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Challenges of Sustainable Construction: A Study of Educational Buildings in Nigeria

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ABSTRACT

Buildings are essential facilities in the delivery of quality education in any nation. Providing not just buildings but sustainable ones is necessary, since educational buildings are meant to serve both the present generation, and generations to come. However, bold statements as to the poor sustainability nature of construction projects in most developing countries around the world have been made by researchers. This study therefore assessed the challenges of sustainable construction (SC) and the possible measures for mitigating the issue of poor sustainability in the Nigerian construction industry (NCI). Survey design was employed and questionnaire was administered on construction participants in selected higher institutions. Data gathered were analyzed using percentage, mean score, Kruskal-Walis H-test, and factor analysis. The study revealed that the significant challenges of SC are majorly construction related, sustainability awareness and knowledge related, finance related, and government related. To improve on the sustainability of construction projects, then strict government policy on SC, and jettisoning the traditional method of construction for innovative sustainability oriented methods, is necessary. The implication of this finding is that, the method and process of operations within the NCI does not favor the attainment of SC. Therefore, if sustainability is to be achieved, a review of construction activities and processes within the industry is necessary.

1. Introduction

The construction industry plays a crucial role in the economy of any nation, and its activities are vital to achieving national socio-economic development goals of providing shelter, infrastructure and employment. According to Ayodele and Alabi (2011) a healthy economy usually experiences an increase in construction activities. Through the construction industry, the government is able to provide adequate public infrastructures for its citizens. It has been stated that public infrastructure touches a wide range of basic amenities, which enhances the capacity of economic agents to conveniently engage in productive activities with reduced stress levels (Oluba, 2008). Awodele (2012) pointed out that among these amenities are school buildings and facilities, which according to

Olanrewaju (2010) are critical factors of production in achieving desirable outcomes with the education system.

With the clamor for sustainable development that is achieved through sustainable construction (SC) in countries around the world, providing school buildings and infrastructure that are sustainable should therefore be paramount in the mind of those responsible for the delivery of these projects. This call for the delivery of SC is as a result of the concern that the ever rising population poses tremendous threat to the limited earth resources. The idea is to therefore provide construction projects that meet the needs of the present without compromising the ability of future generations to meet their own needs (Aghimien *et al.,* 2016; Akbiyikli *et al.*, 2009; Brundtland, 1987; Chartered Institute of Building, 2009).

However, statements as to the poor sustainability nature of construction projects executed in most developing countries have been made in recent times, and the Nigerian Construction Industry (NCI) is no exception (Aje, 2016; Alabi, 2012; Al-Saleb and Taleb, 2010; Baron and Donath, 2016). This poor sustainability performance cut across all sectors where construction products are required in the country, including the education sector. This situation is rather disheartening, considering the fact that educational buildings are supposed to serve not just the present but also future generations. In fact, there have been series of industrial actions carried out by academic bodies in higher institutions within the country in recent times. These bodies' demands among others include the need for standard buildings and up-to-date facilities within the institutions (Edukugho, 2013). This underscore the fact that there is a need to imbibe the concept of SC, so as to provide construction projects that will service generations to come.

Several studies on the challenges of SC in developing countries around the world has emerged (Aigbavboa *et al.*, 2017; Alsanad, 2015; Ametepey *et al.*, 2015; Ayarkwa *et al.*, 2017; Djokoto *et al.*, 2014). However, researches on SC emanating from Nigeria are more focused on SC knowledge issues (Ekung *et al.*, 2016). This includes; its perception, awareness, and sustainable facilities management (Abolere, 2015; Magaji, 2015; Nduka and Sotunbo, 2014), renewable energy and energy efficiency (Ahmed and Gidado, 2008; Bugaje, 2006), green buildings (Olanipekun, 2015), materials and management tools in delivering SC (Aghimien *et al.*, 2016; Oke *et al.*, 2015).

With these studies on sustainability knowledge, green buildings, sustainable facilities management and the likes, the question as to the factors responsible for the poor sustainability performance of construction projects in the country is therefore germane. Considering the need to provide sustainable buildings within the education sector, in a country where poor performance of construction work is prevalent, first understanding the problems that may deter the achievement of this goal is necessary. It is based on this knowledge, that this study assessed the challenges of SC in the NCI, with focus on selected educational building projects in the country. Also the possible measures for achieving SC in the NCI were assessed.

2. Theoretical Background

Sustainability has become a popular paradigm in the industry as a result of a rising concern that human activities are having serious negative impact on the environment. The widely accepted definition of sustainability today is that of the World Commission on Environment and Development (WCED) (1987) which gave the definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Hence, while delivering construction projects, care must be taken not to exhaust the available resources to a point whereby the future generations will not be able to cater for their own needs.

According to Du Plessis (2002) SC is a holistic process aimed at restoring and maintaining harmony between the natural and the built environments and create settlements that affirm human dignity and encourage economic equity. Akbiyikli *et al.,* (2009) stated that SC can be seen as a path way through which the construction industry can move towards sustainable development, bearing in mind the environmental, socio-economic and cultural pillars as observed by Chaharbaghi and Willis (1999). It incorporates the basic themes of sustainable development (Parkin, 2000; Chaharbaghi and Willis, 1999; Sage 1998) and it brings about environmental responsibility, social awareness, and economic profitability objectives to the key players in the built environment (Raynsford, 2000). Thus, sustainability in construction can be said to be a way of finding a balance between economic, environmental and social factors in the design, construction, use and maintenance of buildings.

Research has however shown that sustainability level in most developing countries is low (Alabi, 2012; Aje, 2016; Baron and Donath, 2016). If this is to change, then there should be changes in the thinking, behaviour, production and consumption within the construction industry (Ofori,

1998). Miyatake (1996) also suggested that in order to achieve sustainability, the industry must change the process of construction from linear to cyclic processes which will bring increased use of recycled, renewed and reused resources, and decrease in the use of energy and other natural resources.

Alabi (2012) attributed the low level of sustainability of construction projects delivered within the NCI, to the low level of awareness of the concept of sustainability among construction participants. Alsanad (2015) also made a similar discovery when assessing the awareness, drivers, actions, and barriers of SC in Kuwait. It was observed that the SC implementation is low, and this can be as a result of lack of awareness of the concept within the country. However, Baron and Donath (2016) observed that the major challenge of sustainability implementation in Ethiopia is not that of awareness but appropriateness. It was observed that, while there is awareness about the concept of sustainability, it is not implemented correctly. Either it is completely neglected due to budget constraints, lack of alternative building materials, or knowledge, or it is reduced to the issue of sustainable resource management. These studies therefore show that the understanding of the concept of SC in its holistic form, can be a major challenge towards achieving SC.

According to Beheiry (2006) although considerable research has been, and still being carried out in the area of sustainability, greater focus is generally placed on the environmental pillar. While this might have a positive effect on the environment, considering the social and economic dimensions of sustainability is equally important. A similar observation was made by Alabi (2012) who submitted that the issue of sustainability in Nigeria and Malaysia is mostly viewed from the environment dimension. However, contrary to this submission, Ekung *et al.* (2016) discovered that most construction stakeholders in Nigeria, perceived the social dimension of sustainability as the most important sustainability objective in the delivery of SC. This disparity in both researches further affirms Akbiyikli *et al.* (2009) assertion that the level of sustainability understanding among participants, and its implementation in most construction industries of most developing countries around the word is piecemeal and unstructured.

Miranda and Marulanda (2001) in a study of the SC in developing countries, posited that a major challenge is the fact that it is being perceived as a concept which would add cost to the project. This idea is conceived without critical evaluation of the whole life benefits of SC. A similar observation was made in the study of Aigbavboa *et al.* (2017) which assessed the SC practices in South Africa. It was discovered that the foremost challenges are the assumption of additional cost to building projects, and limited understanding of the benefits of SC. Lowe and Zhou (2003) pointed out that this assumption that SC cost more, without proper evaluation, poses a big challenge in the adoption of SC practices in most developing countries around the world.

Djokoto *et al.* (2014) assessed the barriers to SC in Ghana from the perspective of professionals within the built environment, and discovered that lack of demand was a major barrier. However, in a similar study, Ayarkwa *et al.* (2017) assessed the factors affecting the implementation of SC in Ghana from the architect's perspective, and submitted that lack of financial incentives for construction participants is the most crucial barrier to achieving SC in the country. Reason for the disparity in both study can be attributed to the perception of the population adopted in both studies. Some other factors were also discovered to be important by Ametepey *et al.* (2015). They include; cultural change resistance, lack of government commitment, fear of higher investment costs, lack of professional knowledge, and lack of legislation.

Wai *et al.,* (2012) discovered that monitoring and control, realistic schedule, ability to solve problem, understanding project objective, and well allocation of resources are crucial in ensuring the success of sustainable building construction. Babalola *et al.* (2015) also assessed the factors influencing the general performance of construction projects in Nigeria, and observed that technical capability of the project participants, and the economic environment in which the project is conducted play vital roles in the performance of construction projects. Thus, if successful performance in terms of sustainability is to be attained, then these factors need to be given due attention.

From Abidin *et al.* (2003)'s framework of sustainable issues and activities of construction project, certain major factors can be seen to visibly affect sustainability in any construction project if not properly checked. These include: awareness of the concept of sustainability, technical know-how, availability of local sustainable materials, knowledge of the benefits of sustainability in construction, project management, project monitoring and control, knowledge of sustainable design, awareness of all related legislation, compliance to building guidelines or requirements when designing and constructing, workmanship during construction, site management and supervision, use of technology to improve project process and construction methods.

It is based on these theoretical backgrounds that this study assessed the challenges of SC in the NCI, using key factors as noted in the above discussed studies as yardstick. These assessed challenges towards achieving SC are highlighted in Table 1.

3. Research Methodology

This study adopted a survey approach in which construction participants that have been involved in the delivery of building projects in public tertiary institutions, were sampled. The study was conducted among five public tertiary institutions in the country base on the availability of adequate construction projects executed within 2006 and 2016. These institutions were public institutions and are funded through various government funding schemes. Since the Government is a major contributor to the education sector, and these funding schemes are used in the provision of educational buildings in all public institutions within the country, it can be said that these selected public institutions gives a reasonable insight of happenings in most government owned higher institutions around the country. The private institutions were left out because they are individually owned institutions, and are funded as such. Their details are mostly kept confidential; hence getting data from such schools will be difficult.

Prior to the commencement of the study, details of 66 building projects executed within these institutions were gathered from their individual Physical Planning Unit/ Works Departments. A total of 207 construction participants (exclusive of double or triple usage) were involved in the execution of these identified building projects. These participants include: The Clients,

Table 1: *List of challenges of sustainable construction*

Code	Challenges	Authors
CH1	Poor knowledge of sustainable design	Abidin *et al.* (2003) Baron and Donath (2016)
CH2	Inadequate awareness and knowledge of the concept of sustainability and benefits therein	Alabi (2012), Akbiyikli *et al.*, (2009), Abidin *et al.* (2003), Aigbavboa *et al.* (2017)
CH3	Lack of technical know-how in sustainable construction	Aigbavboa *et al.* (2017), Babalola *et al.* (2015), Reffat (2004)
CH4	Lack of knowledge and availability of alternative sustainable materials	Abidin *et al.* (2003), Baron and Donath (2016)
CH5	Poor understanding of the project objectives and requirements	Abidin *et al.* (2003), Babalola *et al.* (2015), Wai *et al.,* (2012)
CH6	Poor working condition for workers in terms of safety	Abidin *et al.* (2003)
CH7	Lack of related legislation and government support	Abidin *et al.* (2003), Opoku and Ahmed (2014), Ayarkwa *et al.* (2017)
CH8	Fear of increase in cost	Aigbavboa *et al.* (2017), Al-Yami and Price (2006), Lowe and Zhou (2003), Miranda and Marulanda, (2001)
CH9	Incompetence of Contractor/Subcontractors	Abidin *et al.* (2003)
CH10	Unwillingness to adopt new construction methods	Alsanad (2015)
CH11	Poor workmanship during construction	Abidin *et al.* (2003)
CH12	Mode of funding of the project	
CH13	Unrealistic project duration	Abidin *et al.* (2003), Babalola *et al.* (2015)
CH14	Budget constraint	Baron and Donath (2016)
CH15	Poor Construction methods	Abidin *et al.* (2003)
CH16	Economic, physical and Social environment of the educational building project	Abidin *et al.* (2003), Babalola *et al.* (2015)
CH17	Lack of demand for sustainability in construction by clients	Djokoto *et al.* (2014) Opoku and Ahmed (2014), Pitt *et al.* (2009)

Table 2: *Reliability Test*

		N	%		
Challenges	Valid	134	100	Cronbach's Alpha	0.850
	Excluded[a]	0	0.0	Numbers of Items	17
	Total	134	100.0		
Measures	Valid	134	100	Cronbach's Alpha	0.698
	Excluded[a]	0	0.0	Numbers of Items	12
	Total	134	100.0		

[a]List wise deletion on all variables in the procedure

represented by construction professionals in the Physical Planning Unit/Works Department of the institutions; External Consultants (Architects, Quantity Surveyors and Engineers); and the Contractors that handled the identified building projects. The end-users (i.e. the workers; both academic and non-academic, and the students) were exempted from the study as most of them are not "construction learned" nor were they involved in the construction of the identified buildings.

The research instrument used was structured questionnaire designed in parts. Part A dwelt on the background information of respondent, while Part B dwelt on the objectives of the study, which were to assess the challenges of SC, and possible measures towards achieving SC within the NCI. Respondents were provided with several identified factors and measures, and were asked to rate them according to their level of significance. A 5-point Likert scale was employed, with 5 being very high, 4 being high, 3 being average, 2 being low and 1 being very low. For clarification and in order to give the respondent a clear range for their answer, a scale for rating the significance of these factors and measures was given in the questionnaire. A scale of between 0 - 20% was set for very low, 21 - 40% for low, 41 - 60% for average, 61 – 80% high, and above 80% for a very high.

A total of 207 questionnaires were distributed, with 134 retrieved, and ascertained fit for analysis. This shows a response rate of 65% and this is adequate for the study based on Moser and Kalton (1999) who stated that the result of a survey could be considered as biased and of little significance if the return rate was lower than 20-30%. Reason for the high response rate recorded can be attributed to the time taken for the study. Data collection spanned a period of 3 months, with most of the questionnaires being self-administered. Others were sent through emails to respondents.

The validity of the research instrument was done using face validity. This involved randomly selecting construction professionals from both academics and practice (3 each) to ascertain the relatedness of the questionnaire to the research topic. This was done in line with Sushil and Verma (2010) suggestion that face validity is assessed by having expert researchers to review the contents of the test to see if the items seem appropriate. Following critical review of the questionnaire, it was considered face valid. The reliability of the research instrument was further tested using Cronbach's alpha test. The Cronbach alpha value of 0.850 and 0.698 were derived as seen in Table 2. This shows that the instrument used is reliable since the degree of reliability of an instrument is more perfect as the value tends towards 1 (Moser and Kalton, 1999).

Data analysis was done using frequency and percentage for the background information of the respondents. Shapiro-Wilk test was employed in checking the normality of data gathered, while Kruskal-Walis test was employed in testing the relationship in the view of the three categories of respondents (Client, Consultants and Contractors). Factors Analysis was employed to further analyse and group the identified challenges of SC into more manageable and significant size.

4. Findings and Discussion

4.1 Background Information of Respondents

Analysis of the characteristics of the respondents shows that the most represented categories of respondents are the Consultants with 48.7%. This is followed by the Contractors with 31.3% and Clients with 20%. The most

represented professionals are Engineers and Quantity Surveyors with 36.6% and 32.1% respectively. This is followed by Architects and Builders with 19.4% and 11.9% respectively. Most of the respondents sampled holds Bachelor of Science/ Bachelor of Technology degree (36.5%) and Masters of Science/Masters of Technology degree (35.8%), while 17.2%, 9.7% and 0.8% possess Post Graduate Diploma, Higher National Diploma, and PhD respectively. The overall average years of working experience of the respondents is 12.7 years. These vast years of experience in turn influences the number of projects handled by them as an average of 15 construction project was observed. Based on this general information, it can be assumed that the respondents are well equipped not only academically but also in terms of years of working experience, thus, making them capable to provide sufficient response that addresses the objectives of this study.

4.2 Challenges of Sustainable Construction

In order to determine the type of test to be carried out in analysing the data gathered, normality test was first conducted. This was done to find out if the nature of data is parametric or non-parametric. Shapiro-Wilk normality test was employed as it is most suitable when the sample size of a study is less than 2000 (Ghasemi and Zahediasi, 2012). Result in Table 3 shows that the significant value of all the assessed factors are 0.000, which is less than the 0.05 required threshold for normality. Hence the data gathered can be said to be non-parametric in nature. Thus,

Table 3: *Normality Test and Kruskal-Walis Test*

Code	Shapiro-Wilk Test			Kruskal-Walis Test	
	Statistic	Df	Sig.	Chi Square	Sig. p-value
CH1	0.737	134	0.000	0.349	0.840
CH2	0.722	134	0.000	3.850	0.146
CH3	0.785	134	0.000	0.358	0.836
CH4	0.766	134	0.000	0.393	0.821
CH5	0.820	134	0.000	2.000	0.368
CH6	0.809	134	0.000	0.125	0.939
CH7	0.760	134	0.000	0.347	0.841
CH8	0.817	134	0.000	1.313	0.519
CH9	0.830	134	0.000	5.603	0.061
CH10	0.861	134	0.000	0.131	0.937
CH11	0.864	134	0.000	0.779	0.677
CH12	0.824	134	0.000	0.970	0.616
CH13	0.858	134	0.000	1.648	0.439
CH14	0.842	134	0.000	3.401	0.183
CH15	0.833	134	0.000	2.679	0.262
CH16	0.855	134	0.000	1.323	0.516
CH17	0.793	134	0.000	0.388	0.823

Kruskal-Walis test; a non-parametric test used in testing the significant difference in the perception of three or more categories of respondents, was employed in assessing the relationship in the view of the three categories of respondents. Result shows that at 95% confidence level, there is no significant difference in the view of the three categories of respondents as a significant p-value of above 0.05 was derived for all the assessed factors. This implies that the respondents for the study all have similar view as to the challenges of SC within the education sector.

Factor analysis was employed to analyse and group the identified challenges into more manageable and significant size. In order for factor analysis to be carried out, determining the suitability of the data gathered is necessary. The first suitability considered is the sample size and number of variables under study. Pallant (2005) stated that there had been little agreement amongst authors concerning the size of a sample for factor analysis, but recommended the use of a larger sample. However, studies of factor analysis conducted for smaller sample size has evolved in over the years.

Zhao (2008) conducted a study for the minimum sample size in factor analysis and discovered that several authors have proposed several sample sizes. Preacher and MacCullum (2002) suggested that as long as the communalities are high, the number of expected factors is relatively small, and model error is low, researchers and reviewers should not be overly concerned about small sample size. Zhao (2008) went further to suggest a communalities figure of above 0.6 as being suitable irrespective of the sample size being adopted. Result from the communalities in Table 4 shows that fourteen out of the seventeen assessed factors have communalities figure of above 0.6.

Regarding the number of variables, Hair *et al.* (1998) suggested that factor analysis is suitable for 20–50 variables, as the extraction of common factors becomes inaccurate if the number of variables exceeds this range. However, studies have shown that less number of variables can be used (Ahadzie *et al.,* 2008, Kim *et al.*, 2016). Hence it can arguably be stated that the data gathered in this study is suitable for factor analysis, based on the number of factors, coupled with the sample size, and the communalities figure obtained.

Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) and Bartlett's test of sphericity were also adopted in testing the factorability of the data gathered. Tabachnick and Fidell (2007) stated that the KMO index ranges from 0

Table 4: *Communalities of the challenges of sustainable construction*

Challenges	Initial	Extraction
CH1	1.000	0.674
CH2	1.000	0.431
CH3	1.000	0.452
CH4	1.000	0.645
CH5	1.000	0.840
CH6	1.000	0.862
CH7	1.000	0.840
CH8	1.000	0.787
CH9	1.000	0.825
CH10	1.000	0.778
CH11	1.000	0.828
CH12	1.000	0.693
CH13	1.000	0.699
CH14	1.000	0.854
CH15	1.000	0.818
CH16	1.000	0.642
CH17	1.000	0.596

to 1, with 0.6 suggested as the minimum value for a good factor analysis. However, Hair *et al.* (1998) and Stern (2010) suggested that KMO value should be greater than 0.7 if the sample size is adequate. Also Pallant (2005) submitted that Bartlett's test of sphericity shows whether the correlation matrix is an identity matrix. It was further suggested that the Bartlett's test of sphericity should be significant ($p < 0.05$) for the factor analysis to be considered appropriate. Result in Table 5 shows a KMO value of 0.746 and a significant level of 0.000 for the Bartletts test. This result coupled with the 0.850 result obtained from the reliability test carried out through the

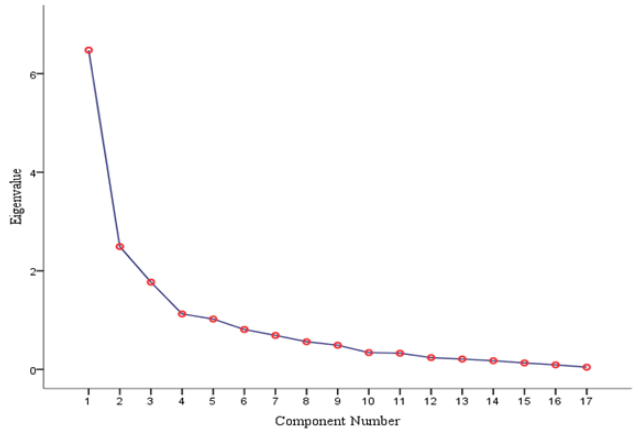

Figure 1: *Scree plot*

Table 5: *KMO and Bartlett's Test*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.746
Bartlett's Test of Sphericity	Approx. Chi-Square	1569.436
	Df	136
	Sig.	0.000

use Cronbach's alpha test, also proves that the use of factor analysis for the data gathered is appropriate.

Following the suitability of the data, factor analysis was conducted using principal component analysis (PCA) with varimax rotation. Pallant (2005) suggested a critical look at the scree plot in other to determine which components to extract or retain. In analysing the scree plot, a change in the shape (elbow) of the plot is identified and only components above this point are retained. A look at the Figure 1 shows that from the fourth component, the plots tend to flattened; hence only components from this point above are retained.

Following the result from the scree plot, result in Table 6 shows the 4 components with eigenvalues greater than 1 that were extracted using the factor loading of 0.50 as the cut-off point. The total variance explained by each component extracted is as follows; component 1 with 38.1%, component 2 with 14.7%, component 3 with 10.4%, and component 4 with 6.6%. Thus, the final statistics of the PCA and the components extracted accounted for approximately 69.8% of the total cumulative variance. This fulfils the criterion of factors explaining at least 50% of the variation as stated by Stern (2010).

Result in Table 7 shows the 4 extracted components and the variables loading on them. Spector (1992) stated that a clear component structure is present when a variable has significant factor loading (loading > 0.50) on one component only. Hence, only factors with 0.5 and above are deemed significant and are considered for discussion under each principal component.

4.3 Discussion of Extracted Factors

4.3.1 Construction Related Factors

The first principal component has the highest factor loading of seven factors and it account for about 38% of the total variance explained. These factors are; poor workmanship

Table 6: *Total variance explained*

Compo-nent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %
1	6.477	38.102	38.102	6.477	38.102	38.102	4.618	27.165	27.165
2	2.491	14.653	52.755	2.491	14.653	52.755	3.542	20.834	48.000
3	1.769	10.409	63.164	1.769	10.409	63.164	2.443	14.372	62.372
4	1.126	6.621	69.785	1.126	6.621	69.785	1.260	7.413	69.785

during construction, poor construction methods, unwillingness to adopt new construction methods, poor working condition for workers in terms of safety, incompetence of contractor/subcontractors, poor understanding of the project objectives and requirements, and unrealistic project duration. Critical analysis of these factors shows that they are related to the process of construction, hence this component was named "construction related factors". The issue surrounding the poor delivery of construction projects in Nigeria has been pointed out in researches (Akindoyeni, 1988; Ogunsemi, 2015; Ogunsemi and Saka, 2006). Oluwakiyesi (2011) submitted that the building practice in Nigeria is still struggling with a lot of challenges which has deter its improvement in terms of project delivery. These factors tend to prevent the industry from being able to deliver projects sustainably.

4.3.2 Sustainability Awareness and Knowledge Related Factors

The second principal component has a factor loading of three variables and it accounts for about 15% of the total variance explained. Variables loading on this component include; inadequate awareness and knowledge of the concept of sustainability and benefits therein, poor knowledge of sustainable design, and lack of technical know-how in SC. Based on the latent properties of these factors, this component was subsequently named "sustainability awareness and knowledge related factors". This finding is in line with Alabi (2012) submission that low level of awareness of the concept of sustainability is a major reason for the poor sustainability performance of construction projects in Nigeria. It also corroborates findings from similar developing countries such as South Africa and Kuwait, where lack of awareness of the concept of SC and understanding the benefits therein, were rated among the top factors to the implementation of SC (Aigbavboa *et al.*, 2017; Alsanad, 2015). Sustainability awareness and knowledge issues also affects the technical know-how of construction participants as regards sustainability. This according to Reffat (2004) is a major issue in the delivery of SC. A similar observation in terms of the influence of this technical know-how on SC was made Aigbavboa *et al.*, (2017) and Osaily (2010).

4.3.3 Finance Related Factors

The third principal component also has a factor loading of three variable, and it accounts for about 10% of the total variance explained. The factors loading on this component are; budget constraint, fear of increase in cost, and mode of funding of the project. These factors are finance related, hence the component was named the "finance related factors". Issues regarding to finance has been observed as a major challenge to achieving SC in developing countries around the world. Ayarkwa *et al.* (2017) observed that financial issues are crucial barriers to the adoption of SC in Ghana. Miranda and Marulanda (2001) also submitted that a major challenge to SC in Peru, is the fact that it is being perceived as a concept which would add cost to the project. This view was described as a "lazy view" of construction participants by Aigbavboa *et al.* (2017). Lowe and Zhou (2003) further asserted that this view poses a big challenge in the adoption of SC practices in most developing countries around the world. Ametepey *et al.* (2015) also observed that the fear of higher cost in SC has proven to be a major challenge to its implementation. This assumption tends to create fear among construction clients, especially in educational sector where projects are financed through diverse government funding schemes. Exceeding the budget of the institutions becomes an issue for those responsible for the delivery of these projects.

4.3.4 Government Related Factors

The last extracted principal component has two factors

Table 7: *Rotated component matrix*

	Component			
	1	2	3	4
Poor workmanship during construction (CH11)	0.865			
Poor Construction methods (CH15)	0.827			
Unwillingness to adopt new construction methods (CH10)	0.807			
Poor working condition for workers in terms of safety (CH6)	0.796			
Incompetence of Contractor/Subcontractors (CH9)	0.727			
Poor understanding of the project objectives and requirements (CH5)	0.720			
Unrealistic project duration (CH13)	0.711			
Inadequate awareness and knowledge of the concept of sustainability and benefits therein (CH2)		0.869		
Poor knowledge of sustainable design (CH1)		0.862		
Lack of technical know-how in sustainable construction (CH3)		0.769		
Lack of knowledge and availability of alternative sustainable materials (CH4)		0.425		
Budget constraint (CH14)			0.919	
Fear of increase in cost (CH8)			0.896	
Mode of funding of the project (CH12)			0.785	
Lack of related legislation and government support (CH7)				0.782
Economic, physical and Social environment of the educational building project (CH16)				0.511
Lack of demand for sustainability in construction by clients (CH17)				-0.384

loading significantly on it and it accounts for about 7% of the total variance explained. These two factors are; lack of related legislation and government support, and economic, physical and social environment of the building project. This component was subsequently named "government and environment related factors". This finding is in tandem with Alsanad (2015) assertion that lack of government support is among the factors to achieving SC. This was also discovered to be significant by Ametepey *et al.* (2015) and Osaily (2010) in Ghana and Palestine. This implies that if SC is to achieved in educational building, and by extension the entire construction industry, government must be proactive in championing this course, as suggested by the Joint International Conference (2016).

4.4 Measures of Improving Sustainable Construction

Having identified the challenges of SC, determining the measures towards improving the sustainability nature of construction projects executed within the NCI was deemed important. Certain possible measures were identified based on the identified challenges and respondents were asked to rate them based on their level of significance. Result in Table 8 shows the rating of these measures and their associated significant p-value derived from Kruska-Walis test conducted to determine the statistical significant difference in the view of the three categories of respondents.

A cursory look at the standard deviation (SD) column on the table shows that 10 out of the 12 assessed variables have a SD of less than 1.0, which indicates that there is little variability in the data and more consistency in agreement among the respondents with respect to these 10 measures. However, there might be some differences to how the remaining 2 measures were interpreted by the respondents since their SD is above 1.0. Kruskal-Walis test shows that at 95% confidence level, there is no statistical significant difference in the view of the respondents as to the significance of the identified measures for improving SC in the NCI. This is so, as a significant p-value of above 0.05 was derived for all the assessed measures.

Result shows that all the assessed measures have a mean value of above average of 3.0, which means that when considered, they all have the tendency of influencing the attainment of sustainability in construction works executed within the NCI. Chief of these factors include; the provision of strict government policy on SC (mean = 4.66), change in the traditional method of delivering public projects and the adoption of SC techniques (mean = 4.52), adequately enlightening of professionals on the concept and

Table 8: *Possible Measures for improving Sustainable Construction*

Measures	Mean	SD	Rank	Chi Sq	Sig.
Provision of strict government policy on sustainable construction	4.66	0.507	1	1.765	0.414
Change in the traditional method of delivering public projects and the adoption of sustainable construction techniques	4.52	0.773	2	1.419	0.492
Adequate enlightening of professionals on the concept and benefits of sustainability	4.46	0.915	3	1.232	0.540
Involvement of professionals with adequate knowledge of sustainable design and construction at the initial stage of project	4.39	0.648	4	2.767	0.251
Avoiding wastage of materials during construction/Adoption of Lean method of construction	4.39	0.671	5	0.209	0.901
Specification and use of readily available sustainable materials	4.22	0.465	6	0.418	0.811
Proper sensitization of the public on the overall advantage of sustainable construction	4.20	0.908	7	0.168	0.920
Compliance to building guidelines or requirements when designing and constructing	4.09	0.568	8	0.087	0.957
Reduction of the consumption of natural materials and more use of recycled materials	4.04	0.812	9	2.349	0.309
Strict compliance with statutory regulations	3.91	1.114	10	2.226	0.329
Use of competent contractors with knowledge of sustainable construction	3.83	0.809	11	2.626	0.269
Adopting Value management early stage of the project	3.75	0.780	12	0.074	0.963
Provision of strict government policy on sustainable construction	3.67	1.149	13	1.274	0.529

benefits of sustainability (mean = 4.46), involving professionals with adequate knowledge of sustainable design and construction at the initial stage of project (mean = 4.39), avoiding wastage of materials during construction/adoption of lean method of construction (mean = 4.39), specification and use of readily available sustainable materials (mean = 4.22), proper sensitization of the public on the overall advantage of SC (mean = 4.20), compliance to building guidelines or requirements when designing and constructing (mean = 4.09), and reduction of the consumption of natural materials and more use of recycled materials (mean = 4.04).

This result implies that if SC is to be achieved within the NCI, the government must be proactive in championing its course, through the provision of strict government policy on SC. A similar observation was made by the Joint International Conference (2016). While these policies are being put in place, construction participants must also be ready to change from the traditional method of delivering projects, to a SC approach. They must be ready to jettison the old practices in delivering construction works, and be ready to adopt innovative ideas; ideas that will promote the sustainability concept in construction projects. Ofori (1998) also suggested that if sustainability in construction is to achieved, there should be changes in the thinking, behaviour, production and consumption within the construction industry. These changes can be in the form of adopting strategies such as lean construction to reduce wastage, and reduction of the consumption of natural materials and more use of recycled materials as suggested by Miyatake (1996).

Although sustainability has become a common topic on the lips of most construction participants today, adequately enlightening professionals on the concept and benefits of sustainability, and proper sensitization of the public on the overall advantage of SC is still necessary. Through this, the knowledge of sustainable design among design teams can increase, as this can prove to be a major hiccup in achieving SC (Abidin *et al.*, 2003). This will also help alienate clients/ the public fear as regards SC being more expensive.

5. Conclusion

The role of sustainable buildings in the delivery of quality

education cannot be overemphasized. However, bold statement with regards to the poor sustainability nature of construction projects in most developing countries (Nigeria inclusive), has been made. The NCI has been characterised with poor delivery of SC projects, and educational buildings suffers this same fate. If this is to change, and SC are to be delivered within the country, then understanding the factors inhibiting the delivery of sustainable building requires significant consideration. Based on this knowledge, this study assessed the challenges of SC and possible measures of improving sustainability in construction projects executed within the NCI.

Based on the findings, the study concludes that the significant challenges of SC within the NCI are; construction related, sustainability awareness and knowledge related, finance related, and government related. The implication of this finding is that, the method and process of operations within the NCI does not favour the realisation of SC. Therefore, if sustainable buildings are to be achieved, then a review of the construction activities and processes within the industry is necessary. This can be achieved through proper monitoring and control of the activities of the industry, towards achieving SC, by regulatory bodies. Also, government at all levels can help enforce the delivery of sustainable projects, through the creation of strict government policy on SC, and provision of means of enforcing them.

Educating construction participants through conferences, seminars, training, and workshops organized by different professional bodies within the industry, on the concept of sustainability and its inherent benefits is necessary. This will help improve the understanding and awareness of sustainability concept and achieve sustainability in its holistic form within the industry. Through these programmes, clients fear with regards to the cost of SC can also be alienated. In the same vein, continuous professional development is also necessary so as to keep construction professionals abreast of SC happenings, and ideas emanating from countries around the world.

It is believed that the findings of this study will go a long way in helping the participants responsible for the delivery of educational buildings across the country to deliver sustainable buildings for effective learning. While this study was limited to educational buildings, it is believed that its findings can be generalised to public projects executed with government's fund within the country. Also findings from this study can serve as a guide towards achieving SC, for construction industries in other developing countries, especially in Africa where construction processes are similar. Findings of this study provides room for further studies in the area of projects executed using private funds. Further research can be carried out, by assessing the factors influencing SC in projects executed within the private sector, in order to compare results from both sectors.

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