Nigerian Building Consulting Firms to adopt lean construction principles was evaluated by Olamilokun (2014). The result of the study revealed that the level of awareness of lean construction principles is increasing. Also, reduced cost and less waste were identified as the most important benefits of adopting lean construction principles; availability of trained professionals and education and skills development are the most important facilitators for adopting lean construction principles. Assessment of Lean Construction Practice in the Nigerian Construction Industry was also conducted by Adegbembo *et al.* (2016). The results showed that most of the construction professionals are aware of lean construction and its approaches. The study therefore recommended that more should be done on lean awareness and understanding as well as training for exposure to the need to adopt the Lean concept.

An Assessment of awareness and barriers to the application of lean construction techniques in Kano State, Nigeria was carried out by Musa *et al.* (2023). It was observed by the authors that there was no sufficient empirical data on Lean models' application in the Nigerian construction industry. The results revealed that the level of awareness/knowledge of lean techniques among construction practitioners in the study area is low. In addition, the study found that the major barriers to the application of lean techniques in construction projects are the absence of awareness workshops to enhance understanding of LC and the lack of education and training required to implement lean construction.

3.0 RESEARCH METHODOLOGY

This study was aimed at investigating the level of lean construction practices (LCP) implementation among Indigenous and multinational construction firms in the Niger Delta region of Nigeria. A survey design was adopted in the study, and random sampling techniques was used to obtain the sample for this study. Quantitative approach was adopted for this study. Data for the study were obtained using 1174 copies of structured questionnaire administered through random sampling technique to obtain information from the construction firms in Niger Delta. The data used in the study were collected using a five-point scale of 1 to 5 (Anyanwu, 2018). Scale 1 represents a very low level of adoption, while scale 5 represents a very high level of adoption of lean construction practices. The method of data analysis used included simple percentage, mean score, and Mann-Whitney test. Using a 5-point scale, the decision rule in this study is that any lean construction practice with an overall mean score of 1.0-1.49, 1.5-2.49, 2.5-3.49, 3.5-4.49, and 4.5-5.0 is considered to have a very low level of adoption; low level of adoption, moderate level of adoption, high level of adoption; and very high level of adoption respectively (Ogenma 2018).

4.0 RESULTS AND DISCUSSION

This section contains the results of the analysis of data collected for the study. It contains the descriptive results of the response rate of questionnaire distributed, and firm characteristics. This section also contains the result of evaluation of the level of adoption of lean construction practices among indigenous and multinational construction firms in Niger Delta region of Nigeria, and the result of the hypothesis which states that there is no significant difference in the level of adoption of lean construction practices among indigenous and multinational construction firms in the Niger Delta region of Nigeria.

4.1 Questionnaire Distribution and Response Rate of the study

Structured questionnaire was the research instrument used in this study. The results of analysis were presented in Table 1. As shown in Table 1, a total of 1,174 questionnaire were administered to construction firms within the study area. From the questionnaire distributed, the response rate ranges between 69.1% and 78.8%. Akwa Ibom state got the highest response rate of 78.8% while Imo state got the least rate of 65.6%. In all, 856 duly completed questionnaires were returned, representing an overall 72.9% response rate. Groves (2006) noted that a response rate of at least 50% is considered adequate for analysis and reporting, a 60% response rate is good and a response rate of 70% is very good. As a guide, researchers typically seek response rates of at least 70% to feel confident that their sample is representative of the sample frame. Hence, the overall response rate of 72.9% in this study is considered very good and adequate.

Table 1: Questionnaire Distribution and Response Rate of the study

S/N	States	Number of questionnaire administered	Number of questionnaire returned	Percentage of questionnaire returned (%)
1	Abia State	120	94	78.3
2	Akwa Ibom State	151	119	78.8
3	Bayelsa State	98	72	73.4
4	Cross River State	146	101	69.2
5	Delta State	130	99	76.7
6	Edo State	133	102	76.7
7	Imo State	96	63	65.6
8	Ondo State	138	94	68.1
9	Rivers State	162	112	69.1
	Total	**1,174**	**856**	**72.9**

4.2 Results of Reliability Test on Construction Firms' Responses

Table 2 showed that all the Cronbach coefficient values were above the 0.7 threshold which indicated that the data collected from the construction firms in the study area were reliable and suggested good inner consistency.

Table 2: Results of Reliability Test on Construction Firms' Responses

States in Niger Delta	Number of Items	Cronbach's Alpha
Abia	496	0.946
Akwa Ibom	496	0.944
Bayelsa	496	0.972
Cross River	496	0.982
Delta	496	0.992
Edo	496	0.989
Imo	496	0.991
Ondo	496	0.973
Rivers	496	0.980

4.3 Type of Organisation

Table 3 depicts the type of organization the respondents work. 90.5% are indigenous firms, while 9.5% constituted multinational firms. This implies that indigenous firms are deeply rooted in the Niger Delta region and were mostly used in the study.

Table 3: Type of Organisation

Type of Organisation	Frequency	Percentage
Indigenous Firms	775	90.5
Multinational Firms	81	9.5
Total	**856**	**100.0**

4.4 Age of Construction Firms used for the Study

Table 4 explains the years of experience of the construction firms. 3.6% of the construction firms have 5 years' experience, 29.8% have around 10 years' experience, 46.6% have 15 years while 15% have 21 years' experience and 5% have above 21 years. This indicates that construction firms used for the study had cognate firm experience in the construction industry.

Table 4: Age of Construction Firms

Age of Firms	Frequency	Percentage
1-5 Years	31	3.6
6-10 Years	255	29.8
11-15 Years	399	46.6
16-20 Years	128	15.0
21 Years and above	43	5.0
Total	**856**	**100.0**

4.5 Number of Employees in the Construction Firms

Table 5 presents the number of employees in the construction firms used for the study. 53.3% were less than 50 which is termed small firms, while 37.6% were between 50 and 250 termed medium firms, and 9.1% had above 250 employees termed large firms. This implies that a good number of employees in small, medium and large indigenous and multinational construction firms were used for the study.

Table 5: Number of Employees in the Construction Firms

Number of Employee	Frequency	Percentage
Less than 50	456	53.3
More than 50 and up to 250	322	37.6
Above 250	78	9.1
Total	**856**	**100**

4.6 Professional Discipline of the Respondents

Table 6 explains the professional background of the respondents used for the study. 18.0% were architects, 28.6% were civil engineers, 13.1% were mechanical, electrical and plumbing engineers, while 28.7% were builders and 11.6% constituted quantity surveyors. The implication of this result is that, Builders were the majority of respondents from the built environment in the study. It also shows a fair representation of the professionals in the construction industry.

Table 6: Professional Discipline

Discipline	Frequency	Percentage
Architecture	154	18.0
Civil Engineering	245	28.6
Mechanical, Electrical and Plumbing Engineering	112	13.1
Building	246	28.7
Quantity Surveying	99	11.6
Total	**856**	**100.0**

4.7 Academic Qualification of the Respondents

Table 7 illustrates the educational level of the respondents. 68.2% had Bachelor's degree, 20.6% had Higher National Diploma, 8.1% had Master's degree, 1.6% had Ordinary National Diploma, while 1.5% of the respondents had a Doctorate degree. It is clear from the result that majority of the respondents have a B.Sc. as a minimum qualification, implying that the respondents had the required academic ingenuity to participate in this magnitude of study.

Table 7: Academic Qualification

Qualification	Frequency	Percentage
OND	14	1.6
HND	176	20.6
BSc	584	68.2
MSc	69	8.1
PhD	13	1.5
Total	**856**	**100.0**

4.8 Years of Professional Experience

Table 8 explains the total years of experience of the respondents in the study. 1.5% of the respondents have 5 years' experience in their construction firm, 20.8% have 10 years' experience, 66.5% have 15 years, while 9.6% have 20 years' experience and 1.6% have above 21 years. This implies that a good number of the respondents have adequate years of professional experience in the construction industry to make knowledgeable contribution to this study.

Table 8: Number of years of professional experience

Professional Experience	Frequency	Percentage
1-5yrs	13	1.5
6-10yrs	178	20.8
11-15yrs	569	66.5
16-20yrs	82	9.6
21yrs and above	14	1.6
Total	**856**	**100.0**

4.9 Level of Adoption of Lean Construction Practices among Indigenous and Multinational Construction Firms in Niger Delta Region of Nigeria

Table 9 shows the extent of adoption/implementation of the constructs and sub-variables of lean construction practices among indigenous and multinational construction firms in the Niger Delta region of Nigeria. The result in Table 9 indicates that for indigenous firms, the following set of lean construction practices have moderate level of adoption; last planner system (LPS) which consists of; master schedule, that is the determination strategy and ensuring project milestones has a mean score (MS) of 3.11, Phase Schedule which entails hand-offs and highlights operational problems (M.S= 3.10), Look-ahead Plan which is the act of Planning to ensure the product is suitable for installation and prepares a plan of improvement if needed (MS=3.09), Weekly Work Plan (WWP), that is agreement to complete the work in the specified sequence (MS=3.10), and increased visualization (MS=3.07). Therefore, the sub-group mean of 3.09 implies that there is moderate level of adoption of last planner system (LPS) among indigenous construction firms in the Niger Delta region of Nigeria. Moreso, among multinational firms; Master Schedule (MS=4.59), Phase Schedule (MS=4.57), Look-ahead Plan (MS=4.56), and Weekly Work Plan (MS=4.51), Increased Visualization (MS=4.41) recorded high level of adoption; therefore, the sub-group mean of 4.53 implies that is very high level of implementation of last planner system among multinational construction firms in the Niger Delta region of Nigeria. In addition, the combined (multinational and indigenous firms) mean score (M.S=3.81) implies that there is high level of adoption of last planner system (LPS) among construction firms operating in the Niger Delta region of Nigeria.

Furthermore, Five S (5s) Work Organization was also analysed. These includes; Sort (MS 2.40), Set/Straighten (MS=2.39), Shine (MS=2.39), Standardize (MS=2.63), and Sustain (MS=2.71). The result shows that the Five S (5s) Work Organization have low level of adoption among indigenous firms. In addition, there is moderate level of adoption of standardized procedures that are easily understandable to implement the first 3 Ss all over the workplace. Table 9 also shows that these processes are moderately sustained through promotions, training, and control, and applied consistently in day-to-day activities. The Five S (5s) showing Sort (MS=2.90), Set/Straighten (MS=2.90), Shine (MS=2.94), Standardize (MS=3.10), and Sustain (MS=3.11) implies that all the Five S (5s) Work Organization were moderately adopted by multinational construction firms in the Niger Delta region of Nigeria. Using the combined mean score of 2.91, it connotes that the level of implementation of Five S (5s) Work Organization among construction firms operating in the Niger Delta region of Nigeria is moderate.

The overall mean score of 2.64 indicated that indigenous construction firms recorded moderate level of Lean Construction Practices adoption. In addition, the overall mean score of 3.12 implied that multinational construction firms in Niger Delta region of Nigeria recorded moderate level of adoption of Lean Construction Practices. In the same vein the overall mean score of 2.88 showed that the overall level of adoption of Lean Construction Practices among construction firms operating in the Niger Delta region of Nigeria is moderate.

Table 9: Level of adoption of lean construction practices among Indigenous and Multinational Firms construction firms

	Lean Construction Practices	Indigenous Firms		Multinational Firms		Combined Mean	
		Mean	Remark	Mean	Remark	Mean	Remark
1	**Last Planner System (LPS)**						
A	**Master Schedule**: the determination strategy and project milestones	3.11	ML.AD	4.59	VHL.AD	3.85	HL.AD
B	**Phase Schedule:** Pull planning, this entails handoffs and highlights operational problems	3.10	ML.AD	4.57	VHL.AD	3.83	HL.AD
C	**Look-ahead Plan:** Devise Work Ready Planning to ensure the product is suitable for installation and prepares a plan of improvement if needed.	3.09	ML.AD	4.56	VHL.AD	3.82	HL.AD
D	**Weekly Work Plan (WWP**): agreement to complete the work in the specified sequence	3.10	ML.AD	4.51	VHL.AD	3.80	HL.AD

	Lean Construction Practices	Indigenous Firms		Multinational Firms		Combined Mean	
		Mean	Remark	Mean	Remark	Mean	Remark
E	**Increased Visualization**	3.07	ML.AD	4.41	HL.AD	3.74	HL.AD
	Sub-Group Mean	3.09	ML.AD	4.53	VHL.AD	3.81	HL.AD
2	**Five S(5s) Work Organization**						
A	**Sort**: Sorting of things should be done based on its frequency of use; consequently, allow easy access to regularly used things.	2.40	LL.AD	2.90	ML.AD	2.65	ML.AD
B	**Set/Straighten:** Motion required for finding or obtaining an object should be minimized to minimize the waste, by providing easy access to required items	2.39	LL.AD	2.90	ML.AD	2.65	ML.AD
C	**Shine**: A clean and tidy environment and machines will increase the satisfaction level of the workers, while decreasing waste due to a messy environment	2.39	LL.AD	2.94	ML.AD	2.66	ML.AD
D	**Standardize**: Standardized procedures should be easily understandable to implement the first 3 Ss all over the workplace	2.63	ML.AD	3.10	ML.AD	2.86	ML.AD
E	**Sustain:** This process should be sustained through promotions, training, and control, and applied consistently in day-to-day activities	2.71	ML.AD	3.11	ML.AD	2.91	ML.AD
	Sub-Group Mean	2.50	ML.AD	2.99	ML.AD	2.75	ML.AD
3	**Total Quality Management (TQM):** (This refers to the organizational efforts to develop a permanent climate in which an organization continuously improves its ability to deliver high-quality products and services to customers.	2.77	ML.AD	3.21	ML.AD	2.99	ML.AD
4	**Visual Management (VM):** (increases	1.29	VLL.AD	2.21	LL.AD	1.75	LL.AD

	speed of operation and reduces the risk of choosing the wrong material through easy material identification)						
5	**Concurrent Engineering**: (parallel execution of development tasks by multi-disciplinary teams to obtain an optimal product in terms of functionality, quality and productivity).	1.21	VLL.AD	2.04	LL.AD	1.63	LL.AD
6	**Just In Time (JIT):** It is a new management philosophy, comprising three facets: people, plant, and systems. It refers to just-in-time ordering of resources or materials when there is a need. This improves the efficiency and timely execution of projects.	1.56	LL.AD	2.41	LL.AD	1.99	LL.AD
	Fail Safe for Quality and Safety: Used to stop defective parts from going through the manufacturing process.	3.10	ML.AD	3.21	ML.AD	3.15	ML.AD

	Lean Construction Practices	**Indigenous Firms**		**Multinational Firms**		**Combined Mean**	
		Mean	Remark	Mean	Remark	Mean	Remark
8	**Daily Huddle Meetings**: The daily huddle meeting is a lean construction technique where meetings are conducted daily. The process gives the members of the project team the opportunity to conclude the previous work with respect to work activities on issues	3.45	ML.AD	4.37	HL.AD	3.91	HL.AD
9	**First Run Studies** (Plan, Do, Check, Act).	3.32	ML.AD	3.10	ML.AD	3.21	ML.AD
10	**The Five Why's**: Repeating 'why' (5 whys) five times, when facing a problem will assist in reaching the core of the problem	1.64	LL.AD	2.07	LL.AD	1.86	LL.AD
11	**Build-in Quality**: Build-in-quality refers to a concept that relates to ensuring that production from one station to another is free from defects and that the use of people to rum the machines is eliminated as much as possible.	3.05	ML.AD	3.26	ML.AD	3.15	ML.AD
12	**Level out the workload**: The idea is used in tandem with a lean manufacturing approach to address the effect of flow variability.	2.78	ML.AD	2.99	ML.AD	2.88	ML.AD
13	**Visual Management Instrument:** It is system refers to a visual management instrument that is commonly employed in manufacturing systems for the purpose of showcasing the status of ongoing	1.85	LL.AD	2.06	LL.AD	1.95	LL.AD

	operations.						
14	**Occupational Health and Safety Assessment Series** (OHSAS): reducing fatalities and serious injuries on a construction site.	3.35	ML.AD	4.25	HL.AD	3.80	HL.AD
15	**Standardized Work:** Standardized work forms the foundation for continuous improvement in lean production, while standardizing both the product and process.	2.99	ML.AD	3.17	ML.AD	3.08	ML.AD
16	**Partnering**: Partnering is a long-term commitment which includes two or more organizations with the aim to achieve a particular business objective together by obtaining the maximum potential of the resources available at each point.	3.00	ML.AD	3.05	ML.AD	3.02	ML.AD

	Lean Construction Practices	**Indigenous Firms**		**Multinational Firms**		**Combined Mean**	
		Mean	Remark	Mean	Remark	Mean	Remark
17	**Total Productive Maintenance (TPM):** The objective of applying TPM is the elimination of waste resulting from defects and unscheduled downtown of equipment, and accidents.	3.03	ML.AD	3.00	ML.AD	3.02	ML.AD
18	**Computer Aided Design (CAD) Models**: (Use of Computer Systems in the Design Process)	3.71	HL.AD	4.30	HL.AD	4.00	HL.AD
19	**Building Information Modelling** (BIM)	1.92	LL.AD	2.67	ML.AD	2.29	LL.AD
20	**Pull Planning**: Pull planning follows the lean construction practice where all the participants collaboratively work back from the end goal towards the starting point, progressing step by step to achieve each milestone.	1.62	LL.AD	2.06	LL.AD	1.84	LL.AD
21	**Six Sigma**						
A	**Work for the customer.** The primary goal of any change you want to implement should be to deliver maximum benefit to the customer	3.50	HL.AD	3.93	HL.AD	3.71	HL.AD
B	**Define the Problem**	3.50	HL.AD	3.93	HL.AD	3.71	HL.AD
C	**Measure the Performance or Problem**	3.50	HL.AD	3.90	HL.AD	3.70	HL.AD
D	**Analyze the Cause of Variation and Defects**	3.50	HL.AD	3.84	HL.AD	3.67	HL.AD
E	**Communicate clearly and train team members to improve**	3.51	HL.AD	3.85	HL.AD	3.68	HL.AD

F	**Control**	3.52	HL.AD	3.86	HL.AD	3.69	HL.AD
	Sub-Group Mean	3.51	HL.AD	3.88	HL.AD	3.69	HL.AD
22	**Modularization/ Prefabrication:** (such as precast concrete)	2.99	ML.AD	4.09	HL.AD	3.54	HL.AD
23	**Target Costing**: the final project cost is considered a design parameter and design are made according to the target cost.	2.93	ML.AD	2.80	ML.AD	2.87	ML.AD
	Overall Mean Score	2.64	ML.AD	3.12	ML.AD	2.88	ML.AD

Source: Researcher's Field Data (2024)

V.L.L.AD – Very Low Level of Adoption, L.L.AD – Low Level of Adoption, M.L.AD – Medium Level of Adoption, H.L.AD – High Level of Adoption, V.H.L.AD – Very High Level of Adoption.

The decision rule of the score range is that: 1.0 - 1.49 = very low, 1.50 - 2.49 = low, 2.50 – 3.49 = Medium, 3.50 – 4.49 = high and 4.50 – 5.0 = very high.

4.10 Mann Whitney U Test for Comparing Level of Adoption of Lean Construction Practices among Indigenous and Multinational Construction Firms in Niger Delta

The following hypothesis was tested to establish the difference in responses of firms' representatives on the level of adoption of lean construction practices based on ownership of the firms in Niger Delta:

H_O: There is no significant difference in the Level of Adoption of Lean Construction Practices among indigenous and multinational construction firms in Niger Delta region of Nigeria.

Mann Whitney U-test was used to test the hypothesis and the decision rule is such that if the p-value is less than 0.05, it means the null hypothesis is rejected and the alternative hypothesis is accepted. Otherwise, the null hypothesis is accepted and the alternative hypothesis is rejected.

The result of Mann-Whitney U test in Table 10 shows that the P-value is 0.007. This value is less than the 0.05 significant level set for the test. This implies that there is significant difference in the level of adoption of lean construction practices among indigenous construction firms and multinational construction firms in Niger Delta. The result in Table 4.10 indicates that multinational construction firms have higher level of adoption of lean construction practices because it is the group with the highest mean rank. From these data, it can be concluded that the level of adoption of lean construction practices among multinational construction firms is significantly higher than the level of adoption of lean construction practices among indigenous construction firms (U = 410.000, p = .007). The higher level of adoption of lean construction practices by the multinational construction firms can be attributed to level of technical, and financial capacity, management commitment towards adoption of lean construction practices, available resources for lean adoption and familiarity with lean techniques, and clear understanding of technical requirements in lean practices among multinational firms.

Table 4.10: Mann Whitney U Test for Comparing Level of Adoption of Lean Construction Practices among indigenous and multinational Construction Firms in Niger Delta

Level of Adoption of Lean Construction Practices among indigenous and multinational Firms	Mean Rank	Sum of Rank	Decision @ 0.05 Significant Level
Indigenous Firms	29.89	1076.00	
Multinational Firms	43.11	1552.00	
Mann Whitney U	410.000		
Wilcoxon W	1076.000		
Z			
P-Value	0.007		**Reject**

4.11 Discussion of Findings

The study on the level of adoption of Lean Construction Practices in the Niger Delta indicated that indigenous construction firms recorded moderate level of lean construction practices adoption. The findings revealed that for indigenous firms, the following set of LCP have moderate level of adoption; Last Planner System (LPS) which consists of; master schedule, that is the determination strategy and ensuring project milestones, Phase Schedule which entails hand-offs and highlights operational problems, Look-ahead Plan which is the act of Planning to ensure the product is suitable for installation and prepares a plan of improvement if needed, Weekly Work Plan (WWP), that is agreement to complete the work in the specified sequence, Increased Visualization, and Last Planner System (LPS).

Moreover, among multinational firms; Master Schedule, Phase Schedule, Look-ahead Plan, Weekly Work Plan, and Increased Visualization recorded high level of adoption. The Five S (5s) showing Sort, Set/Straighten, Shine, Standardize, and Sustain implies that all the Five S (5s) Work Organization were moderately adopted by multinational construction firms in the Niger Delta region of Nigeria. The study also ascertained that multinational construction firms in Niger Delta region of Nigeria recorded moderate level of adoption of Lean Construction Practices. Consequently, the overall level of adoption of Lean Construction Practices among construction firms operating in the Niger Delta region of Nigeria is moderate.

The outcome of this study finally showed that the overall level of adoption of Lean Construction Practices among construction firms operating in the Niger Delta region of Nigeria is moderate. The moderate level of implement can also be attributed to the fact the Senior management/top management was not supportive and committed enough (Albalkhy and Sweis, 2020).

This outcome agrees with the studies by Comelli *et al.* (2019) and Sarhan *et al.* (2018), who reported that there is limited use of lean construction practices in the construction sector.

The outcome of this study is also in agreement with the work of Olamilokun (2014), and Oladiran (2017) in Nigeria; the authors explained that though lean construction practices is not adequately used, there appeared to be an emerging awareness and adoption of the concept of lean construction in the Nigerian construction industry compared to how it was about a decade ago as there is increasing readiness on the part of consulting firms in Nigeria to adopt lean techniques. This study is also in alignment with Amade *et al* (2021) who studied lean construction practices implementation in Nigeria and concluded that lean construction practices (LCP) is slightly implemented at firm level. However, this study has shown that there is improvement in the level of implementation of lean construction practices at firm level in Nigeria. This improvement could be attributed to increase in the awareness of LC and general call for sustainable infrastructural development in the study area. It is also in consonance with Mohammed *et al.* (2019) who stated that the level of lean construction practices' adoption in Nigeria falls below international standard.

The result on the variation of lean construction practices adoption revealed that there is significant difference in the level of adoption of lean construction practices among indigenous construction firms and multinational construction firms in Niger Delta. The result indicated that multinational construction firms have higher level of adoption of lean construction practices because the group came up with the highest mean rank. It is ascertained that the level of adoption of lean construction practices among multinational construction firms is significantly higher than the level of adoption of lean construction practices among indigenous construction firms. This can be attributed to multinational construction firms' top management commitment to lean construction practices adoption, ability to adopt new construction technologies, and adoption of continuous improvement (Sarhan *et al.*, 2018).

5.0 CONCLUSION

This study assessed the level of implementation of Lean Construction Practices among construction firms with a view to promote sustainable infrastructural development in the Niger Delta region of Nigeria. The study evaluated the level of adoption of Lean Construction Practices in the Niger Delta and found that indigenous construction firms recorded moderate level of Lean Construction Practices adoption. The study also ascertained that multinational construction firms in Niger Delta region of Nigeria recorded moderate level of Lean Construction Practices. It was concluded that there is significant difference in the level of adoption of Lean Construction Practices among indigenous construction firms and multinational construction firms in Niger Delta. The study concluded that the overall level of adoption of Lean Construction Practices among indigenous and multinational construction firms operating in the Niger Delta region of Nigeria is moderate.

6.0 RECOMMENDATIONS

Based on the findings and conclusion of this study, the following recommendations were thus proffered.

1. Construction firms and all other stakeholders should improve on the level of implementation of Lean Construction Practices so as achieve sustainable project delivery.
2. Construction firms should improve on the level of implementation of Lean construction practices by creating or supporting Lean research groups and initiatives, adopting a Lean culture, carry out Lean training, adopt Lean as a firm strategy, and ensure adequate management commitment.
3. The construction firms should ensure sufficient supports and commitment by senior management, shared vision, sufficient workforce skills to implement Lean, adequate management/supervisory skills, sustained efforts to engage employees in the meaningful learning experiences, adequate technical knowledge, adequate communication between management and employees/workers, proper/adequate training and mentoring for lean methods.

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IMPLEMENTATION OF GREEN MANAGEMENT PRACTICES FOR SUSTAINABLE INFRASTRUCTURAL DEVELOPMENT IN THE NIGER-DELTA REGION OF NIGERIA

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ABSTRACT
Green management is a paradigm that includes improving environmental awareness, using energy resources and eco-friendly technologies, reuse of wastes, and recycling activities starting from production activities of businesses to packaging and delivering to consumers. The aim of this study is to investigate the level of implementation of green management practices among indigenous and multinational construction firms with a view to ensure sustainability of infrastructural development in the Niger Delta region of Nigeria. Survey design was adopted where data were obtained from 79 valid structured questionnaire. The methods of data analysis were simple percentage, mean score, and Mann Whitney U test. The study indicated that 14(39%) of the green management practices were highly implemented by the construction firms operating in the study, while 22(61%) of the green management practices were moderately implemented by construction firms operating in the study area. The overall mean score of 3.4748 indicated that there is moderate level of implementation of green management practices among construction firms operating in the study area. The extent of implementation of green management practices among multinational construction firms is significantly higher than the level of adoption of green management practices among indigenous construction. It is recommended that the leadership of the construction firms operating in the study area should show more commitment towards implementation of green management practices in infrastructural development for overall sustainability of the infrastructure and the built environment. Government should make regulations and policies that mandate the implementation of green management practices in infrastructural development.
Keywords: *Green Management; Implementation, Infrastructural Development; Niger-Delta Region, Nigeria*

1.0 INTRODUCTION

Infrastructural development is one of the major pillars of developed and developing Nations. However, when infrastructural development is poorly envisioned, conceptualized, planned, designed, developed and maintained, the environment and the inhabitants thereof, humans, animals, vegetation, other development and so on suffer for it. Therefore, there is the need not just to clamor for infrastructural development but sustainable infrastructural development which can be made possible if green management practices are rightly adopted.

Ho *et al.* (2016) defined green management as a set of initiatives or practices that provide eco-friendly products and reduce the negative effect on the environment through green marketing, green human resources management, and green production. Furthermore, for the reason that green management is a new concept, researchers and practitioners have perceived it from different perspectives. Some of them consider green management as a compliance with organization policy and procedures or a positive behaviour of people towards reducing waste and resource consumption. Others considered green management as a new organizational strategy, firm reengineering, or an overarching modification of manufacturing/production processes. It sounds that there is a big difference between these two perspectives, indicating that there is a great continuum or spectrum consisting of several green business activities ranging from simple and easy to the complex and challenging (Loknath and Azeem, 2017). Bobby Banerjee (2001) posited that firms' eco-based strategies may develop from reactive to proactive, that firms can consider eco-challenges as an opportunity to create positive performance, or they can accept or oppose the environmental standards.

Green Management approach is a new management strategy, which aims to achieve a fully sustainable business, of which its results will be seen in the financial, social and environmental areas (Shama and Gupta, 2015). Green management concept is recognized as a proactive environmental strategy that

aims to create positive business performance and the effects will be viewed in the firm environmental, social and financial issues. This concept plays a vital role in developing more effective and efficient forms of organizations, leading to minimizing their noxious effects on the environment, while practicing business activities (Skibińska and Kott, 2015). The basic definition of Green Management emphasizes three dimensions: ecological, social and financial, as is being shown in the stated definition: Green Management is a business functioning in a capacity where no negative impact is made on the local or global environment, the community, or the economy. Green management has become a popular management paradigm adopted by business firms to achieve their goals effectively (Pal and Dey, 2013). Business firms are concentrating more successfully on protecting the environment, taking into account both business ethics and corporate social responsibility perspectives. In the business ethics perspective, green management helps firms stimulate their performance as it supports them to protect or preserve the natural environment (Yang *et al*., 2015).

There is a global demand for implementation of green principles/initiatives in infrastructural development. Studies have shown that encouraging and mandating construction firms, construction professionals, and building owners to go green will help reduce the rate of pollution in the environment. It is on this notion that Skibińska and Kott (2015) highlighted the benefits of green managements towards infrastructural development of a country which includes the reduction of operating cost by reducing the cost of energy consumption, improvement of air quality thereby improving the health of the people in the building and reduction of global warming due excessive flaring of gasses. These benefits therefore show the correlation between green management and sustainable infrastructural development in every society.
Given the background,, the objective of this study is to assess the level of implementation of green management practices among indigenous and multinational construction firms in the Niger-Delta Region of Nigeria. A hypotheses was postulated for this study. The hypothesis states that there is no significant difference in the level of implementation of green management practices among indigenous and multinational construction firms in the study area.

2.0 LITERATURE REVIEW

2.1 The Concept of Green Management

Reducing harmful impacts on the environment is becoming a way of life for many people. This trend has also become very popular with companies as well. Green Management is seen as a new management strategy, which aims to achieve a fully workable business, of which results will be visible in the financial, social and environmental areas (Tran 2009). Green management approach is fundamentally referred to the environmental practices and it is about implementing appropriate eco-friendly activities, which improve the level of people's awareness for environmental protection or minimizing the firms' negative effect on environment (Rawashdeh, 2018). This approach appeared in the second half of the twentieth century, as a response to increase consumer awareness in the ecological conservation area (Ahmad, 2015). Green management consists of implementation of clean and green technology principles or initiatives in the development of infrastructure so as to achieve sustainability of environmental while sustainable development means developing present abilities of next generations who can meet their own requirements by making no compromise (Sawant *et al*. 2013). Green management should be active together with an environmental responsibility sense of businesses (Akatay and Aslan, 2008). The understanding of green management is a management which has ecologic importance by focusing on natural sources and environmental values. It focuses on decreasing the wrecking of human power in the world and exploitation of natural sources and the sustainable development ideals should be more practicable together with green management understanding. Management should balance between waste and combination of the productions along with renewable and non-renewable resources (Hosseini, 2007). Businesses should start to give importance on activities which are suitable with green management by investing in green to be able to

have balance. Business management focuses on usage of skillful and subsidiary workers to gain profit in the name of businesses and management (Tran, 2009).

2.2 **Application of Green Management**

In a general sense**,** Subramanian *et al.* (2016) defined green management as a pool of strategic practices designed to constantly improve the foundation of environmental management, like environmental communication, environmental management system, and conservation biodiversity as well as stimulating employees' behavior towards the environment. Businesses have now become aware that the environment must be preserved and tendered towards green management as a result of the destroyed and demolished environment. Therefore, the concept of green management can be applied in different aspects of the society, ranging from commercial, private to public organization.

2.3 Application of Green Management in Building

Green Building is seen by Darko *et al*. (2017) as the practice of increasing effective protection of the environment, through more reasonable use of resources, which are needed for the building construction. Green management in building refers to issues such as better setting, design, construction, operation, maintenance, and waste removal. A green building is a building that minimizes impact on the environment through resource conservation and contributes to the health of its occupants. U.S Office of Federal Environmental Executive, also sees green building as the practice of increasing the efficiency of a building or site in resources utilization such as energy, water and materials, thus reducing building impacts on human health and the environment". From the above, green building can be said to provide comfortable, aesthetically pleasing and healthful environments (Tran, 2009).

Green building brings together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of constructions on the environment and human health. It often emphasizes taking advantage of renewable resources (U.S. Green Building Council, 2008). Some of them are sunlight through passive solar, active solar, and photovoltaic techniques, as well as using plants and trees through green roofs, rain gardens, and for reduction of rainwater run-off. Many other techniques are applied as well such as using packed gravel for parking lots instead of concrete or asphalt to embrace replenishment of groundwater.

2.4. **Green Management in Construction Projects**

Abidin and Azizi, (2011) opined that green construction projects offer various benefits to the stakeholders such as cost saving in the long run, protecting the environment, enhancing business competitiveness strategy, producing better which creates a good indoor environment and many others. Wioletta (2015) categorized the Green management concept in construction projects into three components: Green building, green energy and green waste. Green building, as stated by Darko and Chan (2016), is a building that, in its design and construction or operation, mitigates or eradicates negative impacts and provides positive impacts to the natural environment and climate. Green buildings create healthy, comfortable economically prosperous places for people to live and work. This however makes the demand for green to rapidly become the most significant trend in the building industry. Conversely, the level of green building in most developing countries are still below the mainstream even with the present trend and are predominantly focused on large development (Abidin, 2010). However, most researchers attribute the low level of green building to the high construction cost of green buildings (Sonagar and Fieldson 2008; Bordass, 2012; Bond and Perrett 2012).

In construction projects, the desire to reduce energy consumption is not only associated with the introduction of the new rules, but there are actions undertaken during the design process, when an effective ventilation system is being planned, the use of appropriate materials for the construction of

walls or ceilings, or the use of solar panels. Therefore, there is a need for green energy in a project. Green energy is primarily associated with the desire to lower energy consumption, through the use of energy efficient appliances and introduction of appropriate procedures. Green waste on the other hand is aimed to reduce waste in the form of water or materials.

Adnan (2018) revealed that there is a moderate implementation of green management practices among firms. In addition, Jovita *et al* (2019) posited that the concept and philosophy of implementing green management practices among corporate entities in Nigeria at a low pace. Furthermore, Ebegbulem (2016) posited that the extent of implementation of green management practices in infrastructural development in Nigeria is still evolving. Goyal (2013) attributed the level of implementation of green management practices to several challenges concerning the implementation of green management principles or initiatives which included the difficulty to implement the practices in the workplace, the policies and procedures required for its adoption, the difficulties of creating awareness and knowledgebase of employees towards successful implementation of green management practices in organization.

2.5 **Green management practices and sustainability in construction**

Green management practices refer to the methods and strategies used by companies and organizations to minimize their environmental impact and promote sustainability. This includes practices such as recycling, energy efficiency, use of renewable energy sources, and reducing waste and pollution (Onwudiwe 2019). Haden, Oyler, & Humphreys, (2009) defined Green Management (GM) as an organization-wide process of applying innovation to achieve sustainability, waste reduction, social responsibility, and a competitive advantage via continuous learning and development and by embracing environmental goals and strategies that are fully integrated with the goals and strategies of the organization. Green building is not simply about protecting the biosphere and natural resources from over-exploitation or over-consumption, nor is it simply about saving energy to reduce our heating bills, it considers the impact of buildings and materials on occupants and the impact of our lives on the future of the Earth (Tom Woolley 1997).

Sustainability in construction and infrastructure is a complex and multifaceted issue that requires a range of different strategies to be effective. By using energy-efficient building materials, designing for energy efficiency, promoting sustainable transportation, and using sustainable construction methods, firms and construction professionals can help to minimize negative environmental impacts and promote the well-being of people and communities. Sustainability in construction and infrastructure refers to the design, construction, and maintenance of buildings and infrastructure systems that minimize negative environmental impacts and promote the well-being of people and communities. There are many different ways to approach sustainability in construction and infrastructure, but some common strategies include using energy-efficient building materials, designing for energy efficiency, promoting sustainable transportation, and using sustainable construction methods.

One key aspect of sustainability in construction is the use of energy-efficient and safe building materials. This can include using materials that are made from renewable resources, such as bamboo or straw, or materials that have a lower environmental impact than traditional building materials, such as insulated concrete forms or structural insulated panels. Additionally, many modern building materials have been designed to have a long lifespan, which can help to reduce the need for frequent repairs or replacements. Another important aspect of sustainability in construction is designing for energy efficiency. This can include incorporating features such as solar panels, green roofs, and natural ventilation systems into building designs. These features can help to reduce a building's energy consumption and lower its environmental impact. Additionally, designing buildings

that take advantage of natural light can help to reduce the need for artificial lighting, which can save energy and reduce costs.

Using sustainable construction methods is an important aspect of sustainability in construction and infrastructure. This can include using construction techniques that minimize waste, such as modular construction or prefabrication, or using construction methods that minimize the environmental impact of construction, such as using low-emitting equipment and materials. Additionally, many sustainable construction projects focus on protecting natural habitats and ecosystems, which can help to preserve biodiversity and promote the well-being of people and communities. Sustainable construction and infrastructure projects can help to create jobs, stimulate economic growth, and reduce dependence on fossil fuels. Therefore, it is crucial that we continue to invest in sustainable construction and infrastructure in order to build a more sustainable and resilient future.

3. METHODOLOGY

The population of this study comprised of indigenous and multinational construction firms in the Niger Delta region of Nigeria. Purposive sampling technique was used to select one hundred and twenty(120) firms that participated in this study. Survey design was adopted where data were obtained from 79 valid structured questionnaire. The methods of data analysis were simple percentage, mean score, and Mann Whitney U test. Mean score was used to analyse the firm characteristics, mean score was used to determine the level of implementation of green management practices by the construction firms in the study area while Whitney U test was used to test the hypothesis. The statistical analysis was conducted using appropriate software, such as SPSS and Microsoft Excel, to generate meaningful insights and draw valid conclusions. Using a 5-point scale, the decision rule in this study is that any green management practice/initiative with an overall mean score of 1.0-1.49, 1.5-2.49, 2.5-3.49, 3.5-4.49, and 4.5-5.0 is considered to have a very low level of adoption; low level of adoption, moderate level of adoption, high level of adoption; and very high level of adoption respectively (Ogenma 2018).

4.0 RESULTS AND DISCUSSION OF FINDINGS

4.1 Questionnaire Distribution and Response Rate

The research instrument used in this study was structured questionnaire. The questionnaire was administered among the construction firms in South- South region of in Nigeria. The results of analysis presented in Figure 1 showed that one hundred and twenty (120) copies of questionnaire were distributed among the construction firms in South-South, Nigeria. A total of seventy-nine (79) copies of questionnaire were retrieved, giving a response rate of 66%. Groves (2006) noted that a response rate of at least 50 percent is considered adequate for analysis and reporting, and a response of sixty percent (60) percent is good. Therefore, the response rate of sixty-six percent (66%) is considered good and adequate for the study.

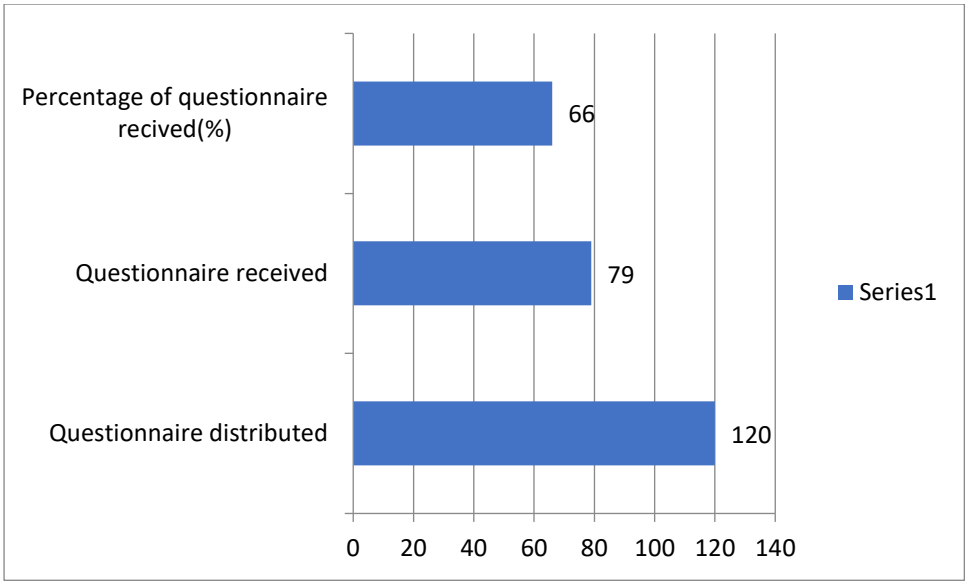

Figure 1: Questionnaire Distribution and Response Rate
Source: Researcher's Field Data (2024)

4.2 Firm Characteristics

Table 1 showed the age of construction firms that participated in this study. The results indicated that 15.2%, 25.3%, 21.5%, 11.4%, 26.6% of the firms are within the age group of 1-5, 6-10, 11-15, 16-20, and above 20 years respectively. Table 1 indicated that majority of the construction firms that participated in this study have operated more than twenty (20) years in the construction industry. The result implied that the firms have adequate work experience, and the information/data obtained from them are valid and reliable.

Table 1: Age of Firms

Age of Firms	Frequency	Percent(%)
1-5	12	15.2
6-10	20	25.3
11-15	17	21.5
16-20	9	11.4
above 20 years	21	26.6
Total	79	100.0

Source: Researcher's Field Data (2024)

4.3 Ownership of Firm

Table 2 showed that 68 (86.1%), and 11(13.9%) of the construction firms that participated in this study are indigenous, and multinational construction firms respectively. The result showed that majority of the construction firms that participated in this study are indigenous firms.

Table 2: Ownership of Firm

Ownership of firm	Frequency	Percent
Indigenous	68	86.1
Multinational	11	13.9
Total	79	100.0

Source: Researcher's Field Data (2024)

4.4 Level of Adoption of Green Management Practices among Indigenous and Multinational Construction Firms

Table 3 showed the level of adoption of green management practices among indigenous and multinational construction firms in the study area. The decision rule is that any green management practice that has mean score ranging between 1-1.49, 1.5-2.49, 2.5-3.49, 3.5-4.49, and 4.5-5.0 is considered to have very low level of adoption, low level of adoption, moderate level of adoption, high level of adoption, and very high level of adoption respectively. Table 3 showed that there is high level of adoption of the following green management practices among indigenous construction firms in the study area. These include taking actions to reduce the number of accidents at work, supporting atmosphere among employees, in order to improve the health of employees and improve their quality of life (MS=3.8088), and Implementation of strategies that reduce waste and decrease water and energy consumption (MS =3.6029). Furthermore, there was moderate level of adoption of the following green management practices by indigenous firms. These include making environmental sustainability a key part of the company's mission and values (MS=3.4882), use of renewable energy sources (MS=3.4882), regular publication of reports and statements on the effects of measures, taken in the field of green management (MS=3.4853), integration of sustainable thinking into the company's overall strategy and culture (MS=3.4735), using eco-friendly materials in packaging (MS=3.4706), encouraging the use of green roofs and other features that improve the energy efficiency of buildings and reduce the urban heat island effect (MS=3.4706), top managers should contain environment protection and continue development by defining environmental politic of the organization (MS=3.4559), encourage the use of green building certifications, such as LEED, to recognize and promote sustainable construction practices (MS=3.4559), and utilisation of energy-efficient lighting and equipment (MS=3.4435). The result in Table 3 indicated that 2(5.6%) of the green management practices recorded high level of adoption/implementation while 34(94.4%) of the green management practices recorded moderate level of adoption/implementation. The overall mean score of 3.3693 indicated that there is moderate level of adoption of green management practices among indigenous construction firms operating in the South-South region of Nigeria.

Furthermore, Table 3 showed that the following green management practices were highly adopted by multinational construction firms in the study area. These include taking action to reduce the number of accidents at work, supporting atmosphere among employees, in order to improve the health of employees and improve their quality of life (MS=4.3636), utilisation of energy-efficient lighting and equipment (MS=4.1818), incorporating sustainability into performance evaluations and decision-making processes (MS=3.9073), implementing recycling programs that reduce waste disposal costs (ms=3.9064), Organizations should determine and control the effects of their activities on the environment (MS=3.8182), top managers should contain environment protection and continue development by defining environmental politic of the organization (MS=3.8182), fulfilling the obligations, associated with the use of environment friendly materials and recycling products, that have been decommissioned (MS=3.8171), organizations should establish an environment management system and should include environment politics, programs and aims(MS=3.7273), organizations should be aware of social responsibilities about the environment and should train their personnel as environmentally-conscious(ms=3.7000), using eco-friendly materials in packaging (MS=3.6364), and the desire to reduce the use of natural resources and energy, through the use of

clean technologies(MS=3.6273). Table 3 showed that 14(39%) of the green management practices were highly implemented/adopted by the multinational construction firms in the study area, while 22(61%) of the green management practices were moderately implemented by the multinational construction firms in the study area. The overall mean score of 3.5802 indicated that there high level of implementation of green management practices among multinational construction firms in the study area.

More so, Table 3 showed the overall results of the combined evaluation of the level of adoption/implementation of green management practices among construction firms operating in the south-south region of Nigeria. The combined mean scores indicated that the following green management practices recorded high level of implementation among construction firms, these include taking action to reduce the number of accidents at work, supporting atmosphere among employees, in order to improve the health of employees and improve their quality of life (MS=4.0862), utilization of energy-efficient lighting and equipment (MS=3.8127), incorporating sustainability into performance evaluations and decision-making processes (MS=3.6478), top managers should contain environment protection and continue development by defining environmental politic of the organization (MS=3.6371), organizations should determine and control the effects of their activities on the environment (ms=3.6224), implementing recycling programs that reduce waste disposal costs (ms=3.6120), fulfilling the obligations, associated with the use of environment friendly materials and recycling products, that have been decommissioned (MS=3.5703), organizations should be aware of social responsibilities about the environment and should train their personnel as environmentally-conscious (MS=3.5618), organizations should establish an environment management system and should include environment politics, programs and aims (MS=3.5549), using eco-friendly materials in packaging(MS=3.5535), making environmental sustainability a key part of the company's mission and values(ms=3.5482), implementing strategies that reduce waste and decrease water and energy consumption(MS=3.5287), regular publication of reports and statements on the effects of measures, taken in the field of green management(MS=3.5063), and integration of sustainable thinking into the company's overall strategy and culture (MS=3.5050). Table 3 indicated that 14(39%) of the green management practices were highly implemented by the construction firms operating in the study, while 22(61%) of the green management practices were moderately implemented by construction firms operating in the study area. The overall mean score of 3.4748 indicated that there is moderate level of implementation of green management practices among construction firms operating in the study area.

Table 3: Level of Implementation of Green Management Practices among Indigenous and Multinational Construction Firms

Green Management Practices	Indigenous		Multi National		Combined		
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Remark
Organizations should determine and control the effects of their activities on the environment.	3.4265	13	3.8182	5	3.6224	5	HLAD
Organizations should establish an environment management system and should include environment politics, programs and aims.	3.3824	20	3.7273	8	3.5549	9	HLAD
Top managers should contain environment protection and continue development by defining environmental politic of the organization.	3.4559	9	3.8182	5	3.6371	4	HLAD
Organizations should be aware of social responsibilities about the environment and	3.4235	15	3.7000	9	3.5618	8	HLAD

should train their personnel as environmentally-conscious.							
Regular publication of reports and statements on the effects of measures, taken in the field of Green Management,	3.4853	5	3.5273	16	3.5063	13	HLAD
The desire to reduce the use of natural resources and energy, through the use of clean technologies.	3.3529	22	3.6273	11	3.4901	16	MLAD
Conducting ongoing work on the development of new, advanced technologies, that will enable to reduce the amount of used materials and raw materials, as well as reduce the level of emissions	3.3676	21	3.5270	18	3.4473	21	MLAD
The company faithfully complies with the relevant laws and signed international agreements,	3.4412	12	3.4545	23	3.4479	20	MLAD
Networking with suppliers in the implementation of the adopted policy	3.3382	25	3.3636	32	3.3509	31	MLAD
Fulfilling the obligations, associated with the use of environment friendly materials and recycling products, that have been decommissioned,	3.3235	27	3.8171	7	3.5703	7	HLAD
Taking action to reduce the number of accidents at work, supporting atmosphere among employees, in order to improve the health of employees and improve their quality of life	3.8088	1	4.3636	1	4.0862	1	HLAD
Utilisation of energy-efficient lighting and equipment	3.4435	11	4.1818	2	3.8127	2	HLAD
Use of renewable energy sources	3.4882	3	3.5091	20	3.4987	15	MLAD
Implementing strategies that reduce waste and decrease water and energy consumption.	3.6029	2	3.4545	23	3.5287	12	HLAD
Integrating green practices that helps firms to achieve business performance as well as environment sustainability	3.3971	18	3.4545	23	3.4258	25	MLAD
Integration of sustainable thinking into the company's overall strategy and culture.	3.4735	6	3.5364	15	3.5050	14	HLAD
Making environmental sustainability a key part of the company's mission and values,	3.4882	3	3.6082	12	3.5482	11	HLAD
Companies can also establish environmental goals and track their progress towards achieving them.	3.4265	13	3.2727	35	3.3496	32	MLAD
Companies can also implement green recruitment practices, such as looking for candidates who have a background in environmental sustainability	3.3088	29	3.5455	14	3.4272	24	MLAD
Reducing energy consumption in order to lower energy bills	3.3029	31	3.5160	19	3.4095	27	MLAD
Implementing recycling programs that reduce waste disposal costs	3.3176	28	3.9064	4	3.6120	6	HLAD
Implementing green recruitment, training and development programs	3.2941	33	3.3636	32	3.3289	33	MLAD
Promotion of environment friendly products or services	3.4059	17	3.5055	21	3.4557	19	MLAD
Use of sustainable business practices in marketing.	3.4118	16	3.5273	16	3.4696	17	MLAD
Using eco-friendly materials in packaging	3.4706	7	3.6364	10	3.5535	10	HLAD

Reducing carbon emissions in production and distribution	3.1147	35	3.4048	30	3.2598	35	MLAD
Promoting the repurposing of products	3.3088	29	3.4364	28	3.3726	30	MLAD
Sales and purchase of eco-friendly building parts and materials	2.374	36	3.218	36	2.7960	36	MLAD
Promoting the use of renewable energy sources, such as solar and wind power, to reduce the reliance on fossil fuels.	3.3324	26	3.4455	27	3.3890	28	MLAD
Encouraging the use of sustainable building materials, such as bamboo and compressed earth blocks, to reduce the environmental impact of construction.	3.3000	32	3.4545	23	3.3773	29	MLAD
Implementing building codes and regulations that promote energy efficiency and reduce the environmental impact of construction.	3.3471	23	3.4909	22	3.4190	26	MLAD
Encouraging the use of green roofs and other features that improve the energy efficiency of buildings, reduce the urban heat island effect	3.4706	7	3.4039	31	3.4373	23	MLAD
Promoting public transportation and non-motorized transportation options to reduce the reliance on cars and trucks.	3.2206	34	3.3455	34	3.2831	34	MLAD
Encourage the use of green building certifications, such as LEED, to recognize and promote sustainable construction practices.	3.4559	9	3.4273	29	3.4416	22	MLAD
Developing other policies and programs to support sustainable urban development and the preservation of natural habitats and biodiversity.	3.3441	24	3.5909	13	3.4675	18	MLAD
Overall Mean Score	3.3693		3.5802		3.4748		MLAD

HLAD-High level of adoption, MLAD- Moderate level of adoption
Source: Researcher's Field Data (2024)

4.5. **Mann Whitney U Test for Comparing Level of Adoption Green Management Practices among Indigenous and Multinational Construction Firms**

The result of Mann- Whitney U test in Table 4 indicated that the P- value is 0.000. This value is less than the 0.05 level of significance set for the test. This implies that there is significant difference in the level of adoption green management practices among indigenous and multinational construction firms. The result in Table 3 revealed that multinational construction firms have higher-level adoption of green management practices because it is the group with the highest mean rank. The result indicated that the extent of implementation/adoption of green management practices in project delivery among multinational construction firms is significantly higher than the level of adoption of green management practices among indigenous construction firms in the study area. The higher level of adoption of green management practices by the multinational construction firms can be attributed to their better technical expertise, greater financial and human capacity as well as top management commitment.

Table 4: Mann Whitney U Test for Comparing Level of Adoption Green Management Practices among Indigenous and Multinational Construction Firms

Level of Adoption of Green Management Practices among Construction Firms	**Mean Rank**	**Sum of Rank**	**Decision @0.05 Significance level**
Indigenous Firms	25.86	931.00	
Multinational Firms	47.14	1697.00	
Mann Whitney U	265.000		

Wilcoxon W	931.000	
Z	-4.314	
P- Value	.000	**Reject**

Source: Researcher's Field Data (2024)

This study is in agreement with Adnan (2018) who revealed a moderate implementation of green management practices among firms. Green management is a paradigm that includes improving environmental awareness, using energy resources and eco-friendly technologies, reuse of wastes, and recycling activities starting from production activities of businesses to packaging and delivering to consumers. The moderate level of implementation of green management practices can be attributed to low awareness, technical, and financial capabilities, and lack or inadequate human resources. This assertion is in line with Goyal (2013) who opined that there are several challenges concerning the implementation of green management practices which included the difficulty to implement the practices in the workplace, the policies and procedures required for its adoption, the difficulties of creating awareness and knowledgebase of employees towards successful implementation of green management practices in organization. The finding of this study is in contrast with Jovita *et al* (2019) who posited that the concept and philosophy of implementing green management practices among corporate entities in Nigeria at a low pace. The improvement observed in this study can be attributed to the conscious efforts by different stakeholders through awareness campaign and sensitization on the need to implement sustainable construction practices in the study area. The finding of this study is in alignment with Ebegbulem (2016), who posited that the extent of implementation of green management practices in infrastructural development in Nigeria is still evolving.

5.0 CONCLUSION AND RECOMMENDATIONS

This study has provided an insight into the level of adoption of Green Management Practices. The study found out that the following green management practices recorded high level of implementation among construction firms. These include taking action to reduce the number of accidents at work, supporting good work atmosphere among employees in order to improve the health of employees and improve their quality of life, utilization of energy-efficient lighting and equipment, incorporating sustainability into performance evaluations and decision-making processes, environment protection and continued development by defining environmental politic of the organization, determining and controlling the effects of their activities on the environment by the organization, and implementing recycling programs that reduce waste disposal costs. Others green management practices that were highly implemented among construction firms in the study area are fulfilling the obligations associated with the use of environment friendly materials and recycling products, creating awareness of social responsibilities about the environment and training their personnel to be environment-conscious, establishing an environment management system, use of eco-friendly materials in packaging, making environmental sustainability a key part of the company's mission and values, implementing strategies that reduce waste and decrease water and energy consumption, and regular publication of reports and statements on the effects of measures taken in the field of green management, and integration of sustainable thinking into the company's overall strategy and culture. The overall mean score of 3.5802 indicated that there high level of implementation of green management practices among multinational construction firms in the study area. However, the overall mean score of 3.3693 indicated that there is moderate level of adoption of green management practices among indigenous construction firms operating in the South-South region of Nigeria. The study found that there is significant difference in the level of adoption green management practices among indigenous and multinational construction firms, Furthermore, the overall mean score of 3.4748 indicated that there is moderate level of implementation of green management practices among construction firms operating in the study area. Based on the findings and conclusion of this study, the following recommendations were thus proffered.

4 The leadership of the construction firms operating in the study area should show more commitment towards implementation of green management practices in infrastructural development for overall sustainability of the infrastructure and the built environment.

5 Government should make regulations and policies that mandate the adoption/implementation of green management practices in infrastructural development

6 Construction firms should train their employees and provide motivation and incentives that will encourage the participation of the employees in implementation of green management practices during infrastructural development.

7 The top management of the construction firms in the study area should ensure adequate and effective implementation of environmental, social, and economic sustainability principles in infrastructural development for the overall sustainability of the infrastructure and the built environment.

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SUPPLY CHAIN MANAGEMENT PRACTICES IN NIGERIAN CONSTRUCTION FIRMS: THE IMPLEMENTATION ASSESSMENT ACROSS SIX GEOPOLITICAL ZONES

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Abstract
Purpose: Construction firms in Nigeria have not fully embraced supply chain management (SCM) practices. This is reflected in the frequent delays, cost overruns and poor quality of work often experienced in the construction projects. Despite the importance of effective SCM in the construction industry, the level of implementation has been abysmally reported. As a result, developing a business case for construction firms in developing countries has been slow due to the dearth of empirical evidence. This paper investigated the level of implementation of SCM practices by construction firms in Nigeria.
Design/methodology/approach: Anchored on survey research design using a questionnaire survey in which a total of 500 copies of structured questionnaire were randomly distributed to medium and large-sized construction firms in Nigeria. A total of 402 valid responses were received giving an overall response rate of 80% and responses were analysed using mean item scores (MIS) and Kruskal Wallis H test to measure the variation in perceptions.
Findings: The finding of the study shows the high level of implementation of SCM practices in Abuja and Lagos State, while Rivers State shows a moderate level of implementation and a low level of implementation in Gombe, Kaduna, and Enugu State. The results show likewise show construction firms' level of implementation of SCM centres around information sharing and quality, long-term relationships, customer relationship management, senior management/top management involvement, and logistics/transportation.
Originality/value: The study provided valuable insight into the current state of SCM in Nigeria. This study contributes to the body of knowledge of SCM in the construction industry, especially in Nigeria, where there is a limited understanding of the subject. The findings of this study can be used to inform policy formulation, training and best practices of SCM in the Nigerian construction industry.
Keywords: *Construction firms, Construction industry, SCM practices, Implementation and Nigeria*

Introduction

The construction sector plays a crucial role in the national development of Nigeria. It is impossible to overstate how important the construction sector is to lowering the unemployment rate, and providing houses, and supporting facilities to sectors of the national economy. In the first quarter of 2019, Nigeria's construction sector contributed 6.17% of the Gross Domestic Product (GDP), (National Bureau of Statistics [NBS], 2019). However, in 2021, the GDP declined from 692520.88 NGN million to 532693.68 NGN million in 2021 (NBS, 2021). McKinsey and Company (2022) attributed the decline to the disruption in construction supply and due to the laggard supply chain management of construction supplies, for that possible reason, the construction industry has suffered a downturn in GDP. Within the construction value chain, goods and services provided by suppliers and subcontractors account for 80% of the total cost of construction projects (Oludare *et al.*, 2018). These strata of the industry also account for over 90% of construction firms (Hagberg *et al*., 2016). Managing an ever-expanding supply chain is now a necessity.

Effective supply chain management (SCM) could save time, improve cash flow capacity, increase productivity, and limit risk. SCM improves effective performance through reduced costs, faster delivery times, and reduced inventory (Maina *et al.*, 2020). Construction firms can therefore leverage SCM to increase its contribution to GDP. Floriano and Leite (2018) asserted that the supply chain (SC) is a continuous process of acquiring construction raw materials and turning them into a finished product by establishing a variety of roles, including sales and marketing, sales forecasting, purchasing, distribution, and manufacturing, through money, information, and materials (Chen, 2011). SCM is the practice of monitoring the flow of data, products (property), and services between and within firms to create strong ties between consumers and suppliers (Khan *et al.*, 2020). SCM often

relies on strategic management, logistics, strategy, partnerships, and marketing (Asad *et al.*, 2016; Malhotra *et al.*, 2017). The focus of SCM is on optimising customer satisfaction. It is a general term that encompasses the collaborative efforts of many firms, corporate functions, and project delivery to meet customer needs (Stock *et al.*, 2010). The integration of multiple functions and processes within and between firms is a central part of SCM (Frankel *et al.*, 2008; Mentzer *et al.*, 2008).

In today's unpredictable construction market environment, construction firms face significant challenges in meeting customer demands and growing competition (Jagan *et al.*, 2019). SCM manages the business from raw material procurement, manufacturing, distribution, customer service, and finally product recycling and disposal (Jagan *et al.*, 2019). All construction firms want to improve their performance to meet customer expectations. Some approaches to SCM are not specific to contractor performance or construction project delivery but can be applied to the construction sector (Haijun and Masego, 2017).

However, research on SCM is relatively nascent, especially in the Nigerian construction industry (Ojo *et al.*, 2013; Aje *et al.*, 2016; Moneke and Echeme, 2016), thereby missing out on contemporary global narratives on SCM practices. The level of awareness and effectiveness of SCM issues in the Nigerian construction industry is low. Ahiakwo *et al.* (2012) advocated an increased awareness campaign among stakeholders. Construction firms in Nigeria face hurdles in the area of SCM including the integration of all construction processes and the activities of various agents and professionals hired by the client to make the project successful (Aje *et al.*, 2016; Moneke and Echeme, 2016). Among these growing engagements, the level of implementation of SCM practice in Nigeria is abysmally reported for instance; SCM practices in Nigeria are regionally reported; in Lagos, Abuja, and Rivers (Amade, 2016; Amade, 2017; Okafor *et al.*, 2021). These studies did not holistically reveal the state of implementation of SCM in Nigeria across the six geopolitical zones, hence the findings of these studies cannot be generalised. However, Aslam *et al.* (2020) believed attention to the implementation of these practices of SCM is still lacking in the construction industry in emerging economies like Nigeria, thus presenting empirical and knowledge gaps. Moreover, studies reviewed focused on other industries for instance; the electronics industry (Sundram *et al.*, 2011); hospitality (Fantazy *et al.*, 2010); manufacturing (Al-Shboul *et al.*, 2010; Asnordin *et al.*, 2021); retailing (Kumar and Kushwaha, 2018); food and beverage (Njoku and Kalu, 2015). Therefore, there is limited information on the level of implementation of SCM practices in the construction industry in Nigeria, thus presenting an empirical and knowledge gap. Therefore, the objective of the study is to assess the level of implementation of SCM by construction firms in Nigeria.

$H0_1$: there is no significant variation on the level of implementation of SCM among the six geopolitical zones in Nigeria.

Literature Review

Early in the 1980s, Oliver and Webber (1982) proposed SCM as a useful technique for controlling the stock of companies that shared the same supply networks. SCM was formerly mostly associated with physical distribution and transportation methods that were influenced by the work of Forrester, (1961). Although the notion of SCM in this modern form is enhanced, total cost management strategy to logistics and delivery operations. SCM has evolved, with historical evolutions originating from Halldórsson *et al.* (2008). The internal-dyadic-chain-network idea emerged, to improve SCM dynamics, complete awareness of practices and operations is essential. Modern supply chains are increasingly affected by global challenges, making it crucial to study SCM from various angles (Yalcin *et al.*, 2020).

SCM is designed to have high cohesion and performance, and construction businesses use it to strengthen stakeholder relationships, boosting customer satisfaction and business success (Yalcin *et al.*, 2020). Cataldo *et al.* (2021) pointed out that SCM practices are used in construction regardless of company information. SC disruption has an impact on the performance and execution of projects (Saka and Mudi, 2007). SCM is crucial for improving efficiency and raising corporate performance (Ou *et al.*, 2010). SCM optimizes teamwork and connects essential construction operations in a multifaceted network. It is linked to the production, sourcing, and delivery of finished products,

adding value to customers and increasing customer happiness (Papadopoulos *et al.*, 2016). There are three types of SCM: human resource chain, support chain, and supply chain (Ojo *et al.*, 2014). The adoption of the supply chain depends on the client and contractor (Emuze and Smallwood, 2013). Figure 2.1 illustrates the supply chain in the construction industry.

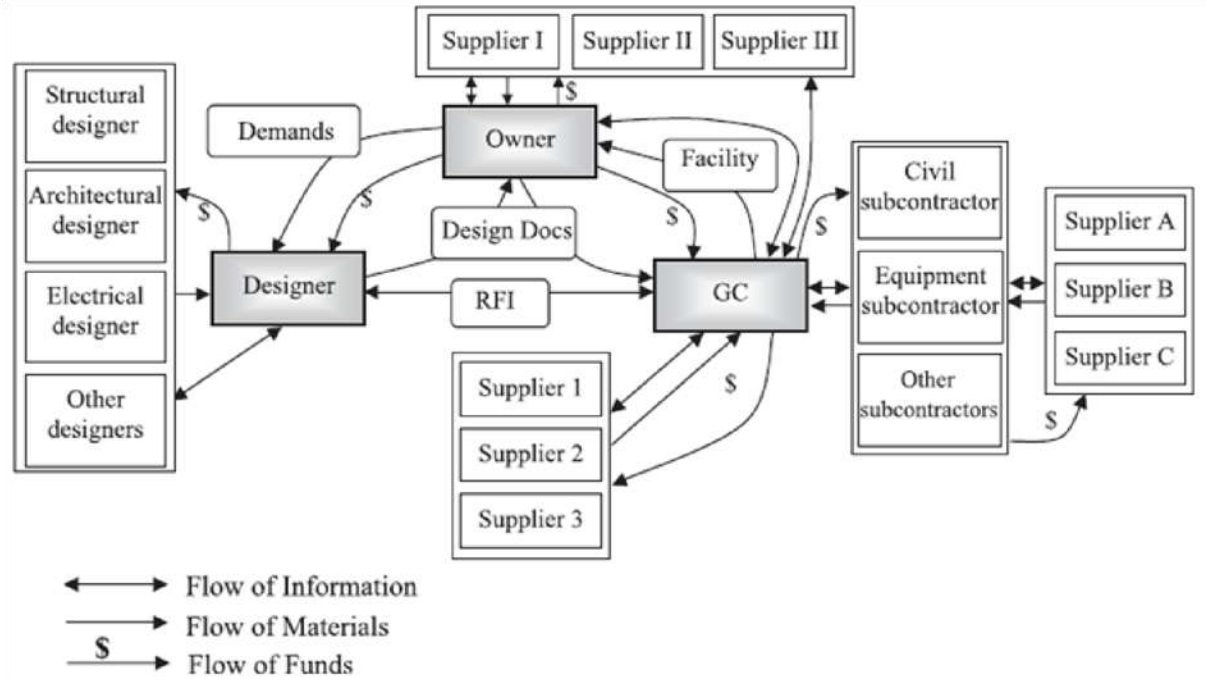

Figure 2.1: Model of the Construction Supply Chain
Source: Xue *et al.* (2005)

SCM has been applied in various industries, particularly in the manufacturing sector (Nguyen *et al.*, 2018). SC efficiency has helped industries overcome low productivity and improve their competitiveness. Companies like Dell, Procter and Gamble, and Wal-Mart have successfully integrated SCM applications, giving them a global competitive advantage. From an empirical perspective, a study by Jylhä and Kähkönen (2018) found out that European construction companies are adopting supply chain management practices to enhance project delivery performance. The most common practices include supplier evaluation and selection, strategic sourcing, and collaborative planning. Construction firms used SCM practices to improve project coordination, reduce risks, and enhance customer satisfaction. These practices are being used to reduce costs, improve project performance, and enhance customer satisfaction. The adoption of these practices is expected to continue in the future. Although, the implementation and effectiveness of these practices can vary depending on the specific context and region.

According to Moneke and Echeme (2016), SCM practices include operations, information exchange, supply and materials management, and customer service. Customer relationship management, information technology, and information quality were noted as SCM practices (Kumar and Kushwaha, 2018). Amade *et al*. (2017) opined that effective supply chain management practices include fostering long-term partnerships and trust among partners, providing finance for the supply chain, measuring supply chain performance continuously, utilising information technology, implementing quality management, supply base management, senior management's commitment, and emphasising supply chain optimisation.

Ogunsemi and Oladinrin (2016) explored the level of adoption of SCM practices in the construction industry in Nigeria. The study found that construction companies in Nigeria were using SCM practices to improve project delivery, reduce project costs, and enhance customer satisfaction. Afolabi and Oluwaseun (2017) examined the determinants of successful SCM in the Nigerian construction industry through a survey of construction professionals. The study finds that effective communication, collaboration, and trust among stakeholders are critical determinants of successful supply chain

management. Ameh and Daniel (2019) examined the current SCM practices in the Nigerian construction industry using a survey of construction professionals. The study finds that supply chain management practices are generally poor in the industry. These studies provide some empirical evidence on the SCM practices in the Nigerian construction industry and the factors influencing their adoption and success. However, further research is needed to develop and test effective SCM practices in the context of the Nigerian construction industry. Despite the advantages of SCM, there is little research or practice on its application in the Nigerian construction sector. Therefore, it is essential to investigate SCM in the context of construction as construction firms need to improve their performance by applying SCM practices well.

Research Methodology

In establishing the level of implementation of SCM, this study adopted a survey design to generate quantitative data across construction firms in Nigeria. Survey design offers wide coverage, cost-effectiveness, speed, measurable results and objectivity in establishing these factors, hence the adoption of the study. The goal of the study was to find solutions to the research issues based on the circumstances of Nigeria's six geopolitical zones, as studies with major representation of the six geopolitical zones in Nigeria are lacking. However, due to a wider coverage, a state is selected to represent each geopolitical zone. Therefore, this study focused on Lagos, Abuja, Rivers, Enugu, Kaduna, and Gombe states. These selected states represent the six geopolitical zones in Nigeria. This has encompassed studies on SCM in Nigeria. The population of this study consists of construction firms operating in the six geopolitical zones in Nigeria. These firms were selected based on experience, expertise and are currently executing projects. The population of construction firms based on geopolitical zone comprises 228 firms in Lagos, 182 in Abuja, 87 in Rivers, 47 in Enugu, 62 in Kaduna and 63 in Gombe state (Table 1), the population of construction firms exist in the directory of the Federation of the construction industry (FOCI). Focusing on construction firms is justified due to their importance, challenges, and potential for improvement in SCM in Nigeria. The sample size for this investigation was selected using a random sampling technique. Random sampling is the basic form of probability sampling and each construction firm in the population has an equal and known chance of being selected. A sample size of 491 was achieved using the Taro Yamane formula (Yamane, 1967).

$$n = N/ [1+N (e)^2]$$

Where $"n"$ is the sample size, "N" is the population (105) and " e " is the level of confidence (95%).

Table 1: Sample Population of the Study

Sampled States (from each Geopolitical zones)	Population (N)	Sample size (n)
Lagos State	228	145
Abuja	182	125
Rivers State	87	71
Enugu State	47	42
Kaduna State	62	54
Gombe State	63	54
Total	**669**	**491**

Furthermore, the primary way of gathering data for this study was through a questionnaire. The questionnaire survey is a rigorous strategy for obtaining data based on a sample. The structured questionnaire's data were gathered on a five-point Likert scale. Each item was followed by a five-point Likert scale with the following values: 1-5, where 1 = very low; 2 = low, 3 = moderate; 4 = high; 5 = very high. Furthermore, a total of 500 questionnaire were administered to construction firms to reduce the effect of non-response bias. This validated the related strategy objective to ensure that the response rate of a study is reasonably close to the minimum sample size. The study retrieved 421

questionnaire and 402 were fit for analysis; this produced a response rate of 80%. Cronbach's test of reliability was performed at 0.70 Alpha suggesting the variables are reliable for generalisation and Cronbach's alpha value between 0.70 and above shows strong internal coherency and dependability. The results of the study showed a Cronbach alpha value of 0.978 > 0.70 on 22 variables. Therefore, the inter-item consistency and instrument reliability are significant since values are above 0.70. This value indicates a high level of consistency and is within the acceptable threshold of 'good' reliability. Lastly, data generated were analysed using mean item scores.

Data Presentation and Analysis

This section presents data analysis relating to the objective and its associated hypothesis tests. The first section presents results relating to the characteristics of the respondents. Subsequent sections present data analysis and discussion of findings.

Characteristics of the Respondents

Data relating to the respondents' characteristics is important to adjudicate whether information emerged from the targeted population. These data sets also provide background information about the respondents and the suitability of the data.

Table 2: Characteristics of the Respondents

Categories	Variables	Frequency	Percentage
Gender	Male	342	85.1%
	Female	60	14.9%
Educational Qualification	HND/BSc	173	43.0%
	MSc/Ph.D	229	57.0%
Professional Affiliation	NIA	60	15%
	NIOB	40	10%
	NSE	80	20%
	NIQS	121	30%
	CIPSMN	101	25%
	Others	-	-
Professional Qualification	Registered member/Fellow	314	78%
	Probationer	88	22%
Years of Experience	0 – 5years	24	6%
	5 – 10 years	60	15%
	10 – 20 years	173	43%
	Above 20 years	145	36%
Location of Respondents	Lagos	125	31%
	Abuja	108	27%
	Rivers	60	15%
	Enugu	30	7.5%
	Kaduna	41	10%
	Gombe	38	9.5%
Position in the firm			
	Project Manager	129	32%
	SC Manager	60	15%
	Operation Manager	40	10%
	Production Manager	40	10%
	Purchasing/Procurement	133	33%

	Manager		
Nature of Construction Project	New Construction	241	60%
	Refurbishment/Renovation	20	5%
	Redevelopment	20	5%
	All of the above	121	30%
Type of Client	Private	60	15%
	Public	60	15%
	Both	282	70%

The result presented in Table 2 shows the characteristics of the respondents. About eighty five percent (85.1%) of the respondents are male and 14.9% are female. This reinforces that male dominates the construction industry. The results presented further revealed the educational qualification of the respondents with 43% of the respondents having HND/BSc and 57% of the respondents possessing MSc/Ph.D. This educational qualification is adequate for the understanding of the research scope and purpose. From a perspective of professional affiliation, 15% of the respondents are architects (Nigerian Institute of Architects), 10% of the respondents are builders (Nigerian Institute of Building), 20% are engineers (Nigerian Society of Engineers), 30% are quantity surveyors (Nigerian Institute of Quantity of Surveyors). In comparison, 25% are supply chain managers (Chartered Institute of Purchasing and Supply Management of Nigeria). Meanwhile, 78% of the respondents are registered members/fellows of the aforementioned professional bodies and 22% are probationers. This portrays a high level of understanding of the construction process and ethics. In terms of years of working experience, 6% had working experience between 0 – 5 years, 15% of the respondents had 5 – 10 years' experience, and 43% had 10 – 20 years' experience which is the highest among all categories and 36% of the respondent had experience above 20 years. This shows a good number of the respondents are experienced and share reliable information on SCM practices in the construction industry. Furthermore, the results in Table 2 also show the location of the respondents, the highest number of respondents operates in Lagos, followed by Abuja at 27%, Rivers at 15%, Enugu at 7.5%, Kaduna at 10% and 9.5% of respondents operate in Gombe State, Nigeria. This distribution is in tandem with the sample size distribution. These selected states represent the six geopolitical zones in Nigeria.

The results presented in Table 2 also show the position of the respondents in the firms, 32% of the respondents are project managers of various respective firms, 15% are supply chain managers, 10% are operation managers and production managers respectively, purchasing/procurement managers are the highest with 33%. Purchasing/procurement and project management are critical aspects of SC. Furthermore, the results revealed the nature of construction projects executed by these firms in the study area, 60% are into new construction, 5% are into refurbishment and redevelopment respectively and 30% are into all nature of construction projects. These demonstrate that SC is vital regardless of the nature of the work. In terms of the type of client these construction firms work for, 15% of the firms execute works for private clients, 15% work for public clients and 70% execute construction for both private and public clients. It can be inferred that these firms have a diverse customer base and therefore require a flexible and adaptable SC. This is also because clients have different requirements and timelines for their construction projects, which may impact the procurement of raw materials and logistics. The sample characteristics are therefore adequate to accept the perceptions of the respondents in the various areas of measurement determined by the study.

The Level of Implementation of SCM Practices Across the Sampled States

The first objective of the study is to evaluate SCM practices implemented in Nigeria. The study also analyzed these SCM practices across sampled states. In this section, 22 SCM variables adopted from the literature were ranked by the respondents. The results of the field survey are analysed using the mean item score. The results presented in Table 4.3 show the level of implementation of SCM practices.

Results presented in Table 3 show the level of implementation of SCM practices in FCT, Abuja (North-Central). The results showed two bands of mean item scores, namely: above (that is, 3.00 to 3.49 and 3.50 to 3.80). The study established a decision rule that a mean item score of 2.99 below indicates a low level of implementation, 3.00 - 3.49 indicates a moderate level of implementation, and 3.50 and above indicates a high level of implementation (Ekung *et al*., 2021). Among the top five most implemented SCM practices are information sharing and quality ranked first with mean item scores of 3.80, followed by customer relationship ranked second with mean item scores of 3.59, long-term relationship and leadership management both ranked third with a mean score of 3.51 and ranked fifth with a mean score of 3.46 is senior management/top management involvement. The critical implemented top ten SCM practices are information sharing and quality, customer relationship management, long-term relationship, leadership management, senior management/top management involvement, outsourcing, supply chain orientation, supplier relationship management, logistics/transportation, and supply chain planning and control. The results presented in Table 3 show the entire SCM constructs had a mean above 3.00 (100%). The study established that items with a mean above 3.00 are significantly implemented. However, supply chain integration, information technology, supply chain finance, trust-based relationships and collaborative procurement were ranked 18th – and 22nd respectively.

The level of implementation of SCM practices in Lagos (South-West) was also shown in Table 3. The results presented show all constructs of SCM had a mean above 3.00 (100%). This is to say the level of implementation of SCM practices in Lagos is significant. From the results, information sharing was ranked first with a mean item score of 3.67, long-term relationship and senior management/top management involvement were both ranked second with a mean item score of 3.48, customer relationship management was ranked fourth with a mean item score of 3.41 and inventory management was ranked fifth with a mean score 3.38. However, despite having a mean score above 3.00, strategic supplier partnership/alliance, outsourcing, supply chain finance, risk and reward sharing, product and materials management, and collaborative procurement were ranked 17th – 21st respectively. Among these twenty-two (22) constructs of SCM practices, information sharing and quality, long-term relationship, senior management/top management involvement, customer relationship management, inventory management, logistics/transportation, supply chain planning and control, supplier relationship management, supply chain orientation, and quality management were ranked the top ten implemented SCM practices in Lagos.

Furthermore, the study further evaluated the level of implementation of SCM practices in Rivers State (South-South). The results of the field survey are analyzed using the mean item score. The results presented in Table 3 show three bands of mean item scores, namely: above 3.00 (3.00-3.67), 2.52 – 2.89 and a mean score below 2.50. From the results, the top five implemented SCM practices are information sharing and quality was ranked first with a mean score of 3.67, customer relationship management was ranked second with a mean score of 3.55, senior management/top management involvement and long-term relationship were both ranked third with a mean score of 3.49 and while leadership management was ranked fifth with a mean score of 3.40. The top ten implemented SCM practices are Information sharing and quality, customer relationship management, senior management/top management involvement, long-term relationship, leadership management, logistics/transportation, supplier relationship management, supply chain planning and control, just-in-time, supply chain orientation and inventory management. These top fourteen SCM practices had mean item scores above 3.00 and they account for 64% of the 22 SCM constructs. This result shows a moderate level of implementation of SCM in Rivers State (South-South). The result presented (Table 3) also shows a low level of implementation of 11 SCM variables which had a mean score below 3.00, which accounts for 50% of the evaluated variables. The results ranked lean/sustainable practice, supply chain integration, trust-based relationships, supply chain finance, information technology, risk and reward sharing, and collaborative procurement as the bottom five.

The study also assessed the level of implementation in Enugu State (South-East). The results presented in Table 3, show four bands of mean item scores, namely: above 3.00 (3.00-3.76), 2.73-2.94, 2.52-2.59 and below 2.00. The top implemented SCM practices are information sharing and

quality ranked first with a mean item score of 3.76, long-term relationship was ranked second with a mean item score of 3.56, customer relationship was ranked third with a mean item score of 3.55, while senior management/top management involvement and supplier relationship were both ranked fourth with a mean item score of 3.48. The top ten implemented SCM practices are information sharing and quality, long-term relationship, customer relationship management, senior management/top management involvement, supplier relationship management, leadership management, supply chain finance, quality management, supply chain orientation and outsourcing. These top ten SCM practices account for a 45% level of implementation. This falls short of the threshold of 50%, this portrays the level of implementation of SCM practices in Enugu is low since 12 out of 22 constructs are insignificant. However, product and materials management, information technology, lean/sustainable practice, trust-based relationships and collaborative procurement were ranked in the bottom five (17th – 22nd respectively).

The study also examined the level of implementation of SCM practices in Kaduna State (North-East). The study also deduces twenty-two constructs of SCM practices from the literature. The constructs were also analyzed using mean item scores. The top five implemented SCM practices (Table 3) are information sharing and quality ranked first with a mean item score of 3.58, the just-in-time practice was ranked second with a mean item score of 3.46, long-term relationship, inventory management, and senior management/top management involvement was both rank third with a mean score of 3.41. The results also showed four bands of mean item score, namely: above 3.00 (3.00-3.76), 2.73-2.94, 2.52-2.59 and below 2.00. Only ten (10) SCM constructs were above the mean item score of 3.00 which accounts for 45% while SCM constructs below 3.00 account for 55% (12 constructs). These results revealed a low level of implementation of SCM practices in Kaduna State. The top ten (10) implemented SCM practices are Information sharing and quality, just-in-time, long-term relationship, inventory management, senior management/top management involvement, supply chain planning and control, customer relationship management, trust-based relationship, supply chain integration and supply chain finance. The least ranked SCM practices are lean/sustainable practice, logistics/transportation, product and materials management, risk and reward sharing and collaborative procurement (ranked 17th-22nd, respectively).

Table 3: Level of Implementation of SCM Practices in Nigeria
M = Mean; R = Rank

	Abuja		Lagos		Rivers		Enugu		Kaduna		Gombe		Aggregated Sample	
SCM Indicators	**M**	**R**	**M**	**R**	**M**	**R**	**M**	**R**	**M**	**R**	**M**	**R**	**M**	**R**
Information sharing and quality	3.80	1st	3.67	1st	3.67	1st	3.76	1st	3.58	1st	3.63	1st	3.68	1st
Long-term relationship	3.52	3rd	3.48	2nd	3.56	2nd	3.56	2nd	3.41	3rd	3.45	2nd	3.49	2nd
Customer relationship management	3.59	2nd	3.41	4th	3.55	3rd	3.55	3rd	3.38	7th	3.43	4th	3.48	3rd
Senior management/Top management involvement	3.46	5th	3.48	2nd	3.48	4th	3.48	4th	3.36	6th	3.38	5th	3.44	4th
Logistics/transportation	3.40	9th	3.37	6th	3.40	7th	2.73	15th	3.54	19th	3.45	2nd	3.31	5th
Supply chain planning and control	3.35	10th	3.35	7th	3.00	13th	3.33	10th	3.40	6th	3.35	7th	3.29	6th
Leadership management	3.51	3rd	3.29	11th	3.46	6th	3.46	6th	2.59	17th	3.31	8th	3.27	7th
Inventory management	3.33	11th	3.38	5th	3.18	12th	2.93	12th	3.41	3rd	3.36	6th	3.26	8th
Supply chain orientation	3.41	6th	3.35	7th	3.36	9th	3.36	9th	2.94	11th	2.97	11th	3.23	9th
Supplier relationship management	3.41	6th	3.35	7th	3.48	4th	3.38	8th	2.85	13th	3.22	9th	3.23	9th
Quality management	3.33	11th	3.33	10th	3.38	8th	2.94	11th	2.93	12th	3.13	10th	3.17	11th
Just-In-Time	3.27	14th	3.25	15th	3.26	11th	2.94	11th	3.46	2nd	2.85	15th	3.17	11th
Outsourcing	3.41	6th	3.22	18th	3.33	10th	3.46	6th	2.74	15th	2.78	18th	3.15	13th
Supply chain finance	3.11	20th	3.17	19th	2.90	16th	3.40	7th	3.30	10th	2.87	14th	3.12	14th
Supply chain integration	3.19	18th	3.29	11th	2.90	16th	2.59	17th	3.35	8th	2.97	12th	3.04	15th
Strategic supplier partnership/alliance	3.29	13th	3.24	17th	3.00	13th	2.85	13th	2.73	16th	2.80	17th	2.98	16th
Trust-based relationship	3.09	21st	3.29	11th	2.55	21st	2.52	21st	3.36	8th	2.90	13th	2.95	17th
Information technology	3.14	19th	3.25	15th	2.72	19th	2.54	19th	2.85	13th	2.82	16th	2.88	18th
Risk and reward sharing	3.25	16th	3.09	20th	2.91	15th	2.74	15th	2.52	21st	2.62	21st	2.85	19th
Lean/sustainable practice	3.27	14th	3.27	14th	2.60	20th	2.54	19th	2.58	18th	2.69	19th	2.82	20th
Product and materials management	3.22	17th	3.08	21th	2.84	18th	2.58	18th	2.54	19th	2.65	20th	2.81	21st
Collaborative procurement	3.01	22nd	3.08	21st	2.45	22nd	1.84	22nd	1.84	22nd	2.52	22nd	2.41	22nd

The study further examined the level of implementation of SCM practices in Gombe State (North-East geopolitical zone). Data generated were analyzed using mean item score. The results presented in Table 3 show two bands of mean item score, namely, mean above 3.00 (3.00-3,63) and mean below 3.00 (2.52-2.97). The top implemented SCM practices in Gombe State are information sharing and quality is ranked first with a mean item score of 3.63, logistics/transportation and long-term relationships both ranked second with a mean item score of 3.45, customer relationship was ranked fourth with a mean item score of 3.43 and senior management/top management involvement was ranked fifth with a mean item score of 3.38. The top ten implemented SCM constructs are information sharing and quality, logistics/transportation, long-term relationship, customer relationship management, senior management/top management involvement, inventory management, supply chain planning and control, leadership management, supplier relationship management and quality management. These top ten implemented SCM practices account for 45% of the 22 SCM practices, this shows a low level of implementation with 55% of the SCM constructs having mean item scores below 3.00 (constructs above 3.00 are significant, while those below are insignificant. There is a low level of implementation of SCM practices in Gombe State. The bottom or least implemented SCM practices are outsourcing, lean/sustainable practice, product and materials management, risk and reward sharing, and collaborative procurement were ranked 17th – 22nd respectively.

However, comparing the level of implementation of SCM across the six sampled States (Abuja, Lagos, Rivers, Enugu, Kaduna and Gombe State) is vital for the study. These states represented the six geopolitical zones. From the results presented above, Abuja and Lagos witness a high level of implementation of SCM practices in Nigeria, this is because these cities are the construction hub of the country and government presence is highly felt in infrastructural development. Rivers State witnessed a moderate level of adoption when compared to Abuja and Lagos and is due to the presence of multinational construction firms and the heavy exploitation of oil and gas. Furthermore, Enugu, Kaduna and Gombe State witnessed a low level of implementation of SCM practices. However, insecurity could play a key factor in the low level of implementation. The top five implemented SCM practices are information sharing and quality, long-term relationships, customer relationship management, senior management/top management involvement, and customer relationship management. Lean/sustainable practice, risk and reward sharing, product and materials management and collaborative procurement witnessed low implementation in Nigeria with 4 out 6 states (only two geopolitical zones had a mean above 3.00) ranking these practices low with a mean below 3.00. Aggregately, the results presented in Table 3 revealed information sharing and quality, long-term relationships, customer relationship management, senior management/top management involvement, and logistics/transportation as the top five implemented SCM practices in Nigeria.

Test of Variation in perceptions on the Level of Implementation of SCM

To determine the level of consistency in the perception of construction firms in various selected states in each geopolitical zones in Nigeria on the level of implementation of SCM, the study tested the hypothesis, which states that there is no significant variation in the level of implementation of SCM among the six geopolitical zones in Nigeria. The study applied the Kruskal Wallis H test to measure the variation in perceptions and level of agreement in ranking perceptions of construction firms about the level of implementation of SCM. The test was validated using the critical p-values where values greater than 0.05 were accepted and values less than 0.05 were rejected. The results presented in Table 4 show that the perceptions of construction firms in the selected states in each geopolitical zone do not vary. The critical p-value p(0.101) is greater than 0.05 and the null hypothesis was accepted. Therefore, the level of implementation of SCM across the six geopolitical zones in Nigeria by construction firms are similar. This implies that construction firms in all six geopolitical zones are implementing SCM at a similar level. The result of this study could be useful for policymakers and stakeholders in the construction industry to identify areas of improvement and implement best practices across all regions. Additionally, it can also aid in benchmarking and setting industry standards for SCM practices in the construction industry.

Table 4: Test of variation/agreement across the six geopolitical zones in Nigeria

State from each Geopolitical zone compared	The extent of variation in perceptions
No of variables (N)	22
Abuja (North-Central	82.93
Lagos State (South-West)	76.48
Rivers State (South-South)	66.32
Enugu State (South-East)	59.41
Kaduna State (North-West)	59.09
Gombe State (North-East)	54.77
Chi-Square	9.213
Degree of freedom (df)	5
p-value	0.101
Significance level	0.050
Decision	Accept

The result shows the SCM practices of construction firms in a typical developing construction market. The finding of the study shows the commendable (high) level of implementation of SCM practices in Abuja and Lagos State, while Rivers State shows a moderate level of implementation and a low level of implementation in Gombe, Kaduna, and Enugu State. This result could be attributed to the difference in market size, infrastructure, economic activities, government policies, and industry concentration. This result reinforces the opinion that Abuja, Lagos State and Rivers State are key economic cities in Nigeria with Abuja and Lagos currently the construction hub of Nigeria. The results also validate the presence of multinational firms in this study area. The findings of Amade (2016), Amade (2017) and Okafor *et al.* (2021) postulated that the level of implementation of SCM is geographically based with a major focus on Abuja and Lagos State, Nigeria.

The top five significant or ranked SCM practices include information sharing and quality, long-term relationships, customer relationship management, senior management/top management involvement, and logistics/transportation. The results show construction firms' level of implementation of SCM centres around information sharing and quality, long-term relationships, customer relationship management, senior management/top management involvement, and logistics/transportation. Overall, the significant level of implementation of SCM practices by construction firms in Nigeria is a positive development. There are multiple reasons for these outcomes, and some of them are as follows; Nigerian construction companies are up against more local and foreign competitors. SCM procedures are therefore given more importance to obtain a competitive edge. Construction firms are searching for methods to enhance their operations to capitalise on the expanding Nigerian construction industry. Construction companies may raise customer happiness, cut costs, and increase efficiency with the use of SCM methods. However, with numerous parties and interconnected procedures, construction projects in Nigeria are getting increasingly complicated. Firms may manage this complexity and guarantee that projects are finished on schedule and within budget by implementing effective SCM processes.

Furthermore, the finding of this study shows information sharing and quality as the most implemented practices of SCM. Information sharing and quality is a positive development for construction firms and clients alike. It allows for greater efficiency, better communication, and improved client satisfaction. This finding is consistent with the finding of Moneke and Echeme (2016), who revealed information flow/sharing and relationship-based practices are the most implemented SCM practices in the construction context, but the human SC witnessed a very low application. In this study information technology, risk and reward sharing, and collaborative procurement witnessed a low level of implementation.

Furthermore, this study validated customer relationship management, long-term relationships and senior management/top management involvement as these constructs constitute significant commendable levels of implementation. Similarly, Chowa *et al.* (2008) added customer and supplier management, information sharing supply chain features and speed of communication. Benedict (2017) revealed that senior management's/top management involvement practice of SCM involves top management of

construction companies training its employees on the needed value of supplier-customer relationships by sharing strategic supply chain information and education. The finding of the study is also inconsistent with the finding of Amade *et al.* (2017), who asserted SCM practices such as trust and long-term associations among supply chain associates are critical for effective management in SC, a mutual understanding among stakeholders must be built on trust in all supply chain activities.

The study revealed low-ranking or insignificant SCM practices in construction firms, particularly in information technology, risk and reward sharing, and collaborative procurement. These practices are crucial for improving firm performance and SCM performance (Al-Shboul *et al.*, 2018). Low awareness and understanding of these practices may hinder their implementation, affecting efficiency, cost reduction, and customer satisfaction (Al-Shboul *et al.*, 2018). Increased awareness and resources may be necessary to support these practices. Notably, information technology witnessed low implementation, this finding reinforces the low level of adoption of innovation in the construction industry (Osunsanmi *et al.*, 2018).

Conclusion

SCM in emerging markets have begun and advanced over the last years, however, it is still in its infancy when compared to research on developed countries. This study determined the level of implementation of SCM practices in Nigeria. However, studies on SCM asserted that the adoption and effectiveness of SCM practices can vary depending on the specific context and region. Within Nigeria, Abuja, and Lagos State showed a commendable level of implementation, while Rivers State showed a moderate level of implementation and a low level of implementation in Gombe, Kaduna, and Enugu State. In an aggregated result, this study revealed a commendable level of implementation of SCM practices such as information sharing and quality, long-term relationships, customer relationship management, senior management/top management involvement, and logistics/transportation.

However, it is noticeable that the level of implementation of SCM practices varies across states, regions and geopolitical zones in Nigeria. For construction firms in these regions to improve and optimise operations, improvement in the implementation of SCM is then vital for survival, but if construction firms in Nigeria do not prioritise or optimise the implementation of SCM practices, the overall performance of the firm may be jeopardised. However, effective SCM practices can bring significant positive impacts to the sector, such as improved coordination and collaboration among stakeholders, optimized procurement processes, reduced waste, and enhanced inventory management. By leveraging economies of scale, negotiating favourable contracts, and implementing just-in-time delivery, firms can reduce costs and enhance their competitiveness. However, some firms may be hesitant to invest in necessary technology, as low implementation of information technology has been established. Despite these results, the potential impact of SCM in Nigeria is significant, leading to shorter project durations, reduced costs, and enhanced quality control. Construction firms operating in Gombe, Kaduna, and Enugu State should conduct comprehensive SC analysis to identify key areas for improvement and develop strategic plans to implement best practices of SCM, while construction firms in Abuja, Lagos and River State should continuously improve the implementation through innovations and continuous improvement initiatives.

This study's findings have practical implications for the need for increased implementation of digitalised SCM practices, training and development programs, collaboration, transparency and improving efficiency and effectiveness of the supply chain, enhancing the quality of construction projects and promoting sustainable development in Nigeria. The study focused on the level of implementation of SCM in Nigeria by delimiting the study to the six geopolitical zones thereby selecting a state to represent each zone, and does not represent all construction firms in Nigeria. Another key limitation of the study is the study's limited sample size which may not be representative of the entire population of construction firms in Nigeria. The findings may not be generalizable to all construction firms in Nigeria. Further studies should take into consideration an improved sample size and select more states from each geopolitical zone to give an entire representation of Nigeria.

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