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Green Building Materials Products and Service Market in the Construction Industry

Chidiebere Emmanuel Eze[1], Rex Asibuodu Ugulu[2], Samuel Ikechukwu Egwunatum[3], and Imoleayo Abraham Awodele[4]

[1]Lecturer, Department of Quantity Surveying, Federal University of Technology, Owerri, Imo State, Nigeria. Email: emmanuel.eze@futo.edu.ng (corresponding author).

[2]Lecturer, Department of Quantity Surveying, Federal University of Technology, Owerri, Imo State, Nigeria. Email: rexugulu@gmail.com

[3]Lecturer, Department of Quantity Surveying, Federal University of Technology, Owerri, Imo State, Nigeria. Email: samuelegwunatum@gmail.com

[4]Lecturer, Department of Quantity Surveying, Federal University of Technology, Owerri, Imo State, Nigeria. Email: a.imole@yahoo.com

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Abstract: The construction industry influences and accelerates national growth and development, but it, however, contributes to unsustainable and eco-unfriendly development which impacts on the economy and environment. To encourage investment in sustainable construction, this study made a case for green building materials (GBM) products and services market in the construction industry of developing countries, through an assessment of the benefits of GBM incorporation in construction projects. The study adopted an internet-mediated questionnaire survey approach and snowball sampling techniques to gathered data from clients, consultants, professionals, and contractors/sub-contractor in the southeast geopolitical zones of Nigeria. Frequency, Percentile, Shapiro-Wilk test, Kaiser–Meyer–Olkin (KMO) and Bartlett's tests, relative importance index (RII) and Kruskal-Wallis test were used to analyse the collected data. The study revealed that the green construction market is unsaturated and under-tapped. With high awareness and low adoption levels of GBM, it was concluded that the most important benefits of GBM that will trigger demand and supply of GBM products and services are improved daylight and reduced need for artificial lighting, improves the quality of life, Increase employees productivity and reduced absenteeism, improve occupants health and comfort, higher profit and return on investment, leads to construction professionals specialisation, reducing greenhouse gas emission from building, reduces toxicity in the internal environment, low operating and maintenance cost, and creates new job opportunities. The uniqueness of this study lies in the assessment of the views of construction stakeholders' in the five states that make up the South-eastern geo-political zone of Nigeria, regarding the key benefits that could trigger the uptake and incorporation of GBM in construction. Developers and Investors in the industry could invest in green construction since there is a ready and unsaturated market for it.

Keywords: Construction industry, green building materials, green building, Nigeria, sustainable construction.

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1. Introduction

The construction industry is economic growth and development driver, and the bedrock of the survival of nations. Thus, the industry is regarded by Eze et al. (2019) as an economic growth influencer and development accelerator. The availability of infrastructures such as roads, bridges, residential and commercial buildings, rail tracks, recreational facilities, among others; reflect a measure of some growth and development triggered by the activities of the construction industry. The rate of growth in construction activities as well as construction firms both in developing and developed economies of the world is unprecedented; this growth is in response to accommodating the increasing human population (John et al., 2019). In spite, of the critical role the industry plays to socioeconomic development, it has contributed largely to unsustainable development, which impacts heavily on the economy and environment (AlSanad, 2015). Earlier, Zhang et al. (2011) and Hwang and Tan (2012), submitted that building and construction-related activities contribute massively to the growing environmental issues being experienced globally. This was attributed to the processes and products employed in the traditional conventional construction approach (Baloi, 2003).

Enormous quantities of natural resources are consumed by which energy source and water are prominent. Raw

materials extraction, processing, transformation, and transportation lead to a decline in resources and ultimately, an imbalance in the ecosystem; thus, resulting in the loss of bio-diversity (Oke et al., 2019). Oke et al. (2019) further submitted that the high-energy consumption of construction activities causes acidic rain and global warming. Considering the contribution of construction activities to environmental degradation, global warming, resource depletion, and damage to the ecosystem, there is a need for construction experts, clients, construction organisations and other industry's stakeholders to be encouraged to take up and start incorporating green building materials (GBM) in all construction operations. This is in response to the growing and urgency required for the global restructuring of the construction industry's activities (Oke et al., 2019), and the need to curtail the unwanted impact of the construction industry's activities on the environment (Abidin, 2010; Aghimien et al., 2019a). According to Abidin (2010), ensuring a responsive construction that will bring about a balance in the economic, social, and environmental dimensions, is through sustainable construction. This involves the incorporation of GBM in the construction processes, activities, and practices.

Sheth (2016) described GBM as special materials for the construction of green buildings and their adaptation is sustainable compared to the conventional buildings. These materials mitigate environmental problems as they are environmentally responsive. According to Onyegiri and Ugochukwu (2016), GBM materials are a friend to the environment, as they are reusable or recyclable and have no negative effects on the environment. These materials in essence help in meeting the needs of the current generation without robbing the future generations of the need to meet their need too (Aghimien et al., 2016). Thus, securing both the present and future generations' needs is a key driving force for GBM uptake and incorporation.

Creating a surge for the demand for GBM products and services in the construction industry will encourage sustainable construction, and this is key to ensuring a safer and cleaner environment. This surge is a loop created from the results of positive feedback within the marketplace and this supplements other benefits such as environment, health and finances (Ashuri and Durmus-Pedini, 2010). Construction professionals are the main agents that will drive the realization of the green buildings according to Hakkinen and Belloni (2011). The client also plays a key role in the adoption of sustainable construction as the construction industry is client-driven (Davies and Davies, 2017). Making clients aware of the inherent benefits of incorporating GBM will help drive and spur a market for GBM products and services. Sustainable construction implementation is facing serious drawback because most of the key actors are ignorant of the potential benefits (Aigbavboa et al., 2017). The key to the uptake, incorporation, implementation, and creation of a sustainable market for GBM products and services is information on the potential benefits of GBM.

Darko et al. (2013) suggested that green building benefits could lead to the creation, expansion, and shaping of markets for green products and services. Aghimien et al. (2019a) posit that understanding the benefits inherent in the integration and adoption of GBM in construction could trigger the change in preference from the conventional traditional materials to more materials that are sustainable. Understanding the benefits of GBM and green/sustainable construction concepts by clients, professionals, and other key construction participants will help overcome some of the major drawbacks influencing the decisions to adopt GBM in construction. It is based on this knowledge that this study set out to make a case for GBM products and services market in the construction industry of developing countries, by assessing the benefits of GBM incorporation in construction, through the sampling of corporate clients, construction professionals, and contractors/subcontractors' perceptions, in the six states of the south-east geopolitical zones of Nigeria.

The outcome of this study will be valuable in making this emerging concept of green building to materialize in no distant time, in Africa, and other developing countries of the world. In the educational sector of advanced countries, like the USA, and Canada, university authorities have exploited GBM and products in academic planning and management education, energy demand and consumption control, water consumption control, waste generation and minimisation, buildings and transportation management (Zhu et al., 2020; Richardson and Lynes, 2007). In terms of knowledge transfer and local capacity development, local firms could collaborate with foreign and multi-national construction firms that are experienced in sustainable concepts. This will lead to specialization, differentiation, and improved competitive advantage of local construction companies in developing countries. In the agricultural sector, the benefits of GBM and products could be exploited in the design of farm buildings for both man and animals, especially for developing countries where agriculture is there the main source of foreign exchange. In practice, knowledge of the key benefits of GBM would assist construction designers in Africa and other less developed countries, in making an appropriate material choice decision during the design and construction phases. There would be an improvement in the GDP of countries that have embraced the green concepts, as there are better performance and productivity across all sectors of the economy. GBM incorporation in buildings increase return on investment, shorter payback period, encourage a high rate of rent. These are good drivers for both foreign and local investors/developers to invest in sustainable housing for the growing population. Knowing the potential benefits of incorporating GBM will increase the appetite of clients and this will help improve the dynamics of demand and supply of green buildings. Once there is demand, then there must be supply for a market to take place.

2. Literature Review

2.1. Status of GBM Market in Construction

Findings from extant literature indicate that there is a low level of GBM integration for achieving sustainability in developing countries (Alabi, 2012; AlSanad, 2015; Baron and Donath, 2016; Aghimien et al., 2018a). Nigeria is yet to have a green building that is internationally certified with a recognized system of rating; however, there is a growing demand by clients for the incorporation of green building features/ technologies in their construction projects (Waniko, 2014). Different reasons have been given for this low level of adoption and implementation of these sustainable building materials. For example, in Nigeria, Kuwait, and Saudi Arabia, Alabi (2012), Aghimien et al. (2018a), AlSanad (2015), and Susilawati and Al-Surf (2011) cited low awareness and knowledge. Aghimien et al. (2018a) also

cited unfavourable construction operational mode and process. In Ethiopia, Baron and Donath (2016) cited incorrect implementation owing to a lack of a holistic understanding of the green concept. In Ghana, green building concept adoption is minimal with four green-certified buildings (Anzagira et al., 2019). In Latin America, Gomes and Silva (2005) cited poor coordination of research efforts as the reason for the low acceleration of green practice implementation. Oni (2015) and Davies and Davies (2017) cited poor attention to the sustainability concept and agenda for low adoption of GBM.

In their recent study, Aghimien et al. (2019a) found that the level of awareness of sustainable building construction by construction professionals is high. This by extension means that there is a growing level of awareness of the existence of alternative GBM available for achieving sustainable construction. Nduka and Sotunbo (2014) and Nduka and Ogunsami (2015) submit that the awareness level and knowledge base of construction experts are on the increase regarding green construction practices. Akadiri et al. (2012) posit that attention on green building practices has grown wider among construction experts and construction management researchers owing to the need to protect the environment.

To attain sustainability through the adoption of GBM, Akadiri et al. (2012) advocated for more implementation and awareness anchored on a framework that would incorporate the principles of energy efficiency, designing to suit human adaptation and cost-efficiency. Daramola et al. (2012) also advocated for green Architecture for achieving Sustainability and environmental protection. Encouraging the use of GBM for achieving green buildings require a thorough attitudinal and radical reorientation of both clients and other stakeholders in the construction industry. This was the reason Aghimien et al. (2018b) advocated for a radical change in the attitude of participants towards the adoption of green building practices. This includes increasing passion and interest in all matters that have to do with sustainability on the side of the clients and construction experts. A dedicated enlightenment effort targeted at changing the potential client's misperception about green buildings, and that will trigger the ability to accommodate changes is advised. It was further stressed that a suitable green star rating system is needed for old buildings instead of concentrating only on new ones. Aghimien et al. (2019a) posit that the green/ sustainable concepts are becoming popular among construction professionals in the built environment; the level of popularity of the concept is proportional to the length of years spent in the industry. However, it was found that while the level of usage of sustainable materials might be high, there are still appreciable levels of non-integration of these materials.

When clients and other construction stakeholders are educated on both the short and long terms benefits of incorporating GBM in their construction projects; the appetite for GBM will increase, leading to wider adoption and implementation of green building practices. This will invariably lead to achieving sustainability in no distant time. Thus, enlightenment would lead to the creation of a competitive sustainable market for GBM products and services. It has been reported that a minimal amount of education available on the benefits of green building is responsible for the poor attitudinal change towards acceptance and adoption of GBM (Hwang and Tan, 2012).

2.2. Green Building Materials

According to Fithian and Sheets (2009), any material with at least one helpful and constructive environmental characteristic is known as 'green (sustainable) material'. An 'eco' or 'green' labeling certified products, which were made, grown or handled under situations that meet standards of sustained use. Pesticide application, harvesting, certain social and economic criteria for workers are known as 'green products' (Fithian and Sheets, 2009). The harvesting mention in the definition is what is called sustainable harvesting; this means that green product harvesting should be what the ecosystem and region provide that will assure future generations that these resources will be available. Green materials are sustainable materials that offer high performance and environmental safety. Thus, GBM evolves from processes that consider the balance in the natural system (i.e. does not cause imbalance to nature) (Badam, 2017). Green materials are generally local and renewable, reclaimable, recyclable, and non-toxic materials. GBM is produced with raw inputs that are harmless and safe to the environment; and most of them are natural and locally-occurring materials (Peckenham, 2016; Cifani, 2017).

Kim and Rigdon (1998) identified fifteen (15) key qualities required to be possessed by a material (product) to be classified as green (sustainable) building materials. these characteristics include pollution prevention at manufacture, waste reduction during manufacture, contains recycled content, embodied energy reduction, use naturally occurring materials, construction waste reduction, local materials, energy efficiency, water treatment and conservation, use of non-toxic or less-toxic materials, renewable energy systems, higher durability, reusability, recyclability, and biodegradability. Patil and Patil (2017) identified lime, fly ash, bamboo, Ferro cement, and eco-friendly tiles are some of the sustainable construction materials. These materials are selected based on certain performance criteria, which include less toxicity, recyclable, renewable, thermal efficiency, locally produced and sourced, and low maintenance cost.

Cifani (2017) suggested eight sustainable building materials that could be used for future projects and these materials include Ferrock, Cork, Sheep's wool, Recycled steel, reclaimed wood, Mycelium, Bamboo, and Low-E Windows coated with tin oxide. Similarly, Peckenham (2016) also suggested eleven GBM that are more sustainable than concrete, and they are; Straw Bales, Grass Crete, Rammed Earth, Hempcrete, Bamboo, Recycled Plastic, Wood, Mycelium, Ferrock, Ash Crete, and Timber Crete. The constructor (2016) posits that the main aim of utilising GBM is to build an energy-efficient structure. It was further stated one needs to know and be aware of these materials before energy-saving structures could be built.

2.3. Benefits of incorporating GBM in Construction

The demand and willingness of clients have been adjudged critical to the development of green buildings (Hakkinen and Belloni, 2011), and by extension integration of GBM in construction. It is the demand by clients, buyers, and users that will bring about the needed increase in green construction across many countries (Pitt et al., 2009; Powmya and Adidin, 2014). This is based on the understanding of the relationship that exists between demand and other vital sections such as supply, price, cost, and value. Therefore, bringing the benefits of GBM to the

knowledge of the ignorant and uninterested construction stakeholders will trigger the appetite for the demand and supply of GBM. Green buildings produced from GBM are beneficial to construction industry stakeholders, as well as building occupants and the larger community. The global construction industry is increasing in the use of Green building practices for infrastructure provisions; thus, government agencies, construction experts are incorporating and adopting green building practices into both new and existing structures (Ahn et al., 2013; Nduka and Ogunsanmi, 2015). Thus, there are enormous benefits in the use of GBM and the practices of the green building aimed at achieving a sustainable built environment

Nationwide construction (2016) identified the benefits of buildings built with green materials to include water efficiency, better health, material efficiency, better environment, and reduction of strain on local resources as a result of overpopulation. According to Koutsogiannis (2018), the 10 crucial benefits of using GBM for sustainable construction are; improved health, increased productivity and reduced absenteeism, cost reduction, higher return on investment, waste minimisation, better use of materials, environmental protection, a new market emergence though new opportunities created, noise avoidance and reduction, allows for experimentation, and better quality life. Buildings produced from GBM offer better quality air, ample natural lighting, better noise control for occupants, pleasant view, improved productivity, less waste, efficient use of water, energy and resources (Ierek, 2017).

Extant literature placed reduction of cost associated with operating a building as the major drivers for incorporating GBM in construction; such associated operating cost includes energy-related (Buys and Hurbissoon, 2011; Windapo, 2014; LaMarco, 2019). LaMarco (2019) posits that there is efficiency in the use of GBM in buildings which leads to savings in money, influences employees' morale. Also, the green serves as a status symbol. Lower operational costs and lower life-cycle costs were identified by (Chan et al., 2009) as the reason for the green building development by businesses in Asia. Abolore (2012) accentuates that green building practices have a significant influence on financial profit and long-term competitiveness; this should be considered alongside the benefits it has to both humans and the environment for their uptake.

In the United States, Ahn et al. (2013) submitted that green building practices increased the total value of both residential and non-residential buildings from $10 billion to between $36 and $49 billion in 2008; this represents a substantial growth. Efforts are being made by designers to utilize green building practices in eradicating conventional buildings and in refurbishing existing structures into making them sustainable (Abolore, 2012; Nduka and Ogunsanmi, 2015). It was further submitted that built environment professionals are now focusing on ensuring that 60% of construction projects' designs are sustainable. Adopting green innovation helps improve property developers' branding image. Also, with established efficient experience sharing schemes, green technologies reduce administration costs. Investment in green building is beneficial to buyers, consumers, architects, quantity surveyors, developers, contractors, and other built environment stakeholders. Green buildings reduce toxicity in the internal environment, there is improved daylighting, reduced employees' absenteeism and improved productivity by at least 16% (Issa et al., 2010; Zhang et al., 2011; Ahn et al., 2013; Afolabi et al., 2013; Umar and Khamidi, 2012; Abolore 2012; Nduka and Ogunsanmi, 2015). In relation to conventional buildings, the green building uses more efficiently resources such as water, energy, land, and materials. It improves the quality of air indoors, uses natural lighting, improved and better health and comfort of occupants, impacts on the productivity of occupants (Kats, 2003; Windapo, 2014).

Green construction practices provide safe and affordable homes (Abimbola and James, 2012), and it helps to achieve high-performance buildings (Essa and Forune, 2008). Adegbile (2013) posits that if properly framed, clients could be convinced to patronized green homes due to benefits such as health, delight, and quality of life that they offer. Reducing impact on the environment, improving occupants' health and their wellbeing, and providing a commensurate return on clients' investment; are the essential goals of green building (Raouf and Al-Ghamdi, 2020). Nduka and Sotunbo (2014) reported that pursing active recycling, conserving natural resources, preventing global warming, decreasing environmental damage cost, and improving productivity; are the top benefits of green building construction.

In South Africa, Simpeh and Smallwood (2018) analysed the benefits of green building and found that the top benefits are reduced energy and water consumption, reduces operational costs, Enhances the value and profitability of assets, reduces life cycle energy costs, and company recognition. They later categorised the benefits into health and community, socio-economic and financial benefits. Darko et al. (2018) reviewed the literature on the benefits of green building and reported that the most important benefits of buildings built with GBM are reduced lifecycle costs, savings in energy consumption, enhanced health, and comfort of occupants, overall improvement in productivity and protection of the environment. Patil and Patil (2017) conclude that GBM selection is based on its numerous advantages, which range from its economic viability, toxic emission reduction, and the overall reduction of environmental impact. They further posit that the utilization of GBM and technology in the development of neighbourhood positively reduces transportation and production costs, carbon emission and provides job and skill enhancement opportunities for members of the community.

Green buildings' benefits to the environment include protection of the ecosystem and biodiversity, improve water and air quality, reduce waste, preservation, and restoration of natural and renewable resources, and reduces heat gain (USEPA, 2009; Darko et al., 2013; Shabrin and Kashem, 2017). Darko et al. (2013) suggested that green building benefits could lead to the creation, expansion and shaping of markets for green products and services, reduced operating costs, enhanced productivity of occupants, and optimized economic performance of the building over its' lifetime. The direct economic benefits of green buildings include better payback period resulting from low energy and water consumption, faster returns on investment, and higher revenue, reduction in operating costs, offers owners and developers higher rent (Shabrin and Kashem, 2017). USEPA (2014) reported that green infrastructure vegetation can help in; Reducing the amount of energy needed for water and wastewater pumping and treatment, reduction in energy used by the building,

reduction in the quantity of carbon IV oxide (CO2) present in the atmosphere. These benefits according to USEPA's (2014) report are the 'climate change-related benefits'. Ashuri and Durmus-Pedini (2010) further submitted that the construction industry would benefit from green construction; such as projects outcome are improved, professionals will be specialised, allows for the integration of technology, partnering with countries with better green rating and exchange of know-how.

Green buildings constructed with GBM have some social benefits. For instance, according to Darko et al. (2013), these buildings are aesthetically pleasing and enhance comfort and occupant's health. It was also postulated by Shabrin and Kashem (2017) that green buildings offer more opportunities for new jobs, especially for the locals in the areas of research and development and exploration since it is a new technology. Researchers' efforts would be to reduce the effect of a greenhouse on the environment and researches into strategies for converting and improving existing buildings to green buildings. The Government of implementing nations will also benefit from the job opportunities green building practices bring. Construction organisations, as well as their employees who are into green construction, would have to pay tax to the government for the revenue generated or earned. In addition to financial gains at the construction stage, Khoshbakht et al. (2017) posit that the post-construction benefits of green buildings are higher energy savings, less number of employees going on sick leave, improved rent, the property value is increased, fewer vacant spaces, opportunities for marketing, lower taxes on carbon, and improved productivity. Regarding rent and property value, Chegut et al. (2014) through an empirical study found that rent paid for office buildings is 20.0% more than for non-green office buildings. Thus, tenants pay more while developers/investors earn more.

3. Research Methodology

This study attempts to make a case for GBM products and service market in the construction industry, through the assessment of the benefits of their incorporation in construction, especially within the southeast geopolitical zone of Nigeria. The southeast zone is made up of five states representing 13.51% of the total states in the six geopolitical zones of Nigeria including the country's capital. The state capitals of the states where selected since they are urban (Adedeji and Fa, 2012), and houses a lot of housing estates, which have been undergoing various forms of modification into making them sustainable housing estate (Nwankwo et al., 2012). Also, many buildings and engineering construction projects are being carried out on a regular basis by both private individuals and investors and governments and their agencies. Furthermore, most government developmental, beautification, and upgrading projects are usually concentrated in the state capital.

This study tapped into the rich benefits of the questionnaire, internet-mediated research, and snowball sampling techniques to gather data from participants. The study started through a review of extant literature regarding the main aim of the research. Following the review, a quantitative research questionnaire was adopted as a tool for the collection of data. The questionnaire was considered most appropriate as it would cover a large audience at a lesser time and it is simple to use (Tan, 2011). The use of a questionnaire in social research techniques is common (Blaxter et al., 2001); and it has the capacity to give an objective and quantifiable research outcome (Ackroyd and Hughes, 1981).

The study surveyed construction professionals, consultants, clients, and contractors/subcontractors working within the five states of the zone. The study sampled participants with a least 5 years of working experience and who are knowledgeable on green (sustainability) construction concepts and are currently engaged within the construction industry. These target characteristics were set to ensure that only quality data are obtained and to reduce response bias. According to Naderifar et al. (2017), there is a low risk of response bias for a homogenous population by target features. Padayachee (2016) submit that professionals and other participants with formal qualifications, career profiles, and higher working experience are mature and are more ready to participate in a web-based survey. Thus, the drop out attrition rate will be reduced. The reason for choosing these set of participants is because of their role in construction generally, and in achieving green construction. Furthermore, the study could not establish any population nor sample size since there is no database of stakeholders with the set features.

Internet-mediated research which involves the use of online platforms such as social media platforms (Padayachee, 2016) was used in the administration of the questionnaire. The Google form was used to create the questionnaire, and the link was sent to the LinkedIn and WhatsApp groups and email addresses of the selected participants across the zone, using details obtained through a preliminary survey. The online platforms save cost and time. It permits speedy access to large participants with common interests (Wright, 2005), and who can be impracticable to reach. Given that this is a sustainability study, the use of an online survey is economical and eco-friendly (Ramsey et al., 2016). Having made the initial contacts with the first sets of participants across the zone, the study adopted the snowball sampling technique. This sampling technique was used because it is a time-saving, efficient, and economical method of reaching specific groups who are difficult to access (Polit-O'Hara and Beck, 2006; Hejazi, 2006; Naderifar et al., 2017). The snowball approach is dependent on referrals (Heckathorn, 2011), and according to Atkinson and Flint (2001), it has the potential for increasing significantly the study sample size.

The design of the questionnaire was in three sections with close-ended questions. The first section of the questionnaire harnessed data on the general information of the respondents. The second section garnered data regarding the status of GBM utilisation and market in the construction industry. The last section focused on the benefits of GBM incorporation in construction. In this section, the participants were required to rate the forty-two identified benefits of GBM in accordance with their level of importance and based on their ability to meet the economic, environmental, and social dimensions of sustainability in the construction industry. Using a scale of 1 to 5; where, 1 means 'not important', 2 being 'slightly importance', 3 being 'moderately important', 4 being 'important' and 5 being 'very important'. After a data collection process that lasted for a period of about 3 months and with 135 responses received, data saturation was deemed to have been reached. Naderifar et al. (2017) posit

that the snowball sampling method involves a gradual and time-dependent process of sample selection, which will continue until data saturation is reached. The 135 responses were deemed adequate for analysis as the focus was on quality and not quantity. The responses obtained in this study are higher than what was recorded in studies of (Aghimien et al., 2020; Aghimien et al., 2019a; Aghimien et al., 2019b; Awodele et al., 2019), that adopted similar sampling technique.

A normality check was conducted to establish the nature of the gathered data, using the Shapiro-Wilk test since the sample size is below 2000 (Ghasemi and Zahediasl, 2012). The gathered data were non-parametric in nature as the significant values obtained were below 0.05. Cronbach's alpha test was used to determine the research instruments' reliability. The test returned an alpha value of 0.953 for the 42 assessed benefits of GBM. Thus, the instrument is reliable as it slightly above the range (0.80-0.95) for a very good reliability level proposed by (Kasim et al., 2019). Kaiser–Meyer–Olkin (KMO) and Bartlett's test of sphericity analyses were used to test the structural validity of the measurement scale adopted. The KMO obtained is 0.807 and the chi-square of 7348.76 and p-value of 0.000 was obtained from the Bartlett test at a degree of freedom of 648. Tabachnick and Fidell (2007) assert that a KMO of $\geqslant$ 0.60 and Bartlett test with p-value $<$ 0.05; is the acceptable range. Based on the results obtained, the scale used is valid. Relative importance index (RII) was used to analyse and rank the identified benefits of GBM. The benefits were ranked in descending order based on their RII values. However, where the two or more variables have the same RII values, the standard deviation (SD) is computed, and the variable with the lowest SD in ranked first. Field (2005) suggested that the variable with the smallest SD should be ranked first, especially, where there is a tie in the Mean scores of assessed variables. The same principle was adopted in this study, but since the study used RII values in its ranking, the computed SD was not displayed. However, where the RII for two variables is the same and the computed SD is the same, the variables are given the same rank. Kruskal-Walis test was used to test the formulated hypothesis. Kruskal-Walis test is suitable for comparing the perception of at least three groups of respondents. The formulated hypothesis for this study is that there is no significant statistical difference in the ranking of the assessed variables by the respondents. There is no significant statistical difference in the views of the respondents across the zone regarding the benefits of GBM.

4. Results and Discussion

4.1 General Information of Respondents

The analysis of the general information of the study participants shows that the highest responses were obtained from Enugu state with 30.37%, this is followed by Imo state (28.89 %), followed by Anambra state with (15.56%), then Abia state (14.07%) and lastly, Ebonyi (11.11%). The respondents' category shows that 35.56% of responses were from contractors/subcontractors, and this is closely followed by construction professionals (28.15%), then clients represent 20.00% of the participants and lastly, consultant organisations are (16.00%). Moreover, about 31.85% of the participants have over 5 years of working experience, 28.89% of the respondents have 11 to 15 years of working experience, 25.19% have 16 to 20 years working experience and lastly, and 14.07% have 20 years and above working experience. The average construction industry experience of the respondents is 12.07 years. In terms of academic qualification, 39.26% of the respondents had Bachelor of Science/Technology degree, followed by hose with Master's degree with (33.33%), then those with Postgraduate Diploma (PGD) with (15.56%), then high national Diploma (HND) with (9.63%), and lastly, Doctorate with (2.22%). The information obtained shows that the respondents have reasonable working experience and the academic credentials to make credible insight into the subject under consideration

4.2 Status of GBM Utilisation in the Construction Industry

The results in Table 1 show that 67.41% of the participants indicated that their awareness of GBM is high, this is followed by 27.41% who indicated an average level of awareness, and lastly, 5.19% indicated that their awareness is low. With this larger proportion of the respondents indicating a high level of awareness, it implies that construction-based experts in Nigeria are aware of the concept and benefits of green/sustainable construction. This result supports the findings of previous studies such as Aghimien et al. (2019a), Baron and Donath (2016), and Nduka and Ogunsami (2015). However, the result obtained in this section is in disagreement with the findings of (AlSanad, 2015; Alabi, 2012; Susilawati and Al-Surf, 2011). The disagreement with these could be linked to the level of innovation in materials and technologies of the construction industries, as well as the experiences and knowledge of the construction stakeholders as at when these studies were carried out

On the level of adoption of GBM, a striking result was obtained. The result shows that 64.44% of the respondents indicated that the level of adoption and incorporation of GBM materials is low. Only a few of the respondents indicated that GBM were adopted in their projects. With this high level of low adoption, this shows a mismatch between the level of awareness and adoption of GBM in construction projects in Nigeria. This could be attributed to the lack of attention to the sustainability agenda (Davies and Davies, 2017; Oni, 2015), and unfavourable operational mode and process used in the construction industry of Nigeria (Aghimien et al., 2018a). A radical attitudinal change of construction stakeholders has been advocated for there to be increase incorporation of GBM in construction.

Furthermore, the analysis of the level of agreement of the respondents regarding the sustainable construction market being largely under-tapped and unsaturated; indicate that 54.07% of the respondents strongly agree, 35.56% of them agree and 8.8% are undecided. With this, a combined proportion of the respondents 89.63% (121) agreed that a lot of efforts are required for attaining sustainability in new projects and in converting the existing conventional buildings into sustainable ones. This further implies that a lot of works are still remaining undone regarding the attainment of sustainability in Nigeria, and indeed other developing countries of the world with similar or less developed economies like Nigeria. Therefore, this further means that there is a ready market for construction firms and other construction-based organisations and professionals who want to diversify and take advantage of the opportunities presented by green construction technology. Construction firms offering sustainability products and

services would definitely be above its competitors and take a greater share of the construction market and industry.

In addition, the analysis shows that knowing the benefits of green construction will create an atmosphere of demand for green products and services. This is evident in the number of respondents who indicated that they 'agree' (46.67%) and 'strongly agree' (39.26%). This implies that people are most likely to take-up and be inclined to the incorporation of GBM in their projects when they know the importance of the materials. Thus, this could trigger the appetite and subsequent demand for green construction products and services. According to Darko et al. (2013), the knowledge of green building benefits could lead to the creation, expansion, and shaping of markets for green products and services. In the same vein, Aghimien et al. (2019a) submit that knowing and understanding the benefits inherent in the integration and adoption of GBM in construction could trigger the change in preference from the conventional traditional materials to more materials that are sustainable.

One of the crucial benefits of GBM is the emergence of a new market through the new opportunities created (Koutsogiannis, 2018). Therefore, the creation of a sustainable construction market is anchored on a sound knowledge of the benefits of GBM incorporation in construction. Cost issues that have remained unresolved in the general construction marketplace (Yudelson, 2005), has also, been blamed for the low adoption of GBM. This has contributed to the green construction market remaining largely untapped. The complexity and fragmented nature of the construction industry is a hurdle that needs to be overcome for a better improvement in the adoption and incorporation of GBM to be achieved. Simpeh and Smallwood (2018) submit that the project-based nature of the green construction market entails that understanding the benefits of green construction will take a longer time to achieve a comprehensive implementation, and by extension the saturation of the green building market. Simpeh and Smallwood (2018) blamed this on building developers and owners, and project financiers who have been reluctant in accepting the benefits of green buildings.

4.3 Benefits of incorporating GBM

The results in Table 2 shows that the ten most important benefits of incorporating GBM in construction assessed are improved daylight and reduced need for artificial lighting (RII=0.947), improves the quality of life (RII=0.932), increase employees' productivity and reduced absenteeism (RII=0.930), improve occupant's health and comfort (RII=0.911), higher profit and return on investment (RII=0.908), leads to construction professionals specialisation (RII=0.889), reducing greenhouse gas emissions from building (RII=0.886), reduces toxicity in the internal environment (RII=0.884), low operating, and maintenance cost (RII=0.880), and creates new job opportunities (RII=0.879). While the least five most important benefits of incorporating GBM are reduced vacant spaces (RII=0.526), the status of the symbol (RII=0.521), meets growing demands by tenants (RII=0.511), reduces administrative cost (RII=0.51), improve government revenue generation through tax (RII=0.437). The key benefits cut across economic, social, environmental dimensions of sustainability. The finding of this study is in line with the reports of (Koutsogiannis, 2018; Ierek, 2017; Simpeh and Smallwood, 2018; Nduka and Ogunsanmi, 2015; Nduka and Sotunbo, 2014; Adegbile, 2013; Raouf and Al-Ghamdi, 2020). Among the critical benefits of using GBM as reported by Koutsogiannis (2018) are; improved health, increased productivity and reduced absenteeism, cost reduction, higher return on investment, environmental protection, and better quality life. Ierek (2017) posits that buildings made with GBM offer better quality air, ample natural lighting, and better noise control for occupants, pleasant view, and improved productivity, less waste, efficient use of water, energy, and resources. The essential goals of the green building according to Raouf and Al-Ghamdi (2020) are reducing the impact on the environment, improving occupants' health and their wellbeing, and providing a commensurate return on clients' investment. Similarly, Adegbile (2013) posits that clients are convinced to patronize green homes due to benefits such as health, delight, and quality of life that they offer.

The finding of Nduka and Ogunsanmi (2015) shows that productivity improvement and improving the quality of life of individuals and society were among the most important potential benefits of building made with GBM. Simpeh and Smallwood (2018) found that reduction of operational cost, improve the value and profitability of assets, improve occupants' health and comfort, and employees' productivity improvement and satisfaction were among the major benefits of incorporating GBM in construction. This study also corroborates Darko et al.'s (2018) report that the most important benefits of buildings built with GBM are reduced lifecycle costs, savings in energy consumption, enhanced health, and comfort of occupants, overall improvement in productivity and protection of the environment. Toxic emission reduction and reduction in the overall environmental impact, reduction in carbon emission, and provision of job and skill enhancement of community members are part of the reasons for GBM selection (Patil and Patil, 2017).

Table 1. Status of GBM utilization in the construction industry

Category	Classification	F.	%
Level of awareness of GBM in construction	Low	7	5.19
	Average	37	27.41
	High	91	67.41
	Total	**135**	**100**
Level of adoption of GBM in construction	Low	87	64.44
	Average	36	26.67
	High	12	8.89
	Total	**135**	**100**
The sustainable construction market is still largely unsaturated and grossly under tapped.	Strongly Agree	73	54.07
	Agree	48	35.56
	Undecided	12	8.89
	Disagree	2	1.48
	Strongly Disagree	0	0
	Total	**135**	**100**
Knowing the benefits of green construction will create an atmosphere of demand for green products and services	Strongly Agree	53	39.26
	Agree	63	46.67
	Undecided	15	11.11
	Disagree	3	2.22
	Strongly Disagree	1	0.74
	Total	**135**	**100**

Table 2. Benefits of green building materials

Variables	RII	Rank	Kruskal Wallis Test		
			Chi-Square	Sig.	Decision
Increase employees' productivity and reduced absenteeism	0.930	3rd	4.883	0.299	Accept
Efficient use of energy	0.667	33	7.766	0.101	Accept
Low operating and maintenance cost	0.880	9th	7.260	0.123	Accept
Improved quality of air	0.812	23rd	8.075	0.089	Accept
Reduce strain on local resources	0.865	13th	8.056	0.09	Accept
Efficient use of materials	0.819	22nd	10.929	0.027*	Reject
Reduction in water consumption.	0.736	30th	4.634	0.327	Accept
Improve occupant's health and comfort	0.911	4th	6.957	0.138	Accept
Waste minimization	0.764	27th	4.491	0.344	Accept
Higher profit and return on investment	0.908	5th	5.985	0.2	Accept
Environmental protection	0.843	16th	6.769	0.149	Accept
Noise voidance and reduction,	0.649	35th	4.713	0.318	Accept
Creates new job opportunities	0.879	10th	8.575	0.073	Accept
Improves the quality of life	0.932	2nd	6.249	0.181	Accept
Pleasant view and aesthetics	0.763	29th	10.752	0.030*	Reject
Cost reduction and savings	0.668	32nd	9.477	0.050*	Reject
Status of symbol	0.521	39th	4.897	0.298	Accept
lower life-cycle costs	0.849	15th	7.989	0.092	Accept
Increase the value of properties	0.661	34th	7.334	0.119	Accept
Enhances company recognition and brand image	0.853	14th	15.563	0.004*	Reject
Efficient experience sharing scheme	0.764	27th	9.196	0.056	Accept
Reduces administrative cost	0.510	41st	13.908	0.008*	Reject
Improved day light and reduced need for artificial lighting	0.947	1st	12.551	0.014*	Reject
Reduces toxicity in internal environment	0.884	8th	14.651	0.005*	Reject
Socioeconomic development	0.530	37th	5.249	0.263	Accept
Reducing greenhouse gas emissions from building	0.886	7th	7.766	0.101	Accept
Provide affordable homes	0.819	21st	7.260	0.123	Accept
Pursing active recycling	0.839	17th	8.075	0.089	Accept
Preventing global warming	0.696	31st	8.056	0.09	Accept
Conserving natural resources	0.804	24th	10.929	0.027*	Reject
Reduces heat gains	0.870	12th	4.634	0.327	Accept
Protection of the ecosystem and biodiversity	0.800	25th	6.957	0.138	Accept
Better payback period	0.570	36th	4.491	0.344	Accept
Offers owners and developers higher rent	0.831	19th	5.985	0.2	Accept
Improved construction project outcomes	0.788	26th	6.769	0.149	Accept
Lead to construction professionals' specialization	0.889	6th	8.812	0.066	Accept
Allows for integration of technology in construction	0.819	20th	8.575	0.073	Accept
Partnering with countries with better green rating and exchange of know-how	0.834	18th	6.249	0.181	Accept
Lower cost of advertising	0.874	11th	10.752	0.030*	Reject
Improve government revenue generation through tax	0.437	42nd	8.837	0.065	Accept
Reduced vacant spaces	0.526	38th	2.456	0.653	Accept
Meets growing demands by tenants	0.511	40th	7.935	0.094	Accept

*p-value < 0.05

GBM ensures a balance between the internal and external environment of a building and does not require a longer time of heating and/or cooling to provide the need comfort. GBM removes toxic emissions in the internal environment of a building; thereby impacting positively on occupants' health and comforts (Darko et al., 2018; Patil and Patil, 2017; Simpeh and Smallwood, 2018). Green buildings are cheap to operate and maintain, even though, it has a high initial cost. According to Shabrin and Kashem (2017), one of the direct economic benefits of green buildings is their low energy and water consumption. USEPA (2014) reported that reduction in the amount of energy need for water and wastewater pumping and treatment, reduction in the energy used by the building; have made the operating cost of this building to be low. The quantity of Carbon IV oxide emission into the atmosphere is the major cause of greenhouse effects. GBM helps to reduce green gas emissions in buildings (USEPA, 2014).

A conducive environment is ideal for optimum performance, productivity, and reduced absenteeism. Construction organisations would normally experience improvement in the outcome of their projects as benefits of venturing into green construction (Ashuri and Durmus-Pedini, 2010). Green building offers a composite benefit, which drives demand for them, as it has been proven to meet the various needs of the tenants (occupants) (Shabrin and Kashem, 2017; Ashuri and Durmus-Pedini, 2010). The high occupancy

rate of the green building offers investors and developers higher revenue and speedy payback period for their investments (Khoshbakht et al., 2017; Raouf and Al-Ghamdi, 2020). Tenants tend to pay more leading to an increase in the earnings of the developers/investors as confirmed by (Chegut et al., 2014), that green office buildings experience about 20% more returns that the non-green ones.

GBM technology is new, meaning that it is still an area that is largely untapped. Thus, it provides job opportunities for locals and researchers. This could be the reason why it was postulated by (Shabrin and Kashem, 2017) that research into the exploration and exploitation of Green technology creates a lot of job opportunity by researchers and locals. Researches into strategies for improving existing non-green buildings into sustainable ones are also carried out by young researchers. Green building technology could lead to specialisation of built environment professionals (Ashuri and Durmus- Pedini, 2010). From the result of the Kruskal-Wallis H test conducted, nine (21.43%) among the assessed variable has a significant p-value of below 0.05. This means that these variables were rated differently by the respondents. These variables have cost reduction and savings, pleasant view and aesthetics, lower cost of advertising, efficient use of materials, conserving natural resources, improve daylight and reduced need for artificial lighting, reduce administrative cost, reduces toxicity in the internal environment, and enhances company recognition and brand image. Based on the significant p-value obtained on the nine variables, the decision is thus, to reject the null hypothesis. Nevertheless, the remaining 33 (78.57%) of the assessed variables had a significant p-value of greater than 0.05. This implies that no significant statistical difference exists in the rating of these variables by the respondents. Therefore, the opinion of the respondents converges at these 33 variables. The decision on these 33 variables is thus, to 'accept' the null hypothesis. There is agreement among the industry's stakeholders sampled regarding the ranking of assessed benefits and their potential in creating a market for GBM products and services. Nduka and Ogunsanmi (2015) reported that the professionals in the building industry ranked the Green building benefits in a similar manner. The combined Kruskal Walis test revealed that the assessed variables had a significant p-value of greater than 0.05 (Sig=0.514). This implies that no significant statistical difference exists in the rating of these variables by the respondents from the different states. Therefore, the opinion of the respondents in the zone converged in all the 42 variables. Based on this, the hypothesis, which states that 'there is no significant statistical difference in the views of the respondents across the zone regarding the benefits of GBM', was accepted.

5. Conclusion and Recommendations

This study sets out to assess the benefits of GBM incorporation in construction, with a view to making a case for GBM products and service market in the construction industry of Nigeria. Utilising an internet-mediated questionnaire survey for the collection of data from construction professionals, consultants, clients, and contractors/subcontractors using the snowball sampling techniques; the study has been able to achieve its aim.

It was concluded that the level of awareness of GBM is high while their adoption and incorporation in construction is low. Also, the sustainable construction market in Nigeria is still unsaturated and under-tapped. Therefore, construction-based firms are advised to take advantage of the ready market presented by green construction technology based to diversify and gain greater market share. Diversification into sustainable construction could lead to differentiation in the general construction market. Thus, as a differentiation strategy, construction firms and professionals are advised to specialize in green building technology and innovation by accepting the innovations and the benefits it offers. Furthermore, knowing the benefits of Green construction can create a demand for green products and services. The presence of demand would naturally trigger supply; and when this is achieved, a market is created. The most important benefits of GBM incorporation in construction that could drive the creation of a sustainable market for GBM products and services are improves daylight and reduced need for artificial lighting, improve quality of life, increase employees productivity and reduced absenteeism, improve occupants health and comfort, higher profit and return on investment, leads to construction professionals specialisation, reducing greenhouse gas emission from building, reduces toxicity in the internal environment, low operating and maintenance cost, and creates new job opportunities.

Considering the key findings of this study, it is recommended that a radical attitudinal change is needed by construction stakeholders, especially the clients and the financiers, to increase the adoption level of GBM. The knowledge of the economic, social, and environmental benefits of GBM is what the clients' needs to make a sound investment decision. To obtain the total supports of the industry stakeholders, adequate information regarding the importance of green building concepts is needed. Legislation on the creation of the green building regulatory council of Nigeria (GBRCN) should be made. The creation of GBRCN will be driven by the government through the parliament, with input from various professional bodies and stakeholders, which must go beyond the construction industry alone. This council when created would be charged with driving and ensuring the creation of awareness of green building technology, guiding principles and tools. The outcome of this study will be useful to investors/developers in the construction industry in making an informed investment decision. The unsaturated sustainability construction market of green building products and services could attract new entrants into the construction markets. It could also lead to diversification and differential of already existing contracting and consulting firms in the construction industry. The findings also add to the existing body of knowledge on green/sustainable construction. This study is limited by the locational boundaries and the small sample size. In addition, an internet-mediated survey normally has a low return rate and high dropout attrition rates. Thus, care should be taken in generalizing the findings of this study. Based on these, a similar study should be carried out in other geo-political zones of the country and indeed in other developing countries by utilizing the same or other survey approaches; so that results could be compared.

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Chidiebere Emmanuel Eze is a Lecturer in the Department of Quantity Surveying, School of Environmental Technology, Federal University of Technology, Owerri, Imo State, Nigeria. He holds National Diploma (ND), Bachelor of Technology, (B.tech), and Masters of Technology (M.Tech) all in Quantity Surveying. He is an experienced construction and project management experts, having over 7 years field work in the construction industry of Nigeria. He is a certified Project Management Professional (PMP), Corporate Member of The Nigerian Institute of Quantity Surveyors (NIQS) and a Registered Quantity Surveyor and Consultant (RQS), having registered with Quantity Surveyors Registration Board of Nigeria (QSRBN). His research interests include Quantity surveying, Construction marketing, construction innovations and ICT, Construction rework, sustainable construction, Project management with specific emphasis in Cost, Schedule, Risk and Quality, Procurement, stakeholders' management.

Dr Rex Asibuodu Ugulu is the current Ag. HOD for Quantity Surveying Department, School of Environmental Sciences at Federal University of Technology, Owerri-Nigeria, which he joined in 2012. Prior to that, he worked in Academia and industry at various capacities; lecturer at Delta State Polytechnic, Ozoro and Quantity Surveyor at Bouygues Construction Nigerian Limited. He holds a PhD degree in Construction Economics and Management from the University of Witwatersrand, Johannesburg, South Africa. He finished his Master of Science degree in Construction Management from Imo State University. Ugulu holds a Bachelor of Science (Honour) degree in Quantity Surveying from Enugu State University of Science and Technology, Nigeria. He is a member of the Nigerian Institute of Quantity Surveyors, a registered Quantity Surveyor and a member Association of Project Management South Africa. He is a recipient of Golden Key International Honor Society for academic excellence as validated by the University of Witwatersrand, Johannesburg, South Africa for outstanding research performance. His research interests are Construction Project Optimization, Construction Works Estimating and analysis of price, and Procurement system.

Samuel Ikechukwu Egwunatum had his degrees in Quantity Surveying from the Federal University of Technology, Akure, Nigeria uptill 2014 specializing in Construction Economics. He started his lecturing career with Delta State Polytechnic, Ozoro, Nigeria after a short stint in industry service where he conceptualized the use of labourers productivity outputs to build cost models for estimating unit rate costs of construction work items and facilitating the cost modelling research group. He is currently a lecturer with Federal University of Technology Owerri, Nigeria. He is a Corporate Member of The Nigerian Institute of Quantity Surveyors, Association for the Advancement of cost engineering and American Society of professional estimators. He has to his credit, published one textbook in Germany on (Lost Labour Claims in Construction Projects: Principles and 2016) and a chapter contribution in the United Kingdom to the book Zero and Net Zero Buildings under the title: Economic Aspects of Zero Energy Buildings. He has over twenty-one published articles.

Imoleayo Abraham Awodele is a Lecturer in the Department of Quantity Surveying, School of Environmental Technology, Federal University of Technology, Owerri, Imo State, Nigeria. He holds B.Tech (Hons) in Quantity Surveying and MSc in Construction Management. Imoleayo has research interest in the general areas of Quantity Surveying and Construction Project Management with particular emphasis on Risk Management in oil and gas, Professional Practice and Procedure, Public-Private Partnerships, Commercial and construction marketing, and Heavy Engineering. He had over seven years of hands-on experience in the field of Civil/Heavy engineering and housing construction and property development and management. He is a member of the Nigerian Institute of Quantity Surveyors and also a Registered Quantity Surveyor with the Quantity Surveyors Registration Board of Nigeria.