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Barriers' to the Development of Green Building Innovations in Tropical Climate

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Abstract - *Within the Nigerian building industry, there had been lack of research innovations in profiling the adoption and implementation of green building practices on building projects. The study examined the level of awareness of green building (GB) innovation, hindrances to the implementation of GB development and the benefits of implementing GB in developing countries. A well structured questionnaire was used to collect information from various respondents who are directly involved in designs and construction of building projects. Random sampling technique was used, through a survey monkey to select fifty (50) respondents across the six geo-political zone of the country out of which forty-one (41) responses were used for the data analysis. The data collected was analyzed using descriptive statistics and relative importance index. Findings revealed that, hindrances to the implementation of GB innovation and practices includes: lack of GB policies, GB index, legislation and regulation to guide the design and implementation of GB Innovation, insufficient knowledge base on the part of professionals to handle GB design and construction, Lack of training for professionals on GB by professional institutions through conference were ranked high. While lack of incentive scheme by government on GB, insufficient technical skill and know-how on GB innovations and lack of collaborations with international organization and institution on GB construction practices were ranked low. Findings also revealed that, the benefits of implementing GB will be attributed to the reduction in the cost of energy used in buildings, reduction on maintenance cost of buildings, efficiency in the management of waste were ranked high. While, preservation of natural resources, Improved aesthetic value of the building and better health condition of occupants and its ability to have less impact on environment and its eco-system were ranked low. The study recommends that Professional bodies should train and educate their members on green building principles and practices, through seminars and conferences to improve their knowledge base on green design, construction methods and techniques, Government should provide incentive scheme for those willing to construct green building and lastly, the study recommends the development of Green Building policies, regulations and Index that will be responsible for creating awareness, provide guidelines, tools and techniques, and rating of buildings for subsequent future projects in the country.*

Keywords: Barriers', Development, Green Building, Innovations, Tropical Climate.

1. Introduction

The importance of buildings to nation's economy cannot be overemphasized as they provide and support to most economic activities. Evidence had shown that the building sector is responsible for high energy consumption, solid and liquid waste generation, global greenhouse emission, external and internal pollution, environmental damage and resource depletion (Chan, Tse and Chung, 2010). Building designs, construction, operation and maintenance require innovation in both engineering and management dimensions. Therefore, a far more alternative approach other than the conventional method of building

has become imperative to satisfy the needs with regards to development without damaging the climate. The method adopted can provide a model from which technological, social, environmental and economic issues would be used to manage buildings towards sustainable future. With respect to this, green building concepts are gaining popularity to serve as a standard to mitigate the environmental impact of new and existing building stock. (Nduka, Olabode, and Ogunsanmi, 2015).

Green building is a practice of creating healthy facilities designed and built in a resource efficient manner, using ecological based principles, bring together vast array of practices and techniques to reduce the impact of building on energy consumption, environment and human health. Globally, the trends towards green building practices have been accepted as a number of buildings have incorporated these basic principles. Green building has emerged as an environmentally beneficial alternative to conventional practices (Cassidy, 2004; Dooley and Rivera, 2004; Nobe and Dunbar, 2004). Innovative technologies and products, along with revived traditional practices, are utilized to create homes that are healthier, durable, and less environmentally destructive than conventional buildings.

Green building practices are commonly defined by the areas of the environment they affect: energy, water, site, air quality, and materials (Wilson, Malin, and Yost, 2001). Adoption of green building practices involves a process of transforming knowledge of conventional building practices into knowledge of green building. Adoption of green building is further challenged by the need to provide an integrated construction approach, as opposed to the modular, highly subcontracted approach found in conventional construction (Mead, 2001).

Studies by (Udechukwu and Johnson 2008; Nwokoro and Onukwube 2011; Otegbulu 2011; Abolore 2012 and Adegbile 2013) on sustainability of green building have been conducted in Nigeria. Nwokoro and Onukwube (2011) assessed the current practices and challenges of sustainable construction. Otegbulu (2011) analyzed the effects of green design on environmental sustainability including its implication and occupiers preferences with respect to building components and services to ascertain the level of their appreciation of green elements. The study found that countries in the tropical region are not green conscious in building designs and environmental management.

In a similar study by Udechukwu and Johnson (2008) suggested that adherence to green principles of design increases the bottom line of economic, environmental and human value. The 2009 Earth Day Green Generation Publication emphasized that the average global earth temperature have gone up by nearly one degree Celsius in the last century and the value is expected to rise in the climate region and developing countries due to human activities which is believed to be more versatile in this region, they includes: The burning of coal, fossil fuel, oil and natural gas, deforestation and industrial and agricultural processes that emits greenhouse gases, mainly carbon dioxide (Victor, 2011).

Green building construction has emerged as a guiding paradigm to create a new kind of built environment that meets the needs of human in the present without limiting the ability of future generation on climate mitigation and environmental impact (Ofori, 2008). Most green building practices fall into seven basic categories: energy saving, land saving, storm water runoff-reduction, material conservation and pollution reduction (ECO Northwest, 2001). Waste generated during construction is reduced by recycling. Energy efficiency is improved, relying on the use of natural light and ventilation, rainwater harvesting system is installed to ensure efficiency. Measures taken to make buildings and construction more sustainable relied on life cycle approaches. Thus, Public awareness on green building has increased significantly in the region, Property owners and clients are seeking commercial buildings that meet acceptable environmental and health levels. Unfortunately, there is lack of legislations and policies structures promoting green buildings; awareness on the part of developers and occupants, professionals in the built environment and other stakeholders also lacked capacity to incorporate green building design and innovations in building

projects. In view of this benefits attributed to green building innovations which is capable of enhancing environmental sustainability in the region, This study examined the hindrances to the development of green building innovations and practices, it also provide information on the benefits of promoting sustainable building practices through the development of green building innovation in Nigeria.

1.1 Attributes of Sustainable Green Building Innovation

Sustainable Green Building development is the challenge of meeting growing human needs for natural resources, energy, shelter and effective waste management while conserving and protecting environmental quality and base essential for future life and development. It has the ability of enhancing both the economic well-being and environmental health of communities in Nigeria. The study is considered very imperative as it focus on the benefits of providing most internal comfort at minimal cost, little negative effect on the people and the environment. The goal is to surpass conventional buildings in operational performance, in terms of environmental sensitivity, occupants' health and comfort, satisfaction and life cycle cost, air and quality of the indoor environment, Reduce operating costs, Improve occupant productivity, Enhance asset value and profits, Optimize life-cycle economic performance and wellbeing of those who live and work in them with respect to less water usage, optimize energy efficiency, conserve natural resources, generate less waste and provide healthier spaces for occupants, as compared with conventional buildings. (ECO Northwest, 2001).

2. Methodology

Primary data for this research was obtained through the development of a well structured open ended questionnaire using the parameter of the study. The well structured questionnaire was used to collect information from various professional respondents such as the architect, builders, quantity surveyors, planners, developers and horticulturist who are directly involved in designs and construction of building projects. Random sampling technique was used through survey monkey to select fifty (50) respondents across the six geo- political zones out of which forty-one (41) responses were used for the data analysis. The data analysis was carried out using percentile method and relative importance index. The percentage method obtained the ratio of a particular opinion by respondents to the total number of respondent. The opinion having the largest number of respondents was considered as representing the majority, upon which the final conclusion to the question was based. On the other hand Relative Importance Index (RII) determined the ranks of different elements. These ranking makes it possible to cross-compare the relative important of the factors or elements as perceived by the respondents. Hence, all the numerical scores of each of the identified factors were transformed to relative importance indices to determine the ranking of the factors. The relative importance index (RII) was evaluated by the following expression.

$$\text{Relative Important Index} = \frac{\sum W}{AN}$$

Where,

W = Weighting given to each factor by the respondents and ranges from 1 to 5

A = Highest weight (i.e. 5)

N = Total number of respondent

3.0 Data Presentation and Analysis

Table 1: Academic Qualification of the Respondent

Qualification of Respondents	Frequency	Percentage Representation
HND	14	34.1
BSC	20	48.8
MSC	6	14.6
OTHERS	1	2.4
Total	**41**	**100.0**

The table above shows that 34.1% of the respondents have HND, 48.8% have BSC, and 14.6% have MSC, with the 2.4% having other of academic qualifications. This clearly revealed that all categories of qualifications involved in design and construction practices of building projects are involved among the respondents.

Table 2: Years of Experience of Respondents in the Construction Industry

Class of Respondents	Frequency Distribution	Percentage Representation
1-5	9	22.0
6-10	15	36.6
11-15	11	26.8
16-20	5	12.2
21-25	1	2.4
Total	**41**	**100.0**

The table above shows that 22% of the respondents have experience of 1-5 years, 36.6% have experience of 6-10 years, and 26.8% have 11-15 years of experience, 12.2% have experience of 16-20 years of experience, 2.4% have an experience of 21-25years. The result revealed that larger percentage of the respondents have experience above 6 and 20 years in the building industry and are capable of providing reasonable information required for the research work.

Table 3: Professions of the Respondent

Professionals	Frequency	Percent Representation
Builders	14	34.1
Architects	0	7.3
Estate Surveyors	1	2.4
Quantity Surveyors	4	9.8
Others	19	46.3
Total	**41**	**100.0**

The table above shows that 34.1% of the respondents are Builders, 7.3% are Architect, 2.4% are Estate surveyor, 9.8% Quantity surveyor. While, others professionals which include Civil Engineers, Horticulture, Mechanical and Electrical Engineers are 46.3% respectively. The outcome of the response indicates that all professionals that are concerned in designs, construction and maintenance of building are among the respondents and majority of them were directly involved in the construction of GB due to their level of experience in recent time.

Table 4: Level of Awareness of Green Building Innovation in Nigeria

Awareness Level	Frequency	Percent Representation
Yes	28	68.3
No	12	29.2
I Don't think so	1	2.4
Total	**41**	**100.0**

The tables above shows that 68.3% are aware of green building innovation, 29.2% are not aware of green building innovation, while just 2.4% doesn't think they are aware of green building innovation in the industry, despite the level of awareness with 68.3% on green building by professionals and stakeholders representing about two–third of the respondent. The professionals have not yet keyed into the basic principles and practice of green building designs and construction of building projects in Nigeria.

The Table 5 shows the ranked factors of stakeholders hindering the adoption and implementation of green building. As ranked by the stakeholders in the industry, Lack of policies, GB index, legislation and regulation to guide the design and implementation of GB Innovation which was ranked first is seen as a major challenge, next to it is insufficient knowledge base on the part of professionals to handle green building designs and lack of training for professionals on GB by professional institutions through seminars and conference were ranked high. While, lack of incentive schemes by government on GB, insufficient technical skill know-how on GB innovations and construction and lack of collaborations with international organization and institution on GB construction practices were ranked low. The ranked factors provide the foresight of the stakeholders view on the hindrances faced towards the adoption and implementation of GB from design to post construction stage of a building project as witnessed in tropical region.

Table 5: Hindrances to the adoption and Implementation of Green Building Designs and Innovation in Tropical Climate Region

S/N	Knowledge and Technical Barriers'	N	DEGREE OF HINDRANCES TO IMPLEMENTATION OF GREEN BUILDING				RII VALUE	RANK
			1	2	3	4		
1	Lack of knowledge base on the part of professionals to handle green building design and construction	41	9	6	11	15	0.69	2nd
2	Insufficient technical skill and know-how on GB innovations and construction	41	9	10	16	6	0.61	6th
o	Insufficient information among stakeholders' on GB innovation and development	41	13	17	8	3	0.51	10th
4	Lack of technological innovation in the country	41	8	8	15	10	0.66	4th
5	Unavailability of green building materials to facilitates GB construction	41	7	11	13	10	0.65	6th
6	Lack of training for professionals on GB by professional institutions through seminars and conference.	41	7	8	16	10	0.67	3rd
7	Lack of collaborations with international institution on GB construction practices	41	14	13	9	5	0.53	13th
	Cost and Economic Barriers'							
8	Insufficient market demand for GB	41	11	14	7	7	0.39	12th
9	Lack incentive schemes by government on GB	41	8	8	17	8	0.66	4th
10	High cost and financial constraint required in meeting the standards for GB rating	41	10	17	11	3	0.54	8th
	Government Barriers'							
11	Lack of government policies, GB index and rating, legislation and regulation to guide the design and implementation of GB Innovation	41	3	8	13	17	0.77	1st

Table 6: Benefits of Implementing Green Building Innovations in Tropical Climate Region

S/N	Benefits of Green Building Innovation in Climate Region	N	BENEFITS OF GREEN BUILDING INNOVATIONS				RII VALUE	RANK
			4	3	2	1		
1	Reduced the cost of energy used and energy conservation in buildings	41	16	19	3	0	0.80	1st
2	Reduced operating or maintenance cost of buildings	41	11	18	10	2	0.73	2nd
	Better air quality and indoor environment	41	11	18	10	2	0.73	2nd
0	Preserved natural resources in the environment and improved	41	3	3	13	22	0.41	5th
4	Reduced impact of buildings on climate change due to Greenhouse gas emission and CO_2	41	3	3	13	22	0.41	5th
4	Improved waste and water management (recycling, re –use and efficient use of waste)	41	6	6	16	13	0.54	4th
5	Improved Aesthetic value of the building and better health condition of occupants	41	3	3	10	25	0.39	6th
6	Less impact and damage on environment and its ecosystem	41	2	2	5	32	0.35	7th

The table above shows that respondents have varying level of agreement on the benefits that are derivable from implementing GB as indicated from their response. The highest level of response is the believed in its ability to reduce the cost of energy used and energy conservation in buildings, reduction on maintenance and operating cost of buildings, better air quality and indoor environment, efficiency in waste management were also raked high, others factors includes: preservation natural resources, Improved aesthetic value of the building, better health condition of occupants and less impact of construction activities on environment and its ecosystem were ranked low on the indices. The result of the ranking shows the benefits that are believed to be beneficial to the building occupants if GB parameters are incorporated in designs and construction by professionals or stakeholders in future building projects.

4.0 Conclusion and Recommendation

Based on the findings of the study, it is concluded that green building adoption by the built environment professionals and other stakeholders can be enhanced by implementing the factors that that are seen to be relevant as ranked by the respondents opinion which include: Enhancement of policies on green building, GB index and rating tools and the provision of legislation and regulation to guide the design and implementation of GB Innovation, enhancement of knowledge base on the part of professionals to handle green building design and construction and development of capacity building through training of professionals on GB by professional institutions through seminars and conference among others. The study also identifies major benefits that could be derived if GB is adopted and implemented in design and construction of building projects which includes: Reduction in the cost of energy used and energy

conservation for buildings, Reduced operating or maintenance cost of buildings, Improvement in the waste management through recycling and efficient use of waste among others. Based on the results obtained in this research, the followings are recommended:

- Professional's institutions should organize seminars, conferences and training programmes to improve their knowledge base on green design, methods and techniques, construction practices on projects.
- Government should lead by example through proper legislations to make relevant laws on green regulations.
- Government should provide incentive scheme for client that intends to construct green buildings that have green rating.
- Finally, this study recommends that professionals should collaborate and establish "Green Building Index" that will be responsible for awareness creation, provide guidelines, tools and techniques, and rating of buildings for subsequent building projects in the country.

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