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Influence of Sustainable Construction Practices Awareness Level on Extent of Usage in Abuja-Nigeria

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ABSTRACT

The construction industry has been under severe pressure in recent times to adopt environmentally friendly approaches to gain a competitive advantage. This is a result of failure to select durable and sustainable materials that comply with the acceptable requirement for standards, appropriate site selection, adoption of flexible and durable designs, proper planning and management of construction activities, and proper commissioning of building systems and equipment before occupation. This study, therefore, is on the influence of sustainable construction practices awareness level on the extent of usage in Abuja – Nigeria. The study elicited data from construction professionals in Abuja-Nigeria using structured questionnaires. Based on the awareness level, managing the site for an improved environment and smart homes had mean score values of 2.23 and 2.45 respectively. In a related development, the results of the extent of usage indicated that cost efficiency and smart homes had mean score values of 2.17 and 2.97 respectively. The paired t-test showed that there was no statistically significant difference in the level of awareness and the extent of usage of sustainable construction practices in the study area. Therefore, it was concluded that the use of the sustainable practice is influenced by prior knowledge and education in terms of awareness of the existence of such practices. Hence, there is a need for proper sensitization of sustainable construction practices on their importance and necessity to humans and the environment.

Keywords : sustainability, sustainable practices, awareness level, construction industry

INTRODUCTION

Sustainability is not considered a new concept as it was used since the 1970's (Al Saleh & Taleb, 2010), even though the practice during the time still largely holds a preservationist philosophy. The concept had only gained global political recognition since it was introduced by the Brundtland Report titled 'Our Common Future' in 1987 at the United Nations Conference on Environment and Development (Lowe & Zhou, 2013). Most published works relating to the concept of a sustainable building however undeniably were influenced by the initial concept of sustainability which is about limiting resources and reducing their impact on the natural environment with emphasis on technical issues such as materials, building components, construction technologies, and energy-related design concepts (El Razaz, 2010; Abidin, 2010).

The sustainable construction concept has been introduced mostly in developed countries while less attention has been given to it in developing countries, where Nigeria is no exception. In the country, for instance, many productive lives and properties have been lost to a series of building collapses and this portends danger to future generations as well as the

socio-economic status of its citizenry (Abolore, 2012). This is a result of failure to select durable and sustainable materials that comply with the acceptable requirement for standards, appropriate site selection, adoption of flexible and durable designs, proper planning and management of construction activities, and proper commissioning of building systems and equipment before occupation (Davies & Davies, 2017).

Despite its perceived role, the construction industry is slow in its adaption of sustainable practices in construction projects (Aigbavboa *et al.,* 2017). Aghimien *et al.* (2018) discovered that in a developing country like Nigeria, there is a low level of awareness in the aspect of sustainability, despite that it has been established that the World today is moving towards sustainable development through the delivery of sustainable construction; one that encourages the preservation of the natural habitat promotes social wellbeing of the occupants and provides the reasonable economic base for the investors and stakeholders. Stakeholders play a major role in sustainable construction practice and all hands must be on deck to achieve the common goal of sustainability. Owolana and Booth (2015) established that in Nigeria, some construction project stakeholders chose to neglect the more important aspects of protection and quality of the environment and focus more on the economic angle. As such, there is still a slow rate of progress in terms of the adoption of sustainable construction practices in Nigeria, though it is one of the largest economies in Africa. Oladokun and Ujene (2017) asserted that there is a low level of preparedness among stakeholders to adopt sustainable construction in Nigeria. Even at that, there is a need to make progress against an appropriate research and development agenda, such that companies can participate in sustainable practices that are consistent and an accessible way of enduring value for both themselves and a diverse set of stakeholders, who are yet to be positively engaged in reporting processes and outcomes (Bal, 2014). The concept of stakeholder engagement, including its practical implementation, in terms of delivering sustainability, is still relatively unexplored. Dania (2016) explored the adoption and implementation of sustainable construction (SC) at the strategic and operational levels by construction firms in Nigeria. The findings of the research demonstrated that the Nigerian market does not present an adequate business case for construction firms, nor does it adequately support the implementation of sustainability. Based on the above, the influence of sustainable construction practices awareness level on the extent of usage in Abuja-Nigeria was explored.

Sustainability in the Construction Industry

Construction is a major industry in the global economy. In 2015, the global construction market estimated US$9.5 trillion, accounting for more than 10% of its gross domestic product (GDP), within the construction market, industrial construction accounts for 21% (IHS Global Insight, 2016). Sustainability studies have usually focused on two sectors which are buildings and infrastructures. The construction industry is at the very heart of the challenge we face in the transition to a more sustainable economy (Alex & Chris, 2013). The industry, therefore, has to shift its practices and embrace one which involves recycling and re-use of materials to reduce energy and natural resources used.

Construction organizations need to provide a collective framework for vision, strategy, and direction towards the common goal of a sustainable future. It is important to state that the industry must have both the ability as well as the knowledge to effectively move towards sustainability (Opoku & Fortune, 2011). Sev (2009) pointed out that both the existing built environment and the process of adding to it, have several environmental, social, and economic impacts. As a result, the construction industry has a significant social responsibility to minimize the damage it projects to the social environment.

The understanding of sustainability is tailored to an established definition provided in Brundtland Report (1987), which states, that sustainability is seen as 'meeting the needs of the

present without compromising the ability of future generations to meet their own needs (Oladokun & Ujene, 2017). The construction industry has been under severe pressure in recent times to adopt environmentally friendly approaches to gain a competitive advantage (Baloi, 2015). Sustainability in the construction industry has become the mainstream of the 21st century since the World Commission on Environment and Development arose from the world summit on Environment in 1987 (Abolore, 2012). Murray and Cotgrave (2007) observed that the meaning of sustainability and sustainable construction is in a continuous evolvement over time and commonly the terms can be interchanged to broadly describe an approach that addresses the social, economic, and environmental challenges mankind faces.

The construction industry, which is important to improve the quality of life in terms of housing, workspace, utilities, and transport infrastructure, is of high economic significance and has serious environmental and social consequences. Studies have established that construction organizations can benefit from implementing sustainable construction approaches (Du Plessis, 2007). Sustainability in the construction industry is therefore obligatory even in the traditional method of project delivery, due to the growing need to save cost, optimize performance and meet stakeholders' external needs (Oladokun & Ujene, 2017). Alex and Chris (2013) espoused that the pursuit of sustainable construction practices will provide numerous opportunities for organizations prepared to take on sustainable challenges.

RESEARCH METHODOLOGY

The study is part of a larger study that adopted a concurrent parallel mixed methods design, however, the survey aspect is reported here. Creswell (2014) stated that collecting, analyzing, and mixing both the quantitative and qualitative data within a single study usually enables the understanding of research objectives more comprehensively. For the questionnaire survey, quota sampling was adopted for this research, this was because it eliminated bias and all individuals were of a similar profession (Chinelo, 2016). For the study, the unit of analysis constituted professionals of various construction companies and governmental/ regulatory bodies in Abuja. These bodies included The Nigerian Institute of Building (NIOB), The Nigerian Institute of Architects (NIA), The Nigerian Society of Engineers (NSE), and The Nigerian Institute of Quantity Surveyors (NIQS) as shown in Table 1. The study adopted probability sampling; it is where the researcher includes cases or participants in the sample because it is believed that they warrant inclusion and every case in the population has an equal opportunity of being selected (Chinelo, 2016; Hamed, 2016). Out of 1685 professionals, 313 were randomly selected and considered to be representative of the professionals based on Krejcie and Morgan's (1970) table.

Table 1. The sample size of each component of the population frame

S/n	Registered Professionals	Population	Sample size
1	Architects (NIA)	631	117
2	Builders (NIOB)	441	82
3	Quantity surveyors (NIQS)	92	17
4	Engineers (NSE)	521	97
	Total	**1685**	**313**

The data collected from questionnaires were analyzed using mean and paired sample t-tests which formed the basis for the conclusion and the recommendations made. The T-Test is often used in hypothesis testing to determine whether a process or treatment has an effect on the population of interest, or whether two groups are different from one another. It was used for this research to compare the means between the level of awareness and the extent of usage of sustainable construction practices.

RESULTS

The analysis shows that only 209 questionnaires were received out of 323 that was administered, making it 64.7% percentage of questionnaires returned. In terms of organizational type, 67.94% work with the public while 32.06 % work with private organizations. In terms of professionals' representation, the result revealed that builders (54.07%) are more, followed by Architects (18.66%), Engineers (12.92%), then Quantity Surveyors (10.53%), and lastly others (3.83%). A look at the year of work experience of the respondents shows that only 15.79% of them have their years of working experience fall within the 1 to 5 range, while 27.75% and 33.01% fall between the range of 6 to 10 and 11 to 15 years respectively. Also, 18.18% and 5.26% of the population fall between the ranges of 16 to 20 years and above 20 years respectively. However, the average years of working experience of the respondents are calculated as approximately 10.79 years. This implies that they are experienced enough to give a valid response.

Table 2. Demographic Information of the Respondents

	Variables	Frequency	Valid percent
Organization	Public	142	67.94%
	Private	67	32.06%
	Total	**209**	**100%**
Profession	Architect	39	18.66%
	Builder	113	54.07%
	Engineer	27	12.92%
	Quantity Surveyor	22	10.53%
	Total	**209**	**100%**
Years of Experience	1-5years	33	15.79%
	6-10years	58	27.75%
	11-15years	69	33.01%
	16-20years	38	18.18%
	Above 20	11	5.26%
	Total	**209**	**100%**

Level of awareness of sustainable construction practices

Table 3 shows the results of the major constructs for the level of awareness of sustainable construction practices while the analysis covers the sub-constructs. The mean values that evolved are as follows; mean value of ≥ 4.50 corresponds to "very low", 3.50-4.49 corresponds to "low", 2.50-3.49 corresponds to "moderate", 1.50-2.49 corresponds to "high" and 1.00-1.49 corresponds to "very high". Under the energy efficiency subgroup; the use of biodegradable materials such as organic paints in construction works with a mean of 3.67 and standard deviation of 1.22 was rated high by the respondents.

For the sustainable procurement subgroup; encouraging the reuse of materials like marine plywood for multiple casting is rated high with a mean score of 2.15. Under the cost efficiency subgroup; the Use of metal formworks for future reuse and the use of locally sourced materials like bamboo were rated high with mean scores of 2.06 and 2.11 respectively. Similarly, under the materials selection group; Reusing and recycling construction and demolition materials, Choosing sustainable construction materials and products whenever possible, and Using materials with longevity were rated high with mean scores of 1.87, 1.89, and 2.21 respectively. Waste management; Employing the Lean process which is finding innovative means of eliminating wasteful activities was rated high with a mean score of 2.16.

Under the appropriate site selection group; locating projects on sites away from the flood plain and avoidance of prime farmland for construction were rated high with mean values of 2.33 and 2.39 respectively. Under the water management group; knowledge on reuse and recycling of water, finding other innovative ways to reduce the use of water, and use of low flush faucets/ambiance was rated high with mean scores of 1.67, 2.14, and 2.24 respectively.

The most rated variables under the indoor environment group are; providing for occupant control of building lighting systems and functional design that allows for proper cross ventilation were rated high with mean scores of 1.52 and 1.72 respectively. The time conservation showed that the use of construction software to design schedules and the use of locally sourced building materials were rated high with mean scores of 1.88 and 2.08 respectively.

The prefabricated materials group showed that the use of prefab polystyrene, prefab lintel, and steel structure for the roof was rated high with mean scores of 1.68, 2.1, and 2.27 respectively. Under the site management for improved environment group; the use of the recyclable container for food to decrease organic waste was rated very high with a mean score of 1.33 while the use of waste bins at different locations of the site, restriction, and institution of simple ways to reduce pollution and minimize environmental tobacco smoking were rate high with mean scores of 1.7, 1.78 and 2.41 respectively. For the smart homes group; the use of smart light bulbs, CCTV, and motion detection perimeter wall and lighting were rated high with mean scores of 1.57, 2.04, and 2.46 respectively. The landscaping group revealed that buildings within walking distance to basic services and near alternative transportation were rated high with mean scores of 1.84 and 1.88 respectively.

From the results, it can be concluded that the level of awareness of sustainability ranges from moderate to high.

Table 3. Awareness of Sustainable Construction Practices

Sustainable Construction Practices	Mean Statistic	Decision
Energy Efficiency	2.72	Moderate
Sustainable Procurement	3.21	Moderate
Cost Efficiency	2.73	Moderate
Materials Selection	2.67	Moderate
Waste Management	3.49	Moderate
Appropriate site selection	3.21	Moderate
Water Management	2.70	Moderate
Indoor Environment	2.78	Moderate
Time Conservation	3.09	Moderate
Prefabricated Materials	2.53	Moderate
Managing the Site for an improved Environment	2.23	High
Smart Homes	2.45	High
Ventilation	3.05	Moderate
Landscaping	2.95	Moderate

The extent of usage of sustainable construction practices

Table 4 indicates the results of the major constructs for the level of awareness of sustainable construction practices while the analysis covers the sub-constructs. Under the energy efficiency subgroup; the use of biodegradable materials, use of electrical appliances, and use of solar energy inverters as alternatives to local electricity were rated high with mean scores of 2.07, 2.28, and 2.28 respectively, appear to be the most used practices by the respondents. For the sustainable procurement group; procuring local contractors adding social

economic benefits to the community and encouraging the reuse of materials like marine plywood for multiple casting were rated high with mean scores of 1.9 and 2.03 respectively.

Under the cost efficiency group; the use of locally sourced materials like bamboo, use of glass blocks and aluminum instead of walls that requires continuous maintenance, use of cost management plan, use of polystyrene for partition wall, and use of metal formwork for future reuse were all rated high with mean scores of 2.04, 2.04, 2.06, 2.22 and 2,42 respectively. Under the materials selection group; use of locally sourced material has a mean of 1.9, choice of sustainable construction materials whenever possible rated 2.34, and use of materials with longevity-2.42 were top among these variables.

The waste management group; appears to be between moderate and low. Under the appropriate site selection group; also appears to be between moderate and low. The most ranked under the water management group are; finding other innovative ways to reduce the used water was rated 2.19. The most rated variables under the indoor environment group are; also appeared to be between moderate to low. The time conservation group; shows that the use of locally sourced contractors and masons, locally sourced building materials and use of software to design construction schedules were rated high with mean scores of 2, 2.25, and 2.44 respectively.

The prefabricated materials group shows that the use of prefab metal formwork was rated high with a mean score of 2.29. Under the managing, the site for improved environment group; restriction and institution of simple ways to reduce pollution was rated high with a mean of 2.02. For the smart homes group; the use of a smart thermostat to regulate indoor temperature and the use of CCTV was rated high with mean scores of 2.33 and 2.5 respectively.

All the variables under the ventilation group were rated as being moderately used. However, the most used among them are; providing 30% increased ventilation above code level or natural ventilation of indoor work area to increase the amount of healthy air inflow, and providing no smoking building or separate ventilation system where smoking is allowed; with mean values of 3.38 and 3.03 respectively. The landscaping group revealed that landscaping with a native drought-resistant plant with a high mean score of 2.22, managing landscaping and parking lots to reduce the excessive area of open pavement that causes heating of area was rated high also with a mean score of 2.44. From the results, it can be concluded that the extent to which sustainable construction practice is used in construction is between moderate and low. This was drawn from the number of mean scores which fell within the group mean classification.

Table 4. Extent of Usage of Sustainable Construction Practices

Sustainable Construction Practices	Mean Statistic	Decision
Energy Efficiency	2.55	Moderate
Sustainable Procurement	3.08	Moderate
Cost Efficiency	2.17	High
Materials Selection	2.84	Moderate
Waste Management	3.41	Moderate
Appropriate Site Selection	3.43	Moderate
Water Management	3.26	Moderate
Indoor Environment	3.25	Moderate
Time Conservation	2.50	Moderate
Prefabricated Materials	2.93	Moderate
Managing the Site for an improved Environment	3.30	Moderate
Smart Homes	2.97	Moderate
Ventilation	2.98	Moderate
Landscaping	3.12	Moderate

Relationship between the perceived level of awareness and extent of usage of sustainable construction practices

The paired sample t-test, sometimes called the dependent sample t-test, is a statistical procedure used to determine whether the mean difference between two sets of observations is zero. A look at Table 5 reveals the mean values of the awareness level and extent of usage of sustainable construction are 2.83 and 2.98 respectively, and their respective standard deviations are 0.88 and 0.680. This gives an early indication of whether the two variables are statistically significant or not. Since, the mean of the two variables is very close with only a difference of 0.15 (Table 6) and thus, closer to zero. It can be said that there is no significant statistical relationship.

Table 5. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Awareness Level	2.8295	70	0.88002	0.10518
	Extent of Usage	2.9821	70	0.68123	0.08142

The Paired Samples Correlations in Table 6 show that the correlation (r=3.60%), is very weak and low. Also, with a p-value of 0.766 which is greater than the 0.05 level of significance, this shows that there is no statistically significant difference between the level of awareness and the extent of usage of sustainable construction.

Table 6. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Awareness Level & Extent of Usage	70	0.036	0.766

To draw up the conclusion, Table 7 which is the result of the paired sample test itself, shows that the Significance (2-tailed) of 0.247 is also greater than 0.05, further confirming that there is no significant statically difference between the two variables. It was concluded that the use of the sustainable practice is influenced by prior knowledge and education in terms of awareness of the existence of such practices.

Table 7. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Awareness Level - Extent of Usage	-0.15263	1.09316	0.13066	-0.41329	0.10802	-1.168	69	0.247

Discussion of Results

The study revealed that the level of awareness of sustainable construction ranges between low to moderate, while the extent to which sustainable construction practice is used in construction is moderate. This was drawn from the number of mean scores which fell within the group mean classification, this also shows that a lot still needs to be done in the area of education and training. This support the findings of (Ahn *et al.*, 2013; Niroumand *et al.,* 2013; Udawatta *et al.,* 2015; Abidin, 2010). It was reported that it is only awareness and knowledge of sustainability practices that can help in the diffusion of the ideas. Ametepey *et al.* (2015) and Holton *et al.* (2018) pointed out that sustainable practices are feared to be more expensive and can amount to higher investment costs when compared to traditional construction, clients are also deterred from embracing sustainable practices due to concerns of higher cost and risks based on the lack of previous experience, unfamiliar techniques, the need for additional testing and inspection, and lack of support from both manufacturers and suppliers.

Also, the adoption of sustainability practices is hinged on the awareness, knowledge, and demands of clients and professionals. This can be done through training and education on the concepts (Niroumand *et al.,* 2013; Udawatta *et al.,* 2015). Furthermore, according to Abidin (2010), the starting point for the implementation of sustainable construction is awareness and drive for its knowledge. The acceptance of the knowledge gained on sustainability will lead to increased demand, and subsequent adoption and implementation. According to Aghimien *et al.* (2018), existing studies have laid more emphasis on the environmental aspect of sustainability and suggested the education and promotion of sustainable practices.

According to Kibert (2013), modern technologies and concepts have now evolved to support sustainable construction practices. Some of these technologies are Building Information Modelling (BIM) and high-efficiency photovoltaic (which are impacting approaches to project design and collaboration. Also, the education of construction-based professionals aimed at encouraging sustainable practices should be emphasized by both firms and the government (Aghimien *et al.,*2018). The willingness of stakeholders to adopt these practices and technologies could be increased, with a better understanding of the driving factors.

CONCLUSION

The research showed that although the awareness level of these practices appeared to be moderate to low while the extent of usage could be deemed as moderate. The paired test carried out showed that the use of the sustainable practice is influenced by prior knowledge and education in terms of awareness of the existence of such practices. This brings to the fore the issue of regular inspections and monitoring of works. This will prompt site professionals to quickly adopt sustainable practices for fear of being sanctioned. Regular inspection of works should be encouraged to make sure other professionals on site are adhering strictly to the building code. The following suggestions are therefore made:

1. The need for proper sensitization of sustainable construction practices on their importance and necessity to humans and the environment.
2. The need for adequate incentive to encourage client and stakeholder engagement and acceptance of sustainable construction practices.
3. Provision of a sustainable building code solely for practices, techniques, and methods of sustainability.

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