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Motivators and Inhibitors of Green Building Technology Integration and Advancement: Nigerian Lecturers' perspective

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ABSTRACT

The potentials of green building technology (GBT) and sustainable constructions are the major reasons for its integration, advancement and adoption in developed countries. Yet, developing countries have not found the motivation to integrate GBTs, and transit to sustainable constructions, which suggests perceived inhibiting forces. This study investigated the perception of tertiary institution lecturers on the motivators and inhibitors of GBT integration and advancement in Nigeria. An empirical questionnaire survey of 163 lecturers from construction and environmental science related courses in 24 tertiary institutions provided data for the analysis. The analysis results ranked "efficiency in construction processes and management practices," that is capable of reducing waste, as the major motivator for GBT integration; "lack of government support for GBTs" was the main inhibitor perceived. The Kendall's coefficient of concordance confirmed concession in rankings, and Kruskal Wallis H test showed that although 7 motivator items, and 8 inhibitor items, were significant, there was no significant difference in the overall lecturers' perception of the motivators and inhibitors of GBTs. As guides to knowledge, research and development, lecturers in environmental related courses should spur interest in GBTs, so as to raise awareness, enhance integration and advancement of GBT. Moving forward requires government to go beyond formulating sustainable construction policy to create GBT funding schemes, and initiate a proven GBT project as a roadmap to facilitate the integration and advancement, and as well, protect the interest of potential investors.

Key words: *Lecturer, Green building technology, Green building, Motivator, and Inhibitor*

Introduction

It has been over three decades now since the call for sustainable development was made, to ensure that the resources at our disposals are managed with the future generations in mind (World Commission on Environment and Development [WCED] 1987). The response of the construction industry led to sustainable construction initiation and green building (GB) concepts development, integration and rapid adoption in developed countries. Sustainable construction addresses the response of the built environment in contributing to sustainability. Green buildings, being the products of sustainable construction, are structures produced in accordance to the principles of *reducing resource consumption, reusing and recycling resources, protecting nature, eliminating toxics, applying life-cycle costing, with focus on quality* (Kibert, 2013).

But the adoption of green building has not fared well in developing countries (Darko and Chan, 2018). Nigeria for instance, has not produced any holistic sustainable or green building except for pockets of verifiable features integration (Okafor 2016). However, transiting from conventional to green buildings entails the integration, and advancement of the enabling technologies.

The technologies integrated in constructions to achieve an end result of a green building are called green building technologies (GBTs). According to Darko and Chan (2018), GBTs are non-replaceable in the advancement of green buildings. GBTs are equipment, products and systems made from the infusion of environmental science and variant technology (Show, 2010). These technologies include: energy-efficient HVAC system, water efficient and recycling technologies, renewable energy integrations, etc. which ensure that buildings conform to the sustainability agenda (Darko and Chan, 2018; Monu and Neelam, 2015; Omrany *et al.,* 2016). GBTs therefore help to minimize the degradation of the environment, achieve zero or low greenhouse gas (GHG), conserve the use of energy and natural resources, and improve health and performance of workers in the environment (Monu and Neelam 2015).

Notwithstanding the benefits offered by green buildings using GBTs, there is serious lag in the rate of its integration in constructions within developing countries. Although most developing countries have not taken the step of introducing regulatory or obligatory measures, Abuamer and Boolaky (2015) observed that GBTs do not advance by mere introduction of obligatory rules and regulations. According to Darko and Chan (2018), the GBT situation in developing countries requires radical steps for behavioural changes towards green concepts. One crucial player in behavioural changes is the teachers, howbeit the lecturers in higher institution, who have been left out of the picture among stakeholders to propel the integration of GBT in constructions. The lecturers in construction, engineering and environmental sciences in developing countries can champion the integration and advancement of GBTs through research and development studies, but appear to be slow in queuing into the sustainability move. The detached interest of university lecturers negates the present global sustainability agenda, especially as it concerns indigenous knowledge development. In Nigeria, the versatility of conventional construction skills amongst contractors, supervisors, engineers, technicians and general industry employees make settling for the status quo sadly more appealing. It could be argued that no construction industry expert/practitioner trained before the last decade received substantial knowledge of GBT and its many benefits to champion the course for its integration in constructions; hence, there is practically no experience in GBTs among lecturers and graduates. Wang *et al.* (2018) underscored the need for the services of 'professional consultants' in GBT integration; and the best crop of individuals to serve in this cadre are lecturers, poised to proffer solutions using research and development. Meanwhile, due to poor attention to sustainability, there is continual exploration of natural resources, constant estate sites in arable and virgin lands, conventional constructions without attention to energy, water, and material wastes (Chukwu *et al.,* 2019). Moreover, lecturers who lack knowledge of GBT can neither inspire researches nor spur students towards GBT; thus, they resort to imbibing conventional constructions skills, and increasing unemployment among graduates of construction disciplines, who have nothing different to offer in the labour market. Therefore, assessing the perceptive of lecturers on factors that motivate or inhibit GBT advancement in Nigeria is vital.

Correspondingly, studies have shown that there are perceived motivators and inhibitors to the advancement of GBTs (Ahn *et al.,* 2013; Chan *et al.,* 2016). Motivators here refer to the focal connectors to sustainable construction goal for which GBTs are necessary to a country or individual. Motivators in literature are referred to as drivers. According to Darko *et al.* (2017), driver is the main reason GBT is implemented by various stakeholders. Drivers are necessary to inspire stakeholders to integrate GBTs in constructions (Odebiyi *et al.*, 2010). Studies have shown that integration of GBTs in constructions have motivators both in developed and developing countries (Akreim and Suzer, 2018). According to Ahn *et al.* (2013), United States were motivated to *go green* in order to achieve energy conservation, improve indoor environmental quality, environmental/resource conservation, and waste reduction. US motivators were further propelled by legislation, executive orders, polices, and incentives from federal, state, and local governments. According to Akreim and Suzer (2018), there are environmental, economic, and social motivators. Studies conducted by Manoliadis *et al*. (2006) and Ahn *et al.* (2013) un-

derscored the importance of environmental protection goals highlighting the environment as the most important factor considered in GBTs. On the other hand, economic motivators are geared to achieve improved workers performance (Hakkinen and Belloni, 2011; Darko *et al.* 2017), increased rental spaces and income (Usman and Gidado 2015) through enhanced property values (Love *et al.* 2012), also creating job opportunities, and bettering national economy (Li *et al.,* 2013). And literature explains social benefits of GBTs to include increasing occupants' health and comfort level (McGraw-Hill, 2013; Dodge Data and Analytics, 2016), creating opportunities for firms to perform corporate social responsibilities, projecting and boosting company's image and reputation (Low *et al.,* 2014), among others. Summarily, the classification of these motivators enables stakeholders to channel efforts to specific desired accomplishments (Akreim and Suzer, 2018), necessary to overcome staggering inhibitors to GBT integration.

Inhibitors to GBT integration can be defined as perceived impedances or conditions that do not support the integration of GBTs in constructions thereby limiting transition to sustainable constructions. Chan *et al.* (2016) classified these GBT inhibitors into five main clusters: (i) economic issues, (ii) attitude and market, (iii) information, knowledge, and awareness, (iv) management and government, and (v) technology and training. Relating to economic issues, inhibitors include cost of GBTs, high market prices, rental charges, and long pay-back periods of GBTs, and lack of financing schemes (Low *et al*., 2014). Inhibiting factors about attitude and market are conflicts of interests among various stakeholders in construction, lack of available and reliable suppliers, non-availability of demonstration projects, (Djotoko *et al.,* 2013; Aktas and Ozorhon, 2015). More worrisome inhibitors according to literature constitute lack of knowledge and awareness, poor databases and information (Rodriguez-Nikl *et al.,* 2015), lack of GBT research and education, and limited experience with the use of nontraditional procurement methods (Chan *et al.,* 2016). Formulating technical standard procedures for green constructions, creating bases to simplify the complexities and rigid requirements involved in integrating GBTs, are some other areas constituting technology and training inhibitors (Chan *et al.,* 2016; Luthra *et al.,* 2015)

Amidst the inhibitors, there is no refuting that knowledge is power; hence lack of baseline knowledge is the major challenge of GBT integration and advancement. Research has repeatedly favoured integrating GBTs in construction over conventional technologies (Darko and Chan, 2018). Integrating and advancing GBTs will among other benefits cushion the meager energy supply in developing countries, such as Nigeria, while reliance on sustainable supplies is extensively exploited. The role of lecturers in this quest cannot be jettisoned. Thus, this paper is aimed at assessing the motivators and inhibitors of GBT integration and advancement in Nigeria construction industry as perceived by lecturers. In line with the specific objectives, this paper sought answers to two questions and hypotheses relating to:

1. What are the main motivators to integrate and advance GBT in Nigeria?
2. What are the inhibitors to integrating and advancing GBT in Nigeria?

Methods

Area of the study

The study covered the five Southeast states of Nigeria, namely Abia, Anambra, Ebonyi, Enugu, and Imo. Southeast Nigeria is densely populated within the limited land mass area of about 29,525km^2 (Wikipedia, 2021). In terms of land mass, the whole South east Nigeria cannot be compared with the size of a state in the north (Niger state for instance). The consciousness of limited resources should stir efforts to save nature and avert environmental decadence currently faced in many parts of the country. Moreover, the upshot in population all over Nigeria makes rural-urban migration and rapid construction developments consistent within the region. It is plausible that lecturers who should lead transition to sustainable construction through GBT development are found in the region, thus the choice for Southeast Nigeria in this study. Although the land mass is small, the region has serious zeal for education and knowledge development, hence the states are rarely rated amongst the educationally disadvantaged in national comparisons.

Each of the Southeast states has at least one federal and one state owned universities, polytechnics and college of education. This study delimited the lecturers of interest to those in the three categories. Federal and state owned institutions have more lecturers, and researchers who are assessed for promo-

tions using similar standards. Professional associations and academic goals are also shared amongst these tiers pertaining to the type of institution. Furthermore, lecturers among the federal and state owned institutions serve as adjunct in the private institutions. Thus, this step averts duplication of responses. Nevertheless, the study covered 24 tertiary institutions comprising of 10 universities, 7 polytechnics, and 7 colleges of education, within Southeast Nigeria.

Study population and sampling technique

The population for the study was 438 lecturers in departments with relevance in construction and environmental preservation, including Departments of Architecture, Civil Engineering, Building Technology/Construction (inclusive of vocational education section), Environmental Studies, and Urban and Regional Planning. Snowball non-probability sampling technique was used to obtain a representative sample of 163 used for the study. This sampling technique is based on the willingness of the respondents. And the respondents can share the questionnaire with other colleagues in the field (Patton 2001). This sampling technique has been used in similar studies (e.g. Darko and Chan, 2018). A total 300 copies of the questionnaire was distributed, and after a period of 7 months, 163 duly completed questionnaires, representing 54%, was used for the analyses. Detailed information concerning the respondents is shown in Table 1 such as name and type of institution, and number of responses obtained.

Instrument for data collection

The instrument used for the study is a structured questionnaire adapted from previous researches on drivers and barriers of GBT development. The instrument has three sections. Section A sought demographic information of the respondents. Section B has 21-item statement on the motivators of GBT advancement, with a Cronbach's alpha reliability coefficient (α) of 0.863 (adopted from Darko *et al.*, 2017, p. 3). This section used a five-point Likert scale ranging from *Strongly Agree = 5* to *Strongly Disagree = 1.* Section C adapted a 26-item statement from Chan *et al.* (2016, p. 4) to ascertain the inhibitors of GBT integration and advancement. The value of Cronbach's alpha reliability coefficient analysis was 0.888. Section C was designed based on five-point Likert scale of *Very critical, VC = 5, Critical, C = 4, Neutral, N = 3, Not critical, NC = 2, and Not very critical, NVC = 1.* Korb (2012) suggested adopting and retaining the validity and reliability of instruments when it suits intended purpose and participant.

In order to further establish the reliability of the instrument, Cronbach's alpha test of internal consistency was conducted on each section of the questionnaire. The result revealed the following: Motivators of GBT integration and advancement, $\alpha = .809$, and inhibitors of GBT integration and advancement, $\alpha = .821$, while the overall reliability index yielded $\alpha = .864$. According to literature, although higher values show stronger internal consistency and reliability of the items, a value of at least 0.6 is acceptable (George and Mallery, 2003; Sekaran, 2003).

Procedure

Data collection was through direct administration and retrieval of questionnaire instrument. Data collected were analyzed using simple percentages for the demographic information, while mean, rank, and Kendall's coefficient of concordance were used to answer the research questions. Based on real limits of numbers, mean scores above 3.49 were regarded as indication of "Agreed/Critical", while mean scores of 3.49 and below were regarded as "Disagreed/Not Critical." Due to the non-probability sampling method used, intergroup comparison was done using Kruskal-Wallis H test, instead of analysis of variance (ANOVA). Kruskal-Wallis H test is the non-parametric option to ANOVA, and does not require data conforming to stringent assumptions. The null hypotheses were tested at 0.05 level of significance. Any item where *p*-value is greater than 0.05, the hypothesis of no significant difference was upheld; but where the *p*-value is less than or equally to 0.05, the hypothesis of no significant difference was rejected.

Results

Table 1 shows a total of 24 tertiary institutions of colleges of education, polytechnics and universities belonging to both the federal and state government. The response rate from each school is equally shown in Table 1.

The result in Table 2 shows mean, standard deviation, rank, and the Kruskal Wallis H Test statistics on the responses of the participants to the motivators of GBT integration and advancement in Nigeria. All the 21 motivator items had mean values

Table 1. Institutions and response rate

Institution Type	Name	No. of Responses	Total
University	Michael Okpara University of Agriculture, Umudike	0	
	Abia State University, Uturu	4	
	Nnamdi Azikiwe University, Awka	7	
	Chukwuemeka Odimegwu Ojukwu University of Technology, Uli	8	
	Alex Ekwueme University, Ndufu-Alike	3	
	Ebonyi State University, Abakaliki	4	64
	University of Nigeria, Nsukka	13	
	Enugu State University of Science and Technology, Enugu	9	
	Federal University of Technology, Owerri	5	
	Imo State University, Owerri	11	
Polytechnics	Abia State Polytechnics	3	
	Anambra State Polytechnics	1	
	Federal Polytechnics, Oko	2	
	Akanu Ibiam Federal Polytechnic, Uwana	6	59
	Institute of Management and Technology, Enugu	27	
	Federal Polytechnics, Nekede	18	
	Imo State Polytechnics, Umuagwo	2	
College of Education	Abia State College of Education, Arochukwu	0	
	Ebonyi State College of Education, Ikwo	0	
	Enugu State College of Education (Technical), Enugu	17	
	Federal College of Education, Eha-Amufu	13	40
	Alvan Ikoku College of Education, Owerri	3	
	Federal College of Education, Umunze	7	
	Nwafor Orizu College of Education	0	
	Total response	**163**	**163**

Table 2. Mean, standard deviation, rank, and test statistics of the motivators of GBT integration and advancement in Nigeria construction industry

Code	Item statement	Mean	SD	Remark	Rank	Test Statistics[a,b]	
						Chi-square	*p*-value
1	Reduce the lifecycle costs of buildings	3.95	0.79	Agreed	18	1.461	.482
2	Greater energy-efficiency of buildings	4.14	0.50	Agreed	9	2.175	.337
3	Greater water-efficiency of buildings	3.86	0.77	Agreed	19	21.710	.000[c]
4	Enhance occupants' health, comfort and satisfaction	4.23	0.71	Agreed	3	2.662	.264
5	Increase overall productivity	4.17	0.63	Agreed	6	5.097	.078
6	Reduce the environmental impact of buildings	4.17	0.92	Agreed	7	10.591	.005[c]
7	Better indoor environmental quality	4.03	0.53	Agreed	12	.109	.947
8	Good company image/reputation or marketing strategy	3.64	0.80	Agreed	21	13.504	.001[c]
9	Better workplace environment	4.11	0.48	Agreed	11	.480	.787
10	Thermal comfort	4.20	0.54	Agreed	4	4.998	.082
11	Better rental income and increased lettable space	3.77	0.81	Agreed	20	10.497	.005[c]
12	Attract premium clients and enhanced property value	4.00	0.71	Agreed	15	5.999	.050[c]
13	Reduce construction and demolishing wastes	4.02	0.85	Agreed	13	.006	.997
14	Preservation of natural resources and nonrenewable fuels/energy sources	4.17	0.68	Agreed	8	.891	.641
15	Set standards for future design and construction	4.14	0.71	Agreed	10	2.492	.288
16	Reduce the use of construction materials	3.97	1.01	Agreed	16	2.530	.282

17	Attract quality employees and reduce employee turnover	4.02	0.85	Agreed	14	.437	.804
18	Satisfaction from doing the right thing (commitment on social responsibility)	3.97	0.73	Agreed	17	1.344	.511
19	Facilitate a culture of best practice sharing	4.25	0.73	Agreed	2	1.413	.493
20	Efficiency in construction processes and management practices	4.27	0.72	Agreed	1	13.104	.001[c]
21	Improve the performance of the national economy and create jobs	4.20	0.80	Agreed	5	15.323	.000[c]
	Kendall's W[d]	.066					
	Chi-Square	84.858					
	Df	20					
	Asymp. Sig.	.000					

a. Kruskal Wallis H Test
b. Grouping Variable: Institution
c. Kruskal Wallis result indicate there is a significant difference in mean value at 0.05 level of sig.; Degree of freedom, df = 2
d. Kendall's W Coefficient of Concordance

greater than 3.49, indicating that the lecturers in several fields of study agreed to the importance of the motivators in the quest for GBT. The standard deviation of the items ranged from 0.48 – 1.01. The ranking according to the mean values in Table 2 shows the first five perceived motivators to include efficiency in construction processes and management practices, facilitate a culture of best practice sharing, enhance occupants' health, comfort and satisfaction, thermal comfort, and improve the performance of the national economy and create jobs. The ranking reveals the GBT motivators perceived by the lecturers to be of major interest in the push to integrate and advance GBT in Nigerian construction industry.

To further verify the agreement in the ranking based on mean values, Kendall W Coefficient of Concordance was used. Kendall *W* uses values of 0 and +1 to rate the extent of agreement among different groups of rankers (Siegel and Castellan, 1988). Result in Table 2 shows that the Kendall's coefficient of concordance and chi-square are .066 and 84.858 respectively, with probability of occurrence under $p<0.001$ (Asymp. Sig. = .000). These results indicate harmony in agreement among the groups of lecturers (in University, Polytechnics, and College of Education) concerning the propelling force to GBT integration.

Table 2 also reveals significant differences in the mean responses of lecturers in the University, Polytechnics, and College of Education on the motivators of GBT integration ad advancement. Thus, the Test Statistics shows the chi-square and *p*-values of the items. Out of the 21 motivator items, 7 items (items 3, 6, 8, 11-12, 20, and 21) had *p*-values less than 0.05 indicating that there are significant differences in the mean responses of lecturers on these motivators at 0.05 level of significance, while 14 motivator items (items 1-2, 4-5, 7, 9-10, 13-19) had *p*-values greater than 0.05, thus indicating that there is no significant difference in the mean responses of the lecturers on these motivators at 0.05 level of significance.

Table 3 further shows the Kruskal Wallis H Test that compared the overall mean responses of the participants based on the institutions (University, Polytechnics, and College of Education). The result shows mean rank of 30.32, 30.75, and 34.36 for Col-

Table 3. Kruskal-Wallis H Test results of the perceived motivators of GBT integration and advancement in Nigeria construction industry

				Test Statistics[a,b]	
	Institution	N	Mean Rank	Mean	Variables
MeanMotivators	College of Education	40	30.32	Chi-Square	.689
	Polytechnics	59	30.75	Df	2
	University	64	34.36	Asymp. Sig.	.708
	Total	163			

a. Kruskal Wallis Test
b. Grouping Variable: Institution

leges of Education, Polytechnics, and University respectively. It also shows chi-square = .689, *p*-value = .708 > 0.05, indicating that there is no significant difference in the responses of the participants at 0.05 level of significance. Therefore, the null hypothesis I, which states that there is no significant difference in the mean responses of lecturers in the university, polytechnics, and college of education (technical) on

Table 4. Mean, standard deviation, rank, and test statistics of the perceived inhibitors of GBT integration and advancement in Nigeria construction industry

Code	Item statement	Mean	SD	Remark	Rank	Test Statistics[a,b]	
						Chi-square	*p*-value
1	Higher cost of green technologies	4.06	0.71	Critical	8	4.06	.131
2	Implementation of GB technologies is time consuming and causes project delays	3.63	0.88	Critical	26	8.45	.015[c]
3	High market prices, rental charges, and long pay-back periods of GBs	3.92	0.82	Critical	17	0.63	.729
4	Lack of financing schemes (e.g., bank loans)	4.24	0.71	Critical	2	12.56	.002[c]
5	Resistance to change from the use of traditional technologies	3.88	0.85	Critical	21	0.49	.782
6	Lack of interest and market demand	4.00	0.94	Critical	13	24.76	.000[c]
7	High degree of distrust about GB technologies	3.84	0.93	Critical	23	2.61	.272
8	Conflicts of interests among various stakeholders in adopting green technologies	3.70	0.79	Critical	25	6.04	.049[c]
9	Lack of available and reliable green technologies suppliers	3.89	0.80	Critical	19	0.48	.787
10	Lack of availability of demonstration projects	3.86	0.81	Critical	22	0.01	.997
11	Lack of tested and reliable GB technologies	3.97	0.93	Critical	14	2.99	.224
12	Lack of GB technologies databases and information	3.95	0.74	Critical	15	1.62	.445
13	Lack of knowledge and awareness of GB technologies and their benefits	4.09	0.79	Critical	7	0.54	.764
14	Lack of reliable GB technologies research and education	3.89	0.84	Critical	20	14.78	.001[c]
15	Unfamiliarity with GB technologies	4.13	0.79	Critical	5	12.17	.002[c]
16	Limited experience with the use of nontraditional procurement methods	3.91	0.79	Critical	18	2.94	.230
17	Lack of government incentives/supports for implementing GB technologies	4.31	0.71	Critical	1	15.25	.000[c]
18	Fewer GB codes and regulations/ legislations available	4.05	0.76	Critical	10	0.14	.932
19	Insufficient GB rating systems and labeling programs available	3.95	0.72	Critical	16	0.22	.897
20	Lack of promotion (i.e., no GB promoters and promotion strategies)	4.11	0.84	Critical	6	6.27	.043[c]
21	Lack of importance attached to GB technologies by leaders	4.14	0.64	Critical	4	0.12	.942
22	Risks and uncertainties involved in implementing new technologies	3.81	1.04	Critical	24	9.53	.009[c]
23	Difficulties in providing GB technological training for project staff	4.02	0.77	Critical	12	4.16	.125
24	Lack of technical standard procedures for green construction	4.06	0.66	Critical	9	3.30	.192
25	Lack of GB expertise/skilled labor	4.16	0.78	Critical	3	3.20	.201

26	Complexity and rigid requirements involved in adopting GB technologies	4.05	0.76	Critical	11	1.60	.450

Kendall's W[d]	.044
Chi-Square	68.134
Df	25
Asymp. Sig.	.000

a. Kruskal Wallis H Test
b. Grouping Variable: Institution
c. Kruskal Wallis result indicate there is a significant difference in mean value at 0.05 level of sig.; Degree of freedom, df = 2
d. Kendall's W Coefficient of Concordance

the motivators of GBTs integration and advancement in Nigeria construction industry, was accepted.

Results presented in Table 4 reveal the inhibitors of GBT integration and advancement in Nigeria construction industry as perceived by lecturers. Table 4 shows the 26 inhibitor items with mean values greater than the 3.49, indicating a concession that the inhibitors are all critical for integrating and advancing GBTs in Nigeria construction industry. Table 4 also shows the ranking of the 26 inhibitor items using the mean values. The GBT integration and advancement inhibitors ranked 1st – 5th are 'lack of government incentives/supports for implementing GBTs', 'lack of financing schemes', 'lack of GB expertise/skilled labor', 'lack of importance attached to GBTs by leaders', and 'unfamiliarity with GBTs', respectively. This ranking shows the major limitations hindering GBT integration.

Kendall's W coefficient of concordance test was used to test the agreement of the ranking among the groups of lecturers. Table 4 shows Kendall's W = .044 (which is less than 1 and close to 0), chi-square = 68.134 (Degree of freedom, Df, = 25) with Asymp. Sig. = .000 (probability level of occurrence, $p<0.0001$), indicating good level of agreement in the opinions of the lecturers in various institution cadres. Table 4 further shows item-by-item chi-square, and p-value of the 26 GBT inhibitor items, showing that 8 items (2, 4, 6, 8, 14-15, 17, and 20) out of the 26 items were significant in the participants opinion on the items, at 0.05 level of significance.

However, Table 5 shows that the result of Kruskal Wallis H test for the overall items was not significantly different at 0.05 level of significance. Table 5 shows that there was no significant difference in the lecturers' response to the inhibitors of GBT integration and advancement; chi-square = 3.674, p-value = .159 at 0.05 level of significance with a mean rank of 30.88, 39.81, and 28.53 for College of Education, Polytechnics, and University respectively. Thus, the null hypothesis II, stating that there is no significant difference in the mean responses of lecturers in university, polytechnics, and college of education (technical) on the inhibitors of GBT integration and advancement in Nigeria construction industry was upheld.

Discussion

The results in Table 2 show the motivators of GBT integration and advancement in order of perceived importance by the lecturers as seen in the ranks. Thus, 'efficiency in construction processes and management practices,' is perceived to be the most important. There is no doubt why this is ranked high-

Table 5. Kruskal Wallis H Test results of the perceived inhibitors of GBT integration and advancement in Nigeria construction industry

				Test Statistics[a,b]	
	Institution	N	Mean Rank	Mean	Variables
MeanInhibitors	College of Education	40	30.88	Chi-Square	3.674
	Polytechnics	59	39.81	Df	2
	University	64	28.53	Asymp. Sig.	.159
	Total	163			

a. Kruskal Wallis Test
b. Grouping Variable: Institution

est by the lecturers as inefficient construction processes and poor management remains one of the major causes of waste in materials and time. This is a vital finding because Nigeria is facing non-stop rising in housing demands due to continuous growth in population, requiring the place of efficiency among workers and management, to minimize the 40% waste effect (Dahiru *et al*., 2014) attributed to the construction industry. This finding cohere with that of Adewuyi and Otali (2013) who lamented wrong construction methods, poor working environment, inefficient workers, as some of the causes of construction waste. In particular, inefficiency is a major cause of waste in construction with many shades to it. Also, in the classification of the causes of construction waste by Luangcharoenrat *et al.* (2019), inefficiency leans towards construction errors, ineffective planning and scheduling, incompetent workforce, designers' inexperience, misuse of tools and equipment among other errors relating to construction methods, planning, and human resources.

The second motivator noted by the lecturers to be important is the attribute of GBT in facilitating the culture of best practices sharing. This is in line with the findings of Mondor *et al.* (2013) who reported that the success of a GB project has impacts on the surrounding cities through information communication program for transformative regional change. The authors explored best practices sharing while partnering with local service providers thereby greening the practices within the region's value chains. Also, Maizza *et al.* (2019) posit that knowledge is a driver of conventional and contemporary cultures, so knowledge sharing culture in an organization helps in identifying best practices, promoting new ideas, and has great impact in sustainable social innovation engineering. It adds up saying that integrating GBT in Nigeria construction industry can be driven by the willingness of the developed nations to share knowledge, information, and technical supports necessary to engineer innovativeness among local researchers in developing countries (Chukwu, *et al.* 2019).

In this study, 'enhancing occupants' health, comfort and satisfaction,' as well as 'thermal comfort' were ranked third and fourth most important motivators respectively. These two GBT motivators speak volume of the essence of comfort for the building users. This finding is in line with Darko *et al.* (2017) whose report ranked enhancing occupants' health, comfort and satisfaction as the fourth most important motivator among building experts; adding that the benefit of GBT integration reflects in reduction of CO_2 emission into the atmosphere. Furthermore, Nigeria is characterized by extreme hot and humid weather in many parts of the country. As industrialization continues to move up the ladder, the extremity of environmental heat also continues, thereby making thermal comfort a high priority. The meager power supply in the country causes the need for alternative power generating equipment, seen everywhere in the Nigeria (Akin, 2017). Using electricity generating sets to realize workable office or livable atmosphere has many negative impacts including noise, emission of GHG, darkening of paints, and damaging of vegetation (Akin, 2017). These adverse environmental degrading results from generators can be reduced or done away with, hence the campaign for GBTs and lecturers' indication of the choice of comfort as a priority.

To 'improve the performance of the national economy and create jobs' was ranked fifth by the participants. According to Li *et al.* (2013), investment in GB results to a boost in the local economy and increases the employment opportunities. This concurs with the findings of Mondor *et al.* (2013) that within four years (2006-2010), the David L. Lawrence Convention Centre (DLCC), a GBT powered centre, raked-in $143 million for Downtown Pittsburgh and $12.5 million in revenue for the centre. There is no doubt that investment in GBTs and transition to sustainable construction will open up another trend of job creation in Nigeria. The construction market has been saturated with conventional skills, making it difficult for the new entrants to get paid jobs. Engaging lecturers and students in workshops, conferences and trainings in GBT, will create another channel of employment opportunities over time and afford easy transition to sustainable constructions thereby affording a healthier economy.

Meanwhile, 'greater water-efficiency of buildings,' 'better rental income and increased lettable space', and 'good company image/reputation or marketing strategy,' were ranked least by the lecturers. This is because the importance of these motivators varies across studies. For example, in Darko *et al.* (2017), greater water efficiency was ranked third, while good company marketing strategy ranked fifth. This observation suffices due to differences in environment, development level, and motivator of interest. Nigeria, like most developing countries,

relies majorly on groundwater to meet both domestic and industrial water needs. This water is available at a depth of 10-50m in many parts of the country (Ekenta *et al.,* 2015). So, to most persons, attaching importance to water seems common. Little wonder, the responses of the participants significantly differ as pertains to water efficiency (item 3, Table 2).

This study also verified the perceived inhibitors of GBT integration and advancement in Nigeria construction industry. It was found that numerous inhibitors are critical to the sustainability move of GBT integration. This is evidenced by the response of the participants who agreed that all the inhibitors examined are critical to GBT integration. However, more critical amongst the militating forces include 'lack of government incentives/supports for implementing GBTs', 'lack of financing schemes (e.g., bank loans),' 'lack of GB expertise/skilled labor,' 'lack of importance attached to GBTs by leaders', and 'unfamiliarity with GBTs'. Chan *et al.* (2016) findings corroborate this finding as these GBT inhibitors relate to the demands on government and management, economic issues, technology and training, as well as information, knowledge, and awareness. This finding also conforms to Ogunsote *et al.* (2016) that the need for government policy is vital for a take-off in sustainable constructions. Likewise, top management support and financial management were observed by Low *et al.* (2014) to be some critical GBT success factors worth redressing.

Implications of the findings

Identifying the perception of lecturers on the motivators and inhibitors of GBT integration and advancement in Nigeria is helpful in addressing issues on transition to green building, and to further enhance the rate of GBT research, development and adoption. Thus, this study provides some implications for lecturers, graduate and undergraduate students of civil engineering, environmental studies, architecture, urban and regional planning, building technology, and technical education. For instance, non-integration of GBTs in constructions implies poor awareness, knowledge, information, and nonconformity to the global sustainability movement. The findings of this study have serious implications on the quality of knowledge delivery in teaching and learning as lecturers with no GBT knowledge cannot produce students with sustainability ideas and passion for environmental preservation. It also implies that tertiary institutions will continue to produce graduates with conventional construction skills, having no interest in filling the gap in the contemporary construction standards. Hence, lecturers in construction and environmental management fields of study need frequent orientation, training, workshops and conferences for capacity building in GBTs. Similarly, lack of government interest, thus without policy documents, implies that neither national vision nor local attention has been accorded to GBTs. There is therefore need for top-down adjustment in the Nigeria construction industry to position the nation on the part of truly supporting the sustainable development goals pertaining to industry and innovation.

Conclusion

The purpose of this study was to assess Nigerian lecturers' perspective of the motivators and inhibitors of GBT integration and advancement in construction industry. Two research questions and two hypotheses were used in this study to examine: the motivators of GBT integration, and the inhibitors to GBT integration and advancement, in Nigeria construction industry. In order to answer these questions, a 47-item questionnaire, partly adopted and partly designed, was used as the research instrument, and was administered to 300 lecturers using snowball non-probability sampling across the 24 tertiary institutions in Southeast, Nigeria.

Motivators of GBT integration and advancement such as efficiency in construction processes and management practices, facilitating a culture of best practice sharing, enhancing occupants' health and comfort and satisfaction, thermal comfort, and improving the performance of the national economy to create more jobs, were of utmost importance to the educational experts. However, the interest of the lecturers in GBTs is faced with critical inhibitors such as lack of government incentives/supports for implementing GBTs, lack of financing schemes, lack of GB skilled personnel, lack of importance attached to GB technologies by leaders, and the alien nature of GBTs. It is therefore imperative to device strategies that will commit the government to toll the ways of sustainable constructions and provide enabling environment for GBTs to thrive, thereby aligning Nigeria construction industry in the radar of sustainability compliant nations.

Based on the findings of this study, the following

recommendations are considered:

1. There is need for the government to make sustainable construction policy for the Nigeria construction industry as a roadmap to promote the GBT integration and enable transition to sustainable constructions across the nation.
2. There is urgent need to create a funding scheme for green projects to cater for the interests of researchers, developers, and investors, so as to ensure both compliance and grassroots development of GBTs.
3. The management of tertiary institutions should form committees to ascertain interest and willingness of the staff members towards GBTs in the concerned fields of study, and provide maximum support through regular capacity building programs, to enable lecturers acquire GBT knowledge and skills for the students, and the future construction workforce.
4. Stakeholders in education, private sectors, donor agencies, and developed nations who are champions in GB should come to the aid of developing nations through resource mobilizations, grants, trainings, and competitions in line with ensuring that the nation develops her GBTs and commits to sustainable constructions.

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Conflict of Interest

There is no conflict of interest among the authors.

References

Abuamer, E. and Boolaky, M. 2015. Consumer behavior towards green building: a study in Abu Dhabi. *International Journal of Business Administration.* 6(3) : 72-85.

Adewuyi, T. O. and Otali, M. 2013. Evaluation of causes of construction material waste-case of Rivers State, Nigeria. *Ethiopian Journal of Environmental Studies and Management.* 6: 746–753.

Ahn, Y. H., Pearce, A. R., Wang, Y. and Wang, G. 2013. Drivers and barriers of sustainable design and construction: the perception of green building experience. *International Journal of Sustainable Building Technology and Urban Development.* 4(1): 35-45. 10.1080/2093761X.2012.759887

Akin, A. O. 2017. Domestic electric power generator usage and residents livability milieu in Ogbomosho, Nigeria. *Environmental Management and Sustainable Development.* 6(1) : 91-104. 10.5296/emsd.v6i1.10941

Akreim, M. A. S. and Suzer, O. 2018. Motivators for green buildings: a review. *Environmental Management and Sustainable Development.* 7(2) : 137 - 156. 10.5296/emsd.v7i2.12690

Aktas, B. and Ozorhon, B. 2015. Green building certification process of existing buildings in developing countries: cases from Turkey. *Journal of Management Engineering*. 31(6) : 05015002. 10.1061/(ASCE)ME.1943-5479.0000358.

Chan, A. P. C., Darko, A., Ameyaw, E. E. and Owusu-Manu, D. 2016. Barriers affecting the adoption of green building technologies. *Journal of Management in Engineering.* 10.1061/(ASCE)ME.1943-5479.0000507

Chukwu, D. U., Anaele, E. A., Omeje, H.O. and Ohanu, I.B. 2019. Adopting green building constructions in developingcountries through capacity building strategy: survey of Enugu State, Nigeria. *Sustainable Buildings.* 4(4), 1-13. https://doi.org/10.1051/sbuild/2019004

Dahiru, D., Dania, A. A. and Adejoh, A. 2014. An investigation into the prospects of green building practice in Nigeria. *Journal of Sustainable Development.* 7(6). 158 - 167.

Darko, A. and Chan, A. P. C. 2018. Strategies to promote green building technologies adoption in developing countries: the case of Ghana. *Building and Environment.* 130: 74-84. 10.1016/j.buildenv.2017.12.22

Darko, A., Chan, A. P. C., Owusu-Manu, D. and Ameyaw, E. E. 2017. Drivers for implementing green building technologies: An international survey of experts. *Journal of Cleaner Production*. http://dx.doi.org/10.1016/j.jclepro.2017.01.043

Djokoto, S. D., Dadzie, J. and Ohemeng-Ababio, E. (2013). Barriers to sustainable construction in the Ghanaian construction industry: Consultants' perspectives. *Journal of Sustainable Development.* 7(1) : 134–143.

Dodge Data and Analytics 2016. *World Green Building Trends 2016: Developing Markets Accelerate Global Green Growth*. http://analyticsstore.construction.com/ 2016 World Green-9408.html

Ekenta, O. E., Okoro, B. U. and Ezeabasili, A. C. C. 2015. Hydrogeological characteristics and groundwater quality analysis for selected boreholes in Ogbaru local government area, Anambra State, Nigeria. *American Scientific Research Journal for Engineering, Technology, and Sciences.* 14(2) : 198-210.

George, D. and Mallery, P. 2003. *SPSS for Windows Step by Step: a Simple Guide and Reference, 11.0 Update, (4th*

Ed.). Boston: Allyn & Bacon.

Häkkinen, T. and Belloni, K. 2011. Barriers and drivers for sustainable building. *Building Research & Information.* 39(3) : 239-255. https://doi.org/10.1080/09613218.2011.561948

Kibert, C. J. 2013. *Sustainable Construction: Green Building Design and Delivery*. New Jersey: John Wiley & Son Inc.

Korb, K. A. 2012. Conducting educational research: steps in conducting a research study. www.korbedpsych.com/R09aAdopt.html

Li, X., Strezov, V. and Amati, M. 2013. A qualitative study of motivation and influences for academic green building developments in Australian universities. *Journal of Green Building.* 8(3) : 166-183.

Love, P. E, Niedzweicki, M., Bullen, P. A. and Edwards, D. J. 2012. Achieving the green building council of Australia's world leadership rating in an office building in Perth. *Journal of Construction Engineering Management.* 652–660.10.1061/(ASCE)CO.1943-7862.0000461,

Low, S. P., Gao, S. and Tay, W. L. 2014. Comparative study of project management and critical success factors of greening new and existing buildings in Singapore. *Structural Survey.* 32(5) : 413–433.

Luangcharoenrat, C., Intrachooto, S., Peansupap, V. and Sutthinarakorn, S. 2019. Factors influencing construction waste generation in building construction: Thailand's perspective. *Sustainability.* 11 : 3638. 10.3390/su11133638

Luthra, S., Kumar, S., Garg, D. and Haleem, A. 2015. Barriers to renewable/sustainable energy technologies adoption: Indian perspective. *Renewable Sustainable Energy Review.* 41 : 762-776.

Maizza, A., Fait, M., Scorrano, P. and Iazzi, A. 2019. How knowledge sharing culture can become a facilitator of the sustainable development in the agrifood sector. *Sustainability.* 11(4) : 952. https://doi.org/10.3390/su11040952

Manoliadis, O., Tsolas, I. and Nakou, A. 2006. Sustainable construction and drivers of change in Greece: a Delphi study. *Construction Management and Economics.* 24(2) : 113-120.

McGraw-Hill. 2013. *World Green Building Trends: Business Benefits Driving New and Retrofit Market Opportunities in Over 60 Countries*. Retrieved from http://analyticsstore.construction.com/world-green-building-trends-smartmarket-report-2013.html

Mondor, C., Hockley, S. and Deal, D. 2013. The David Lawrence convention center: how green building design and operations can save money, drive local economic opportunity, and transform an industry. *Journal of Green Building.* 8(1) : 28-43.

Monu, B. and Neelam, 2015. The advantages and disadvantages of green technology. *Journal of Basic and Applied Engineering Research.* 2(22)*:* 1957-1960.

Odebiyi, S. O., Subramanian, S. and Braimoh, A. K. 2010. Green architecture: merits for Africa (Nigerian case study). *J Altern Perspect Soc Sci.* 2(2) : 746-767.

Ogunsote, B. P., Ogunsote, O. O., Ude, O. A. and Ogunsote, V. B. 2016. Towards the establishment of a green building council and the development of a green building rating system for Nigeria. Retrieved from: https//www.researchgate.net/publication/267784294 accessed: November 12, 2018

Okafor, B. N. 2016. Green building for Nigeria public institutions towards effective administrations of public properties: a case study of military barracks and police stations in Anambra state, Nigeria. *International Journal of Physical and Human Geography.* 4(2): 16-22.

Omrany, H., Ghaffarianhoseini, A., Ghaffarianhoseini, A., Raahemifar, K. and Tookey, J. 2016. Application of passive wall systems for improving the energy efficiency in buildings: A comprehensive review. *Renewable and Sustainable Energy Reviews.* 62 : 1252–1269. http://dx.doi.org/10.1016/j.rser.2016.04.010

Patton, M. Q. 2001. *Qualitative Research and Evaluation Components*. California: Sage, Thousand Oaks.

Rodriguez-Nikl, T., Kelley, J., Xiao, Q., Hammer, K. and Tilt, B. 2015. Structural engineers and sustainability: An opinion survey. *Journal of Professional Issues in Engineering Education and Practice.* 141(3) : 0401-4011. 10.1061/(ASCE)EI.1943-5541.0000228,04014011.

Sekaran, S. 2003. *Measurement: Scaling, reliability, validity. In Research methods for business: A skill building approach.* London: Wiley.

Show, K. Y. 2010. Green technology. *Encyclopaedia of Life Support System.* Retrieved from http://www.eolss.net/sample-chapters/c05/e6-35-55-00.pdf

Siegel, S. and Castellan, N. J. 1988. *Nonparametric Statistics for the Behavioral Sciences, (2nd Ed.)*. New York: McGraw-Hill.

Usman, N. and Gidado, U. M. 2015. An Assessment of the Factors Affecting Green Building Technology (GBT) Adoption. *Jeddah Saudi Arabia.* 13(01).

Wang, W., Zhang, S., Su, Y. and Deng, X. 2018. Key Factors to Green Building Technologies Adoption in Developing Countries: The Perspective of Chinese Designers. *Sustainability*. 10(11) : 4135. https://doi.org/10.3390/su10114135

WCED. 1987. Our Common Future. Brundtland Report, United Nations World Commission on Environment and Development.

Wikipedia, 2021. List of Nigerian states by area. https://en.wikipedia.org/wiki/List_of_Nigerian_states_by_area