

Factors influencing construction of sustainable buildings in Lagos metropolis, Nigeria

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Abstract:

The recent increased demand for housing and infrastructure stems from the upsurge in the human population worldwide. The resultant effects are depletion of resources, generation of waste, pollution, energy consumption, and release of greenhouse gases into the atmosphere; thus, the need for environmentally sustainable buildings and construction practices. This study assessed the factors influencing the construction of sustainable buildings in Lagos Metropolis, Nigeria. Research data were obtained through questionnaires from construction professionals of construction firms who had participated in constructing identified sustainable buildings in Lagos Metropolis, Nigeria. The retrieved data were analysed using frequency distribution mean score ranking) and inferential statistics (ANOVA). The result of the study indicated that the top five significant drivers of sustainable buildings are energy efficiency, improved indoor environmental quality, pollution prevention, waste reduction, and resource conservation. Furthermore, the top four major barriers inhibiting the construction of sustainable buildings can be grouped as finance. Others are management support, government policies, limited sustainable products and materials, and organizational culture. This study assessed the drivers and barriers of sustainable construction in the Nigerian construction industry with a view to proffering measures that will lead to the adoption and implementation of sustainable construction in the country. Furthermore, this study will contribute to the existing literature on drivers of and barriers to sustainable construction in Nigeria.

Keywords: barriers, drivers, construction, sustainable buildings, Nigeria

1 Introduction

The recent upsurge in need for housing and infrastructure is a resultant effect of the rapid population growth around the globe (Alwan et al., 2017). Construction investment in Africa, Asia, and the Middle East are projected to rise to US\$12.9 trillion by 2022 (Report Linker, 2019). The construction industry facilitates socio-economic development in every nation. Nevertheless, the activities of the industry have adverse impacts on the three major sustainability dimensions (economic, environmental, and social) (Karji et al., 2020). The current level of sustainability practice in the construction industry is low compared to the targeted green goals. The central challenge in our present world is the enhanced greenhouse effect i.e., global warming, a resultant effect of the release of GHGs (carbon dioxide, methane, nitrous oxide, and fluorocarbons) by anthropogenic activities (United Nations Framework Convention on Climate Change (UNFCC), 2011). Global emissions from buildings rose for the second consecutive year to 9.7 gigatonnes of carbon dioxide (GtCO₂), representing a 2% increase (UNEP, 2019). In Africa, buildings consumed 61% of total final energy and contributed 32% to total carbon dioxide (CO₂) emissions (IEA, 2019a). GlobalABC revealed in the Global Status report that global progress on reducing emissions is not on track due to

slow-paced energy efficiency improvements compared to floor area and demand growth (IEA, 2019b).

The need to slow down climate change and global warming has made sustainable development a major issue among policy-makers and world leaders (Amuda-Yusuf et al., 2020). Sustainable building or construction has become one of the major global practices of the 21st century (Osuizugbo, 2018). *Green buildings are environmentally sustainable buildings, designed such that they are eco-friendly in all ways. Green building practices reduces the environmental impact of building (Saurabh, 2018).* However, some of the developing countries in the West Africa such as Nigeria are yet to imbibe successfully and implement sustainability practices in the execution of construction projects (Akinshipe et al., 2019; Ametepey et al., 2015; Alabi, 2012; Baron & Donath, 2016; Osuizugbo, 2018). Nigeria has witnessed a slow transition from its traditional construction methods to contemporary sustainable construction (Adindu et al., 2020; Osuizugbo et al., 2020). A study carried out by Dania (2013) revealed that the adoption of sustainability practices in Nigerian construction industry is still lagging behind compared to the rest of the world. This was corroborated by Dahiru et al. (2014) who submitted that the lack of policy or environment limits the practice of green construction in Nigeria to support its adoption.

Previous researchers have investigated the drivers and barriers of the construction of sustainable building globally (Namian et al., 2021; Olowosile, 2020; Azazga, 2019; Ametepey et al., 2015; Tokbolat et al., 2019; Oke et al., 2018; Durdyev et al., 2018; Alsanad, 2015; Marsh et al., 2020; Aghimien, 2018; Tarja & Belloni, 2011) and few locally (Daniel et al., 2018; Onososen et al., 2019; Olowosile et al., 2019; Osuizugbo et al., 2020; Ifije & Aigbavboa, 2020). However, most of these researches were conducted internationally, adapting the results for individual countries could pose the danger of ecological fallacy. Additionally, studies conducted locally in Nigeria may not have elicited the cogent issues because most of the people who responded to the survey were general construction professionals, many of whom have not undertaken the construction of any sustainable building. Thus, this study will investigate the drivers and barriers of constructing sustainable buildings in Lagos Metropolis, Nigeria, which is the hub of construction activities in the country. The respondents will be professionals of construction firms that have undertaken sustainable building construction in the study area. The findings of this study would help all construction stakeholders and policymakers to develop strategies to ease the implementation of sustainable construction in the nation, which will ensure resource conservation and enhance greening the country.

2 Drivers of Construction of Sustainable Buildings

An extant review of the literature revealed several drivers promoting the construction of sustainable buildings. In the US, Roper & Beard (2006) identified five significant factors that promote sustainable building design and operation viz: pollution prevention, harmonization with the environment, resource efficiency, energy efficiency, and integrated and systematic approaches. Ahn et al., 2013 investigated the drivers of and barriers to green design and construction in the US construction industry. The study revealed that the significant drivers of sustainable design and construction are environmental or resource conservation, waste reduction, improving indoor environmental quality, and energy conservation. Alsanad (2015) reported that the major drivers that promote green practices in Kuwait to be educational programs, laws and legislation, economic incentives, and green design guidelines and

construction standards. The five most significant drivers of sustainable construction in Cambodia were reducing building impacts on the environment, conservation of resources, energy efficiency, waste reduction, and improved indoor environmental quality (Durdyev et al., 2018).

Serpell et al. (2013) found out that corporate image, laws and legislation, market identification, company awareness, suppliers' pressure, cost reduction, and clients' requirement are the factors promoting sustainable construction in Chile. Tokbolat et al. (2019) explored the drivers of and barriers to implementing sustainability practices in Kazakhstan construction sector. The critical drivers are waste reduction, energy efficiency, resource conservation, ecology preservation, efficient water management, and the atmosphere. Oke et al. (2018) investigated sustainable construction in the Zambian construction industry. The study indicated that the significant drivers promoting the adoption and implementation of sustainable construction practices are advocacy and awareness, clients' demand, building regulations, developing regulatory mechanisms, and legislation or legal requirement. The study argued that adopting sustainable construction practices can be encouraged through government collaboration with academics, formulation of policies, and enforcement of regulations that aid sustainable construction.

Onososen et al. (2019) found out that financial incentives, government's support, increased awareness, provision of labelling standard, and a sustainable housing policy are the drivers of the adoption of sustainable construction in Nigeria. Tunji-Olayeni et al. (2020) identified five major drivers of sustainable construction in Nigeria through a qualitative method of assessment viz: corporate social responsibility, cost-effectiveness, clients' requirement, international pressure, and competitiveness. In addition, education and training, a sustainability assessment system, and the availability of the national building code are the drivers of sustainability practices in Nigeria (Omapariola et al., 2019). Oyalowo, 2014 conducted a study on barriers to and drivers of sustainable construction. The respondents were real estate developers and property managers. Findings of the study revealed that professional bodies, government regulators, government involvement in sustainable buildings, and investors are the drivers of sustainable construction.

2.1 Barriers Inhibiting Construction of Sustainable Buildings

Karji et al. (2020) found out that the four critical barriers to sustainable construction in the US are managerial barriers, legislative barriers, pre-construction barriers, and financial and planning barriers. The most critical barriers to the adoption of sustainable design and construction are inadequate knowledge and technical skills of subcontractors, long payback periods, tendency to maintain current practices, and initial cost outlay of the project (Ahn et al., 2013). Serpell et al. (2013) conducted a study on awareness, actions, drivers, and barriers of sustainable construction in Chile. The results indicated that the major barriers towards sustainable construction are the lack of financial incentives, lack of integrated design, and affordability. In Finland, Hakkinen & Belloni (2011) found out that the significant barriers of sustainable construction are lack of steering mechanisms, knowledge, economics, innovation, availability of methods and tools, client understanding, timing, cooperation, and networking and procurement and tendering.

Tokbolat et al. (2019) submitted that the barriers to adoption of sustainable practices in Kazakhstan construction sector are longer payback periods, in consideration of sustainability

criteria in the bid evaluation, lack of promotion by government, lack of government incentives, cost of sustainable building option, higher priority dedicated to economic needs, lack of technical expertise, lack of training and education for professionals, and inadequate knowledge on benefits of adopting sustainable practices. Alsanad (2015) reported that the top five barriers to implementing green construction practices are lack of awareness, lack of government support/no incentives, no existing rule to adopt green building, lack of qualified staff, and unwillingness to change. The five most significant barriers to implementing sustainable construction practices are the cost of the sustainable-building option, lack of professional expertise, economic needs of higher priority, lack of statutory requirements that cover sustainable procurement, and lack of government incentives (Durdyev et al., 2018).

Aghimien et al. (2018) identified the main barriers to adopting sustainable construction practices in *Zambian construction industry: unavailability of local green certification, lack of government policies, and lack of financial incentives*. The top five barriers to adopting and implementing sustainable construction in South Africa are resistance to changing traditional construction processes, limited availability of green product suppliers, materials, and technologies, inadequate knowledge, lack of support and incentives from the government, and lack of building codes and regulations. (Marsh et al., 2020). Ametepey et al. (2015) submitted that the five critical barriers to adopting and implementing sustainable practices in the Ghanaian construction industry are lack of commitment from government, lack of professional knowledge, fear of higher investment costs, and cultural change resistance and lack of legislation and regulation. The key barriers to sustainable construction in the Ghanaian construction industry are higher initial financial outlay, lack of public awareness, lack of clients' demand for sustainable buildings, lack of strategy to promote sustainable construction, and lack of government support and incentives. (Djokoto et al., 2013).

Aghimien et al. (2019a) investigated the challenges of sustainable construction in developing countries. The results showed that fear of the increased cost of investment, resistance to change the traditional construction method, client's demand, inadequate knowledge and understanding of the concept of sustainability are some of the major challenges of sustainable construction in developing countries. In Nigeria, Akinshipe et al. (2019) investigated factors inhibiting the practice of sustainable construction. They found that lack of technical expertise and inadequate knowledge in sustainable construction practices are the most significant barriers to adopt sustainable construction. Onososen et al. (2019) submitted that increased financial outlay associated with green building, fear of the need to avoid risk, lack of awareness, lack of government support to drive the process, and inadequate green products are major barriers to sustainable construction. Aghimien et al. (2019b) reported that the significant barriers impeding the implementation of sustainable construction practices in Nigeria are inadequate knowledge of sustainable practices, information and management, regulation and policy, sustainable materials and technology.

3 Research Methodology

This paper examines the factors influencing the construction of sustainable buildings in Lagos metropolis, Nigeria. Lagos was selected as the study location because it is the hub of construction innovations in the nation. The research method employed was quantitative analysis through the use of a questionnaire survey. The respondents were built environment professionals in selected construction companies who had participated in constructing some

identified sustainable buildings in Lagos metropolis, Nigeria. The research work employed the purposive sampling technique. The variables and construct employed in this study were established from an extant review of existing literature. A list of factors (drivers and barriers) influencing the construction of sustainable buildings was constructed from the literature review. The variables in the constructs were made up of 20 factors.

The research instrument was structured into two sections: Section A solicited background information on each firm and its responding officer. Other information included responding officer's designation, highest academic qualification, professional affiliation, and years of experience; Section B sought information on the factors influencing the construction of sustainable buildings in Lagos metropolis. The responses of these companies in section B were retrieved using five Likert scale where; 1 = Not influential, 2 = Fairly influential, 3 = Influential, 4 = Very influential, 5 = Quite influential. A pilot study was carried out to identify sustainable buildings in Lagos Metropolis (see Table 1). Consequently, five sustainable buildings in Lagos were identified and a sample frame of 16 firms (consulting and contracting) who participated in the construction was drafted and copies of questionnaire were administered to construction professionals in each firm. The internal validity of the research instrument was ascertained by subjecting the questionnaire a peer-review process by the research supervisor. The questionnaires were administered to the respondents physically by the principal researcher.

Eighty-nine copies of the questionnaire were distributed to the construction professionals and 62 copies were retrieved—a response rate of 69.66%. IBM SPSS Version 23 was used to analyse retrieved data. The data analysis tools employed in the study were mean score ranking which showed the significance index of the factors influencing the construction of sustainable buildings and ANOVA which was used to determine the level of significance of the agreement between the respondents.

Table 1: Background Information on Responding Officers

	Frequency (f)	Percentage	Midpoints (x)
Highest Academic Qualification			
OND	2	3.2	
HND	8	12.9	
BSc	35	56.5	
MSc	14	22.6	
PhD	3	4.8	
Professional Designation of Respondents			
Architect	19	30.6	
Quantity Surveyor	13	21.0	
Builder	13	21.0	
Engineer	17	27.4	
Years of Work Experience			
0-5 years	27	43.5	3
5-10 years	18	29.0	8
10-15 years	12	19.4	13
15-20 years	3	4.8	18
20-25 years	2	3.2	23
Mean = 7.75			

4 Results and Discussion

The section presents the analysis of the data retrieved from the survey.

4.1 Background Information on Responding Officers

Table 1 reveals the general information about the responding officers. An assessment of the respondents' academic qualification indicated that about 8 (12.9%) have HND, 35 (56.5%) have B. Sc. While 14 (22.6%) have M.Sc. The most represented professionals are architects 19 (30.6%). The least represented professionals 13 (21.0%) were quantity surveyors and builders. An assessment of the professional affiliation of the respondents showed that 19(30.6%) were affiliated with NIA, 17 (27.4%) were affiliated with NSE. An evaluation of the respondents' year of experience revealed that 45 responding officers (72.6%) have been active in the construction industry for fewer than 10 years while 17 (27.4%) have been engaged in construction works for longer than 10 years.

4.2 Factors influencing the construction of sustainable buildings in Lagos state

Table 2 shows the mean ranking of the factors influencing the construction of sustainable buildings based on the designation of the respondents and their overall mean ranking of the factors influencing the construction of sustainable buildings in Lagos Metropolis, Nigeria. The most significant driver of the construction of sustainable buildings based on the architects' responses was energy efficiency (MS= 4.05), followed by pollution prevention (MS = 3.55). The least ranked driver of construction of sustainable buildings was international pressure (MS = 3.05). Quantity surveyors ranked energy efficiency and improved indoor environmental quality (MS= 3.85) as the most significant drivers of the construction of sustainable buildings. The least ranked driver of construction of sustainable buildings was resource conservation (MS = 3.40). An evaluation of the builder's responses revealed that the most significant driver of construction of sustainable buildings was energy efficiency (MS= 3.94). This was followed by pollution prevention (MS= 3.72) and improved indoor environmental quality (MS= 3.61). Engineers ranked pollution prevention (MS= 3.78) as the most significant driver of construction of sustainable buildings. The least ranked driver was international pressure (MS= 3.36).

The overall ranking of the drivers of construction of sustainable buildings revealed that the most significant driver was energy efficiency (MS= 3.89). This was followed by improved indoor environmental quality and pollution prevention (MS= 3.66). The findings of this study agree with Roper & Beard (2006); Ahn et al. (2013); Durdyev et al. (2018); Tokbolat et al. (2019). The least ranked driver was international pressure (MS= 3.44). Further, inferential test was carried out using ANOVA to ascertain the agreement of the respondents on the drivers of construction of sustainable buildings. The result revealed that all the identified drivers had a significance value greater than 0.05. This implies that the respondents were in agreement in their ranking of the identified drivers.

The most critical barrier of the construction of sustainable buildings based on the architects' responses was cost factors (MS= 3.78), followed by financial resources and cost effectiveness (MS = 3.72). The least ranked barrier of construction of sustainable building was cultural and social resistance (MS = 3.16). Quantity surveyors ranked inadequate cost data for sustainable building (MS= 3.85) as the most critical barrier of the construction of sustainable buildings. The least ranked barrier of construction of sustainable building was capacity barrier (MS = 3.35). An evaluation of the builder's responses revealed that the most critical barrier of

construction of sustainable building was financial resources (MS= 3.94). The least ranked barrier of construction of sustainable building was capacity barrier (MS = 2.77). Engineers ranked financial resources and cost factors (MS= 3.78) as the most significant barriers of construction of sustainable buildings. The least ranked barrier was limited range of sustainable products and materials (MS= 3.00). The overall ranking of the barriers of construction of sustainable buildings revealed that the most significant barrier was financial resources (MS= 3.86). This was followed by cost factors (MS= 3.78), cost effectiveness (MS= 3.68) and inadequate cost data for sustainable building (MS= 3.64). This implies that finance is a major determinant in the construction of sustainable buildings. This result agrees with the findings of Karji et al. (2020); Sepell et al. (2013); Ahn et al. (2013); Durdyev et al. (2018) who identified financial constraints as the main barrier inhibiting sustainable construction. The least ranked barrier was capacity barrier (MS= 3.18). Capacity barrier has a mean ranking of 3.18 which is greater than the midpoint on a 5-point scale. This implies that though it was ranked last, it is also a barrier of sustainable construction (Aghimien et al., 2019a; Aghimien et al., 2019b; Akinshipe et al., 2019; Djokoto et al., 2013). Further inferential test was conducted using ANOVA to ascertain the agreement of the respondents on the barriers of construction of sustainable buildings. The result revealed that all the identified barriers had a significance value greater than 0.05. This implies that the respondents were in agreement in their ranking of the identified barriers.

5 Conclusion and Recommendations

This paper examined the factors (drivers and barriers) influencing construction of sustainable buildings. The study established that the most critical driver of construction of sustainable buildings in Nigeria is energy efficiency. This is in sync with the need to reduce energy consumption in buildings and emission of greenhouse gases. Therefore, the Nigerian government should ensure there is a policy towards achieving energy-efficient buildings in the country. In the same vein, contractors must be willing and ready to construct energy-efficient buildings. Another driver revealed was client demand. Therefore, it is imperative for construction clients to be aware of the need for sustainable construction, make clear demands for sustainable buildings without recourse to the initial financial commitment.

The study also revealed that international pressure promotes sustainable construction in Nigeria i.e., construction firms whose headquarters are overseas are compelled to comply with the sustainable practices and policies of the company. Thus, our indigenous construction firms and the Nigerian government should take a clue from this and ensure the adoption and implementation and sustainable construction in Nigeria. Subsequent findings revealed that the significant barriers of sustainable construction are financial resources, cost factors, cost-effectiveness and inadequate cost data for sustainable buildings. The study concluded that finance is a critical barrier inhibiting sustainable construction in Nigeria. Thus, it is recommended that the government should make efforts to subsidize cost of materials required for construction of sustainable buildings. Consequently, financial incentives should be available to encourage construction of sustainable buildings. The study further revealed that government policies inhibit construction of sustainable buildings in Nigeria. Therefore, the government must make policies that aids and encourages construction of sustainable buildings and the adoption of sustainable practices generally in the country. Capacity barrier was also identified as a barrier to sustainable construction.

Table 2: Factors Influencing the Construction of Sustainable Buildings

S/N	Factors influencing the construction of sustainable buildings	Overall		Architect		Quantity Surveyor		Builder		Engineer		ANOVA	
		Mean	Rk	Mean	Rk	Mean	Rk	Mean	Rk	Mean	Rk	F	Sig.
	Drivers												
D1	Energy efficiency	3.89	1	4.05	1	3.85	1	3.94	1	3.73	2	0.60	0.61
D2	Improved indoor environmental quality	3.66	2	3.44	4	3.85	1	3.61	3	3.73	2	0.68	0.56
D3	Pollution prevention	3.66	2	3.55	2	3.60	6	3.72	2	3.78	1	0.29	0.82
D4	Waste reduction	3.57	4	3.44	4	3.84	3	3.33	7	3.57	4	1.55	0.20
D5	Resource conservation	3.46	5	3.50	3	3.40	7	3.55	4	3.42	6	0.14	0.93
D6	Client demand	3.45	6	3.11	6	3.70	5	3.38	6	3.57	4	2.37	0.07
D7	International pressure	3.44	7	3.05	7	3.75	4	3.55	4	3.36	7	2.09	0.10
	Barriers												
B1	Financial resources	3.86	1	3.72	2	4.00	2	3.94	1	3.78	1	1.14	0.33
B2	Cost factors	3.78	2	3.77	1	3.70	5	3.88	2	3.78	1	0.22	0.88
B3	Cost effectiveness	3.68	3	3.72	2	3.90	3	3.66	3	3.42	6	1.79	0.15
B4	Inadequate cost data for sustainable building	3.64	4	3.61	4	4.20	1	3.22	7	3.47	5	1.19	0.25
B5	Top management support	3.60	5	3.38	11	3.70	5	3.55	4	3.73	3	0.77	0.51
B6	Government policies	3.58	6	3.50	6	3.85	4	3.27	6	3.68	4	2.20	0.09
B7	Limited range of sustainable products and materials	3.41	7	3.44	9	3.65	7	3.16	10	3.36	7	0.99	0.39
B8	Organizational culture	3.37	8	3.61	4	3.50	11	3.16	10	3.21	9	1.26	0.29
B9	Delays in obtaining certification and permit for sustainable buildings	3.37	8	3.50	6	3.55	9	3.22	7	3.21	9	0.77	0.51
B10	Inadequate information regarding the financial and economic benefits and opportunities of sustainable building	3.36	10	3.27	12	3.50	11	3.33	5	3.31	8	0.26	0.85
B11	Cultural and social resistance	3.29	11	3.16	13	3.55	9	3.22	7	3.21	9	0.72	0.54
B12	Lack of incentives for promoting sustainable building	3.28	12	3.44	9	3.60	8	3.05	12	3.00	13	1.87	0.14
B13	Capacity barriers	3.18	13	3.50	6	3.35	13	2.77	13	3.10	12	2.47	0.06

Therefore, our academic institutions should make sustainable construction a key part of the curriculum. Likewise, construction firms should embark on regular training that will facilitate and improve the industry's knowledge of sustainable construction methods and processes.

6 References

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