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-Wallis 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
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,
observation was made in the study of Aigbavboa (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 world.

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, 

| 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), Ref-fat (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)     |
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-Wallis 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

| Table 2: Reliability Test |
|---------------------------|
| **N** | **%** |
| Challenges: Valid | 134 | 100 |
| Excluded | 0 | 0.0 |
| Total | 134 | 100.0 |
| Measures: Valid | 134 | 100 |
| Excluded | 0 | 0.0 |
| Total | 134 | 100.0 |

*a List wise deletion on all variables in the procedure*
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, Kruskal-Wallis 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

| Code | Shapiro-Wilk Test | Kruskal-Wallis 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     |
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 order 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 flatten; 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 fulfills the criterion of factors explaining at least 50% of the variation as stated by Stern (2010).

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      |

Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | 0.746

Bartlett’s Test of Sphericity

| Approx. Chi-Square | 1569.436 |
|--------------------|----------|
| Df                 | 136      |
| Sig.               | 0.000    |

Table 5: KMO and Bartlett’s Test

Figure 1: Scree plot

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 accounts for about 38% of the total variance explained. These factors are: poor workmanship
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 “finance 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).

4.3.4 Government Related Factors

The last extracted principal component has two factors 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.

| Component | 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 |

Table 6: Total variance explained
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 in how the remaining 2 measures were interpreted by the respondents since their SD is above 1.0. Kruskal-Wallis 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.

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-Wallis test conducted to determine the statistical significant difference in the view of the three categories of respondents.

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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 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 |
sustainability concept in construction projects. Ofori (1998) also suggested that if sustainability in construction is to be 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. 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 sustainable construction. 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).

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|
| Reducing 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/adoptions 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.

References

Abidin, Z. N, Khalfan M, & Kashyap M. (2003). Moving Towards More Sustainable Construction. Proceedings of the Construction and Building Research Conference of the Royal Institution of Chartered Surveyors. School of Engineering and the Built Environment University of Wolverhampton, 1st to 2nd September.

Abolore, A. A. (2012). Comparative Study of Environmental Sustainability in Building Construction in Nigeria and Malaysia”, Journal of Emerging Trends in Economics and Management Science, 3 (6) 951-961.

Aghimien, D. O, Awodele, O. A. & Aghimien, E. I. (2016). Providing Sustainability in Educational Buildings Through the Use of Compressed Stabilized Interlocking Earth Blocks. Journal of Construction Engineering, Technology and Management, 6(2)130-140.

Ahadzie, D. K., Proverbs, D. G. & Olomolaiye, P. O. (2008). Critical success criteria for mass house building projects in developing countries”, International Journal of Project Management, 26, 675–687.

Ahmed, A. & Gidado, K. (2008). Evaluating the Potential of Renewable Energy Technologies for Buildings in Nigeria”, In: Dainty, A (Ed) Proc 24th Annual ARCOM Conference, 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 1175-1182.

Aigbavboa, C., Ohiomah, I., & Zwane, T. (2017). Sustainable construction practices: “a lazy view” of construction professionals in the South Africa construction industry”, The 8th International Conference on Applied Energy Procedia, 105, 3003–3010.

Aje, I. O. (2015). Effective Financing Options for Sustainable Construction in a Developing Economy. A Paper Delivered at a 2-Day National Seminar on Sustainable Construction in a Developing Economy: Factors and Prospects organized by The Nigerian Institute of Quantity Surveyors, Ondo State Chapter Held at Theodore Idibiye Francis Auditorium, Federal University of Technology, Akure Ondo State from Thursday 8th – Friday 9th October.

Abkhiyikli, R., Dikmen S. U. & Eaton D. (2009). Sustainability and the Turkish construction cluster: A general overview. Proceedings of the Construction and Building Research Conference of the Royal Institution of Chartered Surveyors, University of Cape Town, 10-11 September.
Akintoye, A. (2000). Analysis of factors influencing project cost estimating practice", *Construction Management and Economics*, 18, 77-89.

Alabi, A. A. (2012). Comparative Study of Environmental Sustainability in Building Construction in Nigeria and Malaysia", *Journal of Emerging Trends in Economics and Management Sciences*, 3 (6), 951-961.

Al-Saleh, Y. M. & Taleb, H. M. (2010). The Integration of Sustainability Within Value Management Practices: A Study of Experienced Value Managers in the GCC Countries", *Project Management Journal*, 41(2), 50–59.

Al-Sanad, S. (2015). Awareness, Drivers, Actions, and Barriers of Sustainable Construction in Kuwait. *International Conference on Sustainable Design, Engineering and Construction, Procedia Engineering*, 118, 969–983.

Al-Yami, A.M. & Price, A.D.F. (2006). A framework for implementing sustainable construction in building briefing project", *In Boyd, D. (Ed.) Proceedings 22nd Annual ARCOM Conference, Association of Researchers in Construction Management, Birmingham, 4-6 September*, 327-337.

Ametepey, O., Aigbavboa, C., & Ansah, K. (2015). Barriers to successful implementation of sustainable construction in the Ghanaian construction industry. *6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, Procedia Manufacturing*, Vol.3, pp. 1682–1689.

Awodele, O. A. (2012). Framework for Managing Risk in Privately Financed Market Projects in Nigeria. PhD thesis submitted to Heriot-Watt University School of the Built Environment.

Ayarkwa, J., Acheampong, A., Wiafe, F., & Boateng B. E. (2017). Factors Affecting the Implementation of Sustainable Construction in Ghana: The Architect’s Perspective. *ICIDA 2017 - 6th International Conference on Infrastructure Development in Africa - 12-14 April, Knust, Kumasi, Ghana, 377–386.*

Ayodele E. O. & Alabi O. M. (2011). Abandonment of construction projects in Nigeria; Causes and effects", *Journal of Emerging Trends in Economics and Management Sciences*, 2(2), 142-145

Babalola, I. H., Oluwatuyi, O. E., Akinloye, L. & Ayewalehinmi, E. (2015). Factors Influencing the Performance of Construction Projects in Akure, Nigeria. *International Journal of Civil Engineering, Construction and Estate Management*, 3(4), 57-67.

Baron, N. & Donath, D. (2016). Learning from Ethiopia – A discussion on sustainable building. *In Proc. of SBE16 Hamburg International Conference on Sustainable Built Environment Strategies – Stakeholders – Success factors*, Held from 7th to 11th March in Hamburg, Germany.

Beheiry, S. (2006). *Measuring Sustainability*. The American University of Sharjah, Sharjah, UAE. Available on: www.scheller.gatech.edu/centers

Brundtland Report, (1987). *Our Common Future*. United Nations Assembly, Report of the World Commission on Environment and Development. Annex to General Assembly Document A/42/427.

Bugaje, I. M. (2006). Renewable Energy for Sustainable Development in Africa: A Review. *Renewable and Sustainable Energy Review*, 1-10.

Chaharbaghi, K. & Willis, R. (1999). Study and practice of sustainable development. *Engineering Management Journal*, 9(1), 41-48.

Chartered Institute of Building (2009). *Sustainability and Construction*. Chartered Institute of Building, UK. Available on: www.ciob.org.uk

Cuyvers, K., Weerd, G., Dupont, S., Mols, S. & Nuytten, C. (2011). Well-being at school: does infrastructure matter? OECD publications. Available on: www.oecd.org/publishing/corrigenda

Djokoto, S. D., Dadzie, J., & Ohemeng-Ababio, E. (2014). Barriers to sustainable construction in the Ghanaian construction industry: consultants’ perspectives. *Journal of Sustainable Development*, 7(1), 134-143.

Edukugho, E (2013). *Education sector stinks! Infrastructure bad, now worse*, Vanguard Newspaper. Available on: http://www.vanguardngr.com/2013/12/education-sector-stinks-infrastructure-bad-now-worse/

Ekung, S., Oaikhena, E. & Ejekwu, T. (2016). Validated Indicators of Sustainability in Construction Project Management Activities -Stakeholders’ Perception, *In Ebohon, O. J., Ayeni, D. A, Egbu, C. O, and Omole, F. K. Procs. of the Joint International Conference (JIC) on 21st Century Human Habitat: Issues, Sustainability and Development, 21-24 March, Akure, Nigeria, 765-774.

Ewa U. E., (2013). Root Causes of Project Abandonment in Tertiary Institutions in Nigeria", *International Business Research*, 6 (11), 149 – 159.

Fadokun, J. B. (2009). University research capacity in Nigeria and the factors of National development in a knowledge-based economy, National Institute for Educational Planning and Administration, Nigeria. Available on: umconference.um.edu.my/upload/43-1

Ghasemi, A. & Zahediasl, S. (2012). Normality Test for Statistical Analysis: A guide for non-statisticians", *International Journal of Endocrinol Metab*, 10(2), 486-489.
Hair, J. F., Anderson, R. E., Tathan, R. L. & Black, W. C. (1998). Multivariate data analysis. Upper Saddle River, New Jersey: Prentice Hall.

Joint International Conference (2016). 21st Century Human Habitat: Issues, Sustainability and Development. Communiqué of the Joint International Conference, held at the Federal University of Technology, Akure, Nigeria from 21st to 24th March

Kim, S., Lee, Y., Nguyen, V.T. & Luu, V.T. (2016). Barriers to Applying Value Management in the Vietnamese Construction Industry. Construction in Developing Countries, 2016 (Early View), 34-45.

Lowe, D. J. & Zhou, L. (2003). Economic factors of sustainable construction. RICS COBRA Foundation Construction and Building Research Conference, University of Wolverhampton 1st - 2nd September 2003. London: The RICS Foundation, 113-126.

Magaji, N. (2015). Sustainable Facilities Management: Appraising the professionals’ Awareness, Knowledge and Performance. An unpublished Masters in facilities Management, Department of Building, Ahmadu Bello University, Zaria – Nigeria.

Miranda, L. & Marulanda, L., (2001). Sustainable construction in developing countries a Peruvian perspective. Agenda 21 for Sustainable Construction in Developing Countries, Latin America Position Paper.

Miyatake, Y. (1996). Technology development and sustainable construction. Journal of Management in Engineering, 12(4) 23–27.

Moser, C.A. & Kalton, G. (1999). Survey Methods in Social Investigation. 2nd Edition. Gower Publishing Company Ltd, Aldershot.

Nduka, D. O. & Sotunbo, A. S. (2014). Stakeholder Perception on the Awareness of Green Rating Systems Benefits and Accrual Benefits in Construction Projects in Nigeria. Journal of Sustainable Development in Africa, 16(7), 118-130.

Ofori, G. (1998). Sustainable construction: principles and a framework for attainment – comment. Construction Management and Economics, 16, 141–145.

Oghogu, C. O. (2011). Modes of Funding Nigerian Universities and the Implications on Performance. Journal of International Education Research, 7(4), 75-82.

Ogunsemi, D. R. (2015). Value for Money in Construction Projects: The Quantity Surveyor’s Quest”, 71st Inaugural Lecture delivered by Prof. D. R. Ogunsemi at the 2500 Capacity Auditorium, Federal University of Technology, Akure, Ondo State.

Ogunsemi, D. R. & Saka, N. (2006). The NEPAD Initiative and the Challenge of Efficient Cost Management of Infrastructure Development in Nigeria. Paper presented at the 22nd Biennial Conference of the Nigeria Institute of Quantity Surveyors, Calabar, 22nd to 25th November.

Oke, A. E., Aghimien, D. O. & Olatunji, S. O. (2015). Implementation of Value Management as an Economic Sustainability Tool for Building Construction in Nigeria. International Journal for Managing Value and Supply Chain, 6(4), 55-64.

Okojie, J. A. (2009). Innovative funding in the Nigerian university system. Available at http://www.unilorin.edu.ng/unilorin/downloads/okojie-innovative%20Funding.ppt

Olanipekun, A.O. (2015). Successful Delivery of Green Building Projects: A Review and Future Directions. Journal of Construction, 8(1), 30-40.

Olanrewaju A. A (2010). Quantitative analysis of criteria in university building maintenance in Malaysia”, Australasian Journal of construction Economics and Building, 10(3), 51-61.

Oluba, M. (2008). Who Should Provide Public Infrastructure in Nigeria?” Economic Reflections, 8,4

Oluwakiyiyesi, T. (2011). Construction Industry Report: A Haven of Opportunities. Vitiva Research.

Onuoha, L. N. (2013). Financing Higher Education in Nigeria: The Role of Internally Generated Revenues and How University Managements Can Maximize the Sources. Canadian Social Science, 9(1), 9-14.

Opoku, A., & Ahmed, V. (2014). Embracing sustainability practices in UK construction organizations: factors facing intra-organizational leadership, Built Environment Project and Asset Management, 4(1), 90-107.

Osaily, N. Z. (2010). The key Barriers to Implementing Sustainable Construction in West Bank – Palestine. Robert Kennedy College / Zurich University of Wales / UK, March.

Pallant, J. (2005). SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS for Windows (Version 12). 2nd Edition, Allen and Unwin, Crows Nest NSW 2065 Australia.

Parkin, S. (2000). Context and drivers for operationalizing sustainable development”, Proceedings of ICE, 138,9 – 15.

Pitt, M., Tucker, M., Riley, M. & Longden, J. (2009). Towards sustainable construction: promotion and best practice. Construction Innovation, 9(2), 201-224.

Preacher, K. J., & MacCallum, R. C. (2002). Exploratory Factor Analysis in Behaviour Genetics Research: Factor Recovery with Small Sample Sizes, Behaviour Genetics, 32, 153-161.
Raynsford, N. (2000). Sustainable construction: The Government’s role, Proceedings of ICE. 138, 16–22.

Reffat, R. (2004). Sustainable construction in developing countries. Proceedings of First Architectural International Conference, Cairo University, 24-26 February, Cairo.

Sage, A. P. (1998). Risk management for sustainable development. IEEE International Conference on Systems, Man and Cybernetics, 5, 4815 – 4819.

Spector, P. (1992). Summated rating scale construction: an introduction. Newbury Park, California: Sage Publications.

Stern, L. (2010). A visual approach to SPSS for Windows: a guide to SPSS 17.0. 2nd ed., Boston: Allyn and Bacon.

Sushil, S. & Verma, N. (2010). Questionnaire Validation Made Easy. European Journal of Scientific Research, 46(2), 172 – 178.

Tabachnick, B.G. & Fidell, L.S. (2007). Using multivariate statistics. 5th edition, Boston: Pearson Education.

Wai, S. H., Yusof, A. M., Ismail, S., & Tey, K. H. (2012). Critical Success Factors for Sustainable Building in Malaysia, 123 -127.

Zhao, N. (2008). The Minimum Sample Size in Factor Analysis. Available on: https://www.encorewiki.org/plugins/servlet/mobile#content/view/25657