STRATEGIES FOR GREEN BUILDING MATERIAL ADOPTION IN NIGERIA CONSTRUCTION INDUSTRY

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ABSTRACT

The construction industry of any nation is one of the greatest and most important sectors that strengthen economic development. It is the least sustainable industry in the world as it consumes more than half of all the non-renewable resources humankind use in construction works, especially housing. The activities of the industry contribute greatly to environmental pollution which is among the world largest consumer of energy, material resources, water, and land dereliction. This study aims to appraise green building materials within the Nigerian construction industry, with a view to suggesting a veritable strategy for their adoption. To achieve this, a Mixed Method Design was adopted. A total of 372 questionnaires were distributed for the purpose of the study, 156 valid questionnaires were administered. Descriptive method of data analysis was adopted using simple random sampling technique and through the use of interview. Percentages, Frequency, Mean Item Score (MIS), and Relative Importance Index (RII) were used to analyse the collected data through the administration of questionnaire. The study found that construction stakeholders are aware of the existence and adoption of some green materials like empty plastic bottles, clay and mud, grasses, bricks, stone and timber, with the correlation showing an insignificant level of $p>0.05$. The major drivers of green building materials adoption in construction are; resource efficiency, reduction in the lifecycle costs of buildings, legislation / legal requirement, financial incentives, and cost reduction, the Resource efficiency is ranked 1st with RH of 0.972 while Developing regulatory mechanisms is the least with RH of 0.473 of Driver of GBM Adoption in NCI. Also, higher costs of green building construction, lack of professional knowledge and expertise in green building, lack of importance attached to green building technology by senior management, lack of financing schemes such as bank loans, and lack of government incentive are the major barriers to the adoption of green building materials in construction, the Barrier to Green Building Materials Adoption in Construction is highest in Higher expenses of Green buildings construction and lowest in Lengthy repayment timeframes from implementing GBT with 0.99 and 0.50 respectively. Provision of incentives to encourage innovation in sustainable construction, rigorous green building promotion by government, use of technologies that permit the deconstruction and recycling of the building components, and adequate training centres with adequate funding of research and development; were the strategies for improving the adoption of green building materials, strategies to improve GBM uptake has 0.99 RH value, ranked 1st Establishment of enticements to inspire invention in sustainable construction and 0.70 RH value for Provision of Sustainable Materials Selection Criteria which is ranked the least. It was concluded that there is a very strong and positive relationship between level of awareness and adoption of GBM and was recommended that appropriate legislations should be put in place by the Nigerian government to encourage the adoption of green building practices in the construction industry with support from top stakeholders and the provision of financial and other incentive to encourage the adoption of GBM.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Construction industry is one of the primary sectors of the Nigerian economy which account for its growth and development through provision of infrastructure that carters for the wellbeing of the society (Isa, 2017). The construction industry has been adjudged as one of the greatest and vital industries that strengthen the economic development of any nation which by virtue of its size, contributes greatly to environmental pollution and is among the world largest consumer of energy, material resources, water, land dereliction (Ding, 2008, Ding *et al.,* 2010; Ding *et al.,* 2011). Fifty percent (50%) of non-renewable and renewable resources consumed by humans are used for construction work, especially housing, thus, constitute the least sustainable industries in the world (US *Department of Energy*, 2016).

Horvath (2004) posits that construction has a huge amount of effects on the natural environment and consideration for green building covers a bigger aspect of the construction industry (Nwafor, 2006). The construction industry consumes 12- 16% of all water available, an energy production totalling 40%, 40% of all raw materials, renewable as well as non-renewable resources making up 32, 25% of all timber and produce 30-40% solid waste and 35-40% of carbon dioxide (CO_2) is emitted globally (Son *et al.,* 2011; Berardi, 2013; Low *et al.,* 2014).

This damaging effect of construction industry with regards to the balanced ecosystem has triggered a global outcry for the acceptance/application of sustainable practices in the industry (Wang *et al.,* 2014). The demand for green building has over the past two decades experienced an increase in green building concepts and practices globally (Xue,

2016). Consequently, green building development is now the viable means for delivering building that are less harmful effect to the environments and one of the ways to achieving this, is the proper understanding of the issues relating to the acceptance of Green Building Material (GBM) in the Nigeria building industry (Adebayo, 2012). Green building can be conceptualized with regards to extending the concept of sustainability to building and construction activities and this can help achieve a state of sustainability as far as the construction industry is concerned (Mbamali, 2005).

Green building can be referred to as the use of environmentally responsible process in maximizing the effective usage of resources like water and energy with the view of creating a healthy land, water and also the quality of air all over the building in question (Shittu, 2014). According to Kibert (2008) and Bourdeau (1999), "green building may be well-defined as the formation and responsible management of a healthy environment based on the efficiency of resources and principles of ecology". Green building materials are special materials for green building construction and the adaptation of this system is more sustainable compared to the conventional building (Sheth, 2016). Green building materials are environmentally friendly materials that helps to mitigate or limit issues that are potentially harmful to the environment (Greenomics, 2016).

Ideal building materials are materials with no negative/ harmful effect on the environment and such material ought to be substantially reusable or recyclable and also, the material should be considered as a friend to the environment (Oyegiri & Ugochukwu, 2016). The Construction industry in Nigeria is not an exception to this challenge, as the level of carbon dioxide emission and environmental pollution is also on the increase. Nigeria is a country which mostly depend on Portland cement, sand and

gravel for its building materials fulfilment and hydrocarbons for its energy need which are not sustainable (Sambo, 2014).

Public consciousness of environmental issues has experienced significant improvements in Nigeria and so, property title-holders and also clients now try to find commercial buildings with acceptable and satisfactory environmental standard, where standard health level can be obtained through green building development (Shittu, 2014). Unfortunately, the uptake level of the green building material concept is still very low and not properly documented in the industry. In order to tackle these sustainable issues, there is the need for a radical approach toward delivering construction projects and the adoption of diverse eco-friendly materials/tools that will help manage projects and deliver them sustainably (Aghimien *et al.*, 2018).

Based on the afore mentioned, it is imperative to appraise the acceptance of green building materials within the Nigerian construction industry and one of the ways to achieving environmentally friendly built environment is the uptake and incorporation of constructions using green building materials. Hence, the need for the study which sort to appraise the uptake aimed at the adoption and acceptance of green building materials in the Nigerian construction industry.

Green building materials are materials that make ideal use of resources, generate least amount of waste and are harmless to environment and people (David, 2015). For example, using materials like lime in building can help buildings absorb carbon rather than releasing it that will eventually result to reduction in dangerous effect on the environment (Ashish, 2012).

1.2 Statement of the Research Problem

Increase in the demand of houses has led to the consumption of more energy, resources and raw materials that are accountable for the upsurge of the air's carbon content that is dangerous to human wellbeing and the environment at large (Akshay, *et al.,* 2015). As stated earlier, contemporary designs obviously consume a high number of physical resources like materials, energy and money in their construction, maintenance and usage; nonetheless they can also result in negative effects for example, loss of amenity and biodiversity which are much more tough to assess.

Each year, building construction activities globally consume raw materials up to three billion tons representing about 40% of total use world-wide. In tropical region like Nigeria with hot and cold weather depending on location, there is need to take the preservation of Nigeria finite energy and ecological resources seriously now more than important (Shittu, 2014).

Therefore, the construction industry is causing various environmental hazard that has call for the need to build with more sustainable materials also known as "environmentally friendly materials", so as to help in the creation of an ecological environment for living.

The environmental gains of building with green building materials includes the safety of ecological community, improved water and air quality which improves the occupant's health, fewer waste flowing into water bodies and the conservation of natural resources. These benefits will yield in lowering costs of operations because they typically use a smaller amount of energy and materials (Mehta, 2013). Despite the vital importance of green building materials to the construction industry as well as the for the environmental stability, the construction industry in Nigeria is yet to substantially

implement the use of green building material in their construction processes (Akadiri *et al.,* 2012; Afolabi & Olamide, 2012; Opaluwa *et al.,* 2015 and Ikechukwu & Ugochukwu, 2016).

This study is therefore required at this time when the effects of climate changes and global warming is severe on the built environment. Thus, investigating the utilization of green and sustainable materials and locally accessible materials that are environmentally friendly within the Nigerian Construction Industry (NCI) would lead to a better future.

1.3 Research Questions

The following research questions provide the framework for this study:

1. What is the level of awareness of green building materials (GBM) and its adoption within the NCI?
2. What are the drivers of GBM adoption in the NCI?
3. What are the barriers to the adoption of GBM?
4. How can the uptake of GBM towards Sustainable Construction Practices (SCP) be improved?

1.4 Aim and Objectives of the Study

This research is aimed at appraising adoption of green building materials within the NCI, with the view to developing strategies for its uptake towards SCP.

In achieving this aim, the following specific objectives include;

1. To determine the level of awareness and adoption of green building materials (GBM) within NCI.
2. To determine the drivers of GBM adoption.
3. To examine the barriers to GBM uptake in Nigeria.

4. To propose strategies for an improved GBM uptake leading to SCP in NCI.

1.5 Justification for the Study

In many developed and some developing countries, the construction industry is developing sustainability ethics grounded on "the principles of resources efficiency, health and productivity". In Nigeria, sustainable construction and the use of sustainable materials has gotten inadequate attention and awareness (Dania, 2007). Studies have however discovered that the level of sustainability in many developing countries is low (according to Alabi, 2012; Aje, 2016; Baron & Donath, 2016) and statements as to the poor nature of sustainability in construction projects carried out in most developing countries have been made in recent times, and the NCI is not excluded (Aje, 2016; Alabi, 2012; Al-Saleb & Taleb, 2010; Baron & Donath, 2016).

Several studies about the challenges of Green Building (GB) in third world (developing) countries around the world has emerged (Aigbavboa *et al.,* 2017; Alsanad, 2015; Ametepey *et al.,* 2015; Ayarkwa *et al.,* 2017; Djokoto *et al.,* 2014). However, researches on "GB and its material adoption" emerging from Nigeria are more centred on GB knowledge issues (Ekung *et al.,* 2016). This includes; its perception, awareness, and sustainable facilities management (Aluko 1997; Magaji, 2015; Nduka & Sotunbo, 2014), renewable energy and energy efficiency (Ahmed & Gidado, 2008; Bugaje, 2006), GB (Olanipekun, 2015), materials and management tools in delivering GB (Attman *et al.,* 2019; Augenbroe *et al.,* 2009).

However, GBM for building should be considered as an important rationale in the field of green architecture with environmental sustainability in urban as well as rural societies in the country, which raises questions to the role institutions can play in order

to create knowledge and a better sustainable future based on green building construction, the design and the materials which is perceived as a commencement of fresh era for the country (Shittu, 2014).

The need for sustainable world has arisen and Nigeria cannot be left behind. Educating the leaders in collaboration with the stakeholders can support the facilitation for developing as well as adopting sustainable buildings in the country. It is important to decide building green with the use of GBM early at the design stage so as to make the building compatible with the environment which helps to optimize the entire success of the building project by incorporating the green potential, reduction in redesigning and to ensure viable economic aspect in relation to the green elements.

Therefore, the outcome of this research determines to complement the existing bodies of knowledge/ data about the principles, practices, adoption and importance of GBM in the NCI. This will further encourage the industry's stakeholders in validating its adoption, usage and implementation within the country for both public and private construction projects in Nigeria.

1.6 Scope and Delimitation of the Study

This research work proposes to adequately cover strategies for GBM adoption with the view to improve the adoption of the GBM and also, improve the SCP within the NCI. It is imperative to note that the degree of awareness/development and acceptance of green building, its materials and practices in the NCI when executing this research might affect the data gathering process thus depending on data/information from appropriate professionals in the fields, structured interview/data gathered from relevant authorities, journals, related researches and reports. Consequently, the extent of green building, its

materials and development in the country, time factor and other relevant factors, the study shall be restricted to the strategies for GBM adoption within the NCI.

1.7 Operational Definition of Terms

Green building: "Green building denotes both a structure and application of processes that are environmentally responsible and resource efficient during a building life cycle" (Baumann *et. al.,* 2008).

Sustainable development: this refers to the "the organizing principle for meeting human development goals even though at the same time sustaining the ability of natural systems to make available the resources and ecosystem services upon which the economy and society depends on" (Brundtland report, 1987).

Sustainable construction: "This is a process of designing, renovating or adapting a building in compliance with environmental rules and energy saving procedures" (Environmental Protection Agency, 2016)**.**

Green building materials (GBM): "GBM are materials that are available locally for energy efficiency, sustainability, durability and lessens side effects on environment to make efficient sustainable structure and also, reduce the pollution content on the environment" (Akshay *et. al.*,2015).

Sustainable Building: A sustainable building, or green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use — energy, water, and materials — while reducing building impacts on human health and the environment during the building's lifecycle, through better siting, design, construction, operation, maintenance, and removal (Hari S., 2015).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Sustainable Construction

According to Kunszt, (2013) Sustainable construction (SC), can be characterized as "the conception and accountable administration of an all-encompassing built environment dependent on the proficient and natural standards of resources". Sustainability can be viewed as "addressing the requirements of the present without bargaining the capacity of people in the future to address their needs" as characterize by Harrison, (2010) and Bond, (2010). According to Munier, (2015), this meaning can be acknowledged as the most commonly utilized one, as it is stated in the World Commission on Environment and Development 1987 as found in the Brundtland Report. Regularly, the words 'sustainable' and 'green' are utilized reciprocally. Be that as it may, Chan *et al.,* (2005), opined that 'sustainability ' also captures the environmental, monetary and social problems associated with buildings. The researcher in addition re-counts that the Conseil International du Bâtiment (CIB), a worldwide development research body and organizing association in 1994, characterized the term ' sustainability construction' as the "conception and management of a sound and thorough built environment, in view of effectiveness of resources and natural plan. RICS (2010), then again, gives a meaning of 'green building' as a green structure or workable structure resulting from a plan theory that centres around intensifying the effectiveness of resource utility, including materials, water, and energy, at the same time decreasing structural effects on social wellbeing as well as the environment throughout the building's life cycle, by means of improved location, plan, development, management, support and demolition. According to

Munier, (2015), sustainable development is regularly befuddled by certain individuals who feel that ideas, for example, 'sustainable' and “development” can't exist together, whereas others imagine that both of the words repudiate one another. Munier, (2015) alluded to the phrase 'sustainable development' as a subjective change including the economy, yet additionally institutional, environmental and social variations. As indicated by Mclntyre, Ivanaj & Ivanaj (2019), sustainability has three mainstays to it, particularly: Social (fundamental human requirements, value, cooperation, social responsibility), Economic (development, market extension, externalization of expenses), and Environmental (conveying limit, practical yield, biodiversity, resource preservation).

2.2 Sustainable Construction Practices (SCP) and Awareness in Construction Project

The awareness on green building is known as a promotion exercise and ideal strategic model through which people to comprehend why a precise issue is important. In addition, it enables one to know the desired goals and how and what is essential to accomplish a task (Chan and Kumaraswamy, 2012). The individual actions, commitment to principles, desire for knowledge and absolute involvement are variables that affect the level of awareness for green building (Abolore, 2012). In communication industry, awareness means to generate a base auditor for a merchandise and or services. Therefore, the main focus of awareness is to accomplish insight to the individuals. Communication and publicity make efforts to repeat information to potential consumers severally, before the information get better publicity. This revolution in technology has underwritten in positively for delivering and collecting information (Nduka & Sotunbo, 2014) for instance, signs, the internet and printed publications. Nonetheless, the green

building perception must be circulated in to contribute in general communal awareness and reception.

In recent times, there have been a lot of studies on the consciousness of green building. Research has revealed that conventional information and consciousness for built environment experts is a significant instrument for creating green building facts and capacities. Ameh, *et. al*., (2007) confirmed that the Nigerian specialists in the building industry are conscious of the ideologies concerning sustainability. Furthermore, most knowledge on sustainable building rehearses are sourced from individual examinations. In the kingdom of Bahrain, there are preparedness by law fabricators or legislators to make a regulation for sustainable buildings. This was contained in the report of Denscombe, (2007) and Flanager (2007), who concentrated upon applying building – incorporation Photo Voltaic (BIPV) or Wind energy (BIWE) in Bahrain.

These policy makers were found to be concerned about what the reaction of investor and consumers will be due to their seemingly level of knowledge and awareness on relevance and influence of building- incorporation PhotoVotaic (BIPV) or Wind energy (BIWE) in the far future. Architects and Contractors are likewise intrigued and sharp in carrying out supportable building project, albeit more information and preparation is needed on building–incorporation PhotoVotaic (BIPV) or Wind energy (BIWE) establishment (Denscombe, 2007).

Awareness of level of sustainability alongside green construction is still at the “sensible to good” array especially in the Kuwait Construction industry. This was the findings of Dietz *et. al.,* (2001), who investigated the showcase facts, awareness of level and appropriateness of the perception of green building in the midst of construction stakeholders of the Kuwait construction industry. It was suggested that training,

seminars, courses, conferences, public announcement, study tour and workshops should be emphasis as means of educating the stakeholders on green and sustainable construction, to increase the awareness of level and facts. In the study of Waniko (2014), in which the familiarity of the green building concepts was assed among construction experts, it was confirmed that the Nigerian construction experts are conscious of the green building perceptions and practices. There is an advanced proportion of the public are not knowledgeable and not conscious of the green building practices in the Nation of Saudi-Arabia. This was reported by Susilawati & Al-Surf (2011) who investigated communal knowledge and community consciousness on the concept of green building practices in the Kingdom of Saudi Arabia.

2.3 Green Building

The first truly green building dated far back when most buildings where built using local materials (Freed, 2008). These were the Anasazi Indians stone dwellings (Meinhold, 2009). They appeared around the 700A.D which best describes these buildings and includes apartment-house style communities that had good-looking stone masonry. The idea for saying such buildings were green buildings as the fact that the Anasazi had an understanding of the sun and heating, also natural ventilation and the way they capture water while stone, wood and mud were the only constituents used (Freed, 2008). These buildings constructed by the Anasazi were noticed to be totally toxins free and healthy.

Green buildings are known as structures which are intentionally planned and constructed to support the environment with consideration also to the social and economic priorities. Going green incorporates both short term and long term performance (Baumann *et. al.,* 2002). Practicing green measures as well as adopting its perception is a process that can help educate individual on sustainable way to increase

the survival of the earth. Over the last twenty years, as a global concern, the missing connection between architectural education and professional practice were literally talked about (Elnachare, 2010).

Green building construction is beyond the idea of putting together collection of recent green technologies or resources, it is rather a method in where all elements and systems related to the structure and location are reanalyzed, put together and fully used as a fragment of the whole building solution uses an average of 30% less energy compared to conventional building and material waste created throughout the building process is reduced or recycled (Shittu, 2014).

2.3.1 Advantages of green buildings

Srinivas (2019) discussed how green buildings have had a lot of advantages in India and these advantages range from the tangible benefits which consist of decreasing energy utilization from 20% to 40% alongside decreasing drinkable water utility within a range of 30% to 40% to the imperceptible gains which consist of the safety and health of the inhabitants of the building, better productivity for inhabitants, improved cosiness for the dwellers, and improved practices from the first day, by having the latest systems or skills encompassed. Furr (2019) explains the advantages of green buildings are numerous and consist of reduction in capital investments in light of accessible motivations, decrease in working expenses through diminished utilizations (use of power and water), decrease in staff costs identified with expanded profitability and labourer wellbeing, and expanded working income (net metering, higher rentals and expanded inhabitancy).

Green buildings have numerous benefits as regards to the environment, and also costs included yet the most focused on advantage might be viewed as decreased use of power and water (Srinivas, 2019) and cost advantages as focused on by Furr, (2019).

2.3.2 Limitations and risks of green buildings

According to Anderson, Bidgood and Heady (2010), green building development is not exactly same with conventional buildings, but similar to conventional construction, green projects are also accompanied with claims and disputes. They also emphasised on likely green litigation due to new inexpert entrants in the green market and the unfamiliar risks.

Bowers & Cohen, (2019) discussed that while numerous dangers of green structure / building are like the dangers of ordinary development, the adding of efficiency benchmarks/sustainability and the need to accomplish a specific degree of confirmation change the battleground generally. Additionally, they bring up the threats confronting plan experts, to be specific as Leadership in Energy and Environmental Design (LEED) licensed experts, fashioners are required to show better expectations of care, while tolerating the way that plan disappointments may bring about rebelliousness with LEED accreditation of the task and how responsibility may emerge from the disappointment of frameworks or parts to perform sufficiently over the structure's lifecycle.

2.3.3 Rating system of green building in construction industries of the world

Innovation is required in the engineering and management building designs, construction, operations and maintenance (Nduka & Sotunbo, 2014). During the lifespan of a building which consist of interconnected actions which span from

conception phase, construction and maintenance to finally decomposition, significant issues arise. As the cycle progress from stage to stage, a lot of requirements are generated which covers economic consideration, social and environmental matters from effective savings in building systems, and in agreement through standards and building codes. Thus, building evaluation structures continue to gain acceptance in assisting as a standard to assess the performance of both new and present environmental buildings (Nduka & Sotunbo, 2014).

Advances on green building practices can be traced to the UK's Building Research Establishment (BRE) which founded the preliminary assessment structure named Building Research Establishment Environmental Assessment Method (BREEAM) in the year 1990 which was preceded by the USA Green Building Council's Leadership in Energy and Environmental Design (LEED) in 1996 (Dmochoswki *et al.*, 1987). Green building concept is a global phenomenon that has been recognized by many developing and developed countries, of which Nigeria is not excluded.

Adegbile, (2013) posits that studies on green building within Nigeria have shown that Nigeria is faced with the issue of advancing execution principles, frameworks, codes and the administrative way to alleviate, thwart and to build up the fabricated climate. Laws have been promulgated by Federal Government of Nigeria to safeguard the Nigerian environment as pointed out by (Nwokoro & Onukwube, 2011). These laws according to Nwokoro and Onukwube, (2011) include; National Policy on Environment (NPE) of 1989, Environmental Impact Assessment Act of 1992 (EIA Act) and Federal Environmental Protection Agency Act of 1988 (FEPA).

Furthermore, efforts are already on ground to sustainable building by various professional bodies and private organizations. Glavic, (2007) affirmed that presence of

Green Building Council of Nigeria (GBCN) at imminent participation level with World Green Building Council. It was uncovered that the recently settled committee has not yet created an appraising device. This incited the Green Building Council of South Africa (GBCSA) to permit the appropriation of Green Star SA in rating structures forthcoming in Nigerian when Green Building Council of Nigeria (GBCN) will be set up and will have the ability to create & work its personal assessment framework.

Gou (2016), features a few nations that have founded green rating guidelines and devices to incorporate Building Research Establishment Environmental Assessment Method BREEAM (UK); Green Star (AUSTRALIA); Leadership in Energy and Environmental Design LEED (USA); Comprehensive Assessment System for Building Environmental Efficiency CASBEE (JAPAN); Green Globe (CANADA); Green Mark (SINGAPORE); Greenship (INDONESIA); Hong Kong Building Environmental Assessment Method HK-BEAM (HONG KONG) and Greenhomes (INDIA). These ranking systems differs from country to country based on needs and prevailing situations.

Green Building Council (GBC) grants utilization of apparatuses in existence from different nations with negligible changes to duplicate their nearby setting or else make fresh redid devices explicitly for its market (Nduka & Sotunbo, 2014). It was highlighted that, the absence of set up institutional constructions that advances green structure mindfulness with respect to customers, inhabitants, experts in development industry and different partners, proficient ability to consolidate green structure issues and openings and monetary assets to attempt green structure plan, development and redesign (Nwokoro & Onukwube, 2011). It is worthy of mention that South African alone has formed a Green Building Council and rating system in Africa. The green

building council is recognised as Green Building Council of South Africa (GBCSA) and a ranking scheme, Green Star SA.

There are four (4) most commonly used rating system worldwide (Gou and Xie, 2016); and these includes; Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM). Green Globe and Green Star and eleven (11) additional ranking schemes utilized around the globe which are; Energy Saving, Green Mark, German Sustainable Building Certificate, Building Environmental Assessment Method (HK-BEAM), Waste Reduction and Health (EEWH), Ecology, Green Building Standard SI-5281, , Green Rating for Integrated Habitat Assessment (GRIHA),Comprehensive Assessment System for Built Environment Efficiency (CASBEE), LiderA, Haute Qualité Environnementale (HQE), 3-Star, and Green Building Certification System (GBC)

2.4 Green Building Materials (GBM)

Building material is characterized as a combination of natural or processes minerals or mixtures utilized in designing development which incorporate concrete, sand, granite, gravel, built up steel, underlying steel, sandcrete block, burned blocks, cement blocks, rooftop materials and others (Opara, 1999). Resources, contamination and execution are the broadest rules of building materials (Berge, 2010) and resources utilized by any development material incorporate every one of the unrefined energies and materials utilized from stages of its extraction to that of its removal. Contamination as mentioned above alludes to all dangerous emanations coming about because of the creation of the material, items utilized to clean and keep up the material, off-gassing from materials during their lifetime, and last burning or landfilling. Suddell, (2018) broadcasts that the construction industry is the subsequent biggest area responsible for the utilization of

green material and execution is the standard for how well the material does the work for which it was created (Milani, 2015).

Green materials and refined materials perform distinctively on the grounds that green materials will in general be more mind boggling and have diverse positive characteristics and, if accurately used, can bring an or more to the building industry through upgrading the functionality of the buildings. As soon as contrasted with customary or local materials, strategies and advancements, green materials can give energy effectiveness in buildings. Nevertheless, May (2016), preserves that not every type of green material would suit every circumstance. As opined by Albino, Balice & Dangelio (2019), a green material is one that limits natural effect all through the whole life cycle.

Nevertheless, Baumann, & Bragd, (2012) assessed that the disarray on the meaning of green materials is still there and according to Attmann (2019), a material is said to be green when it is environmentally friendly, renewable, biodegradable and recyclable and these materials can be arranged into: nano-materials, (for example, nano-carbon tubing), biomaterials (biotic materials like polyurethane, carbon, straw), smart materials, (for example, carbon-fiber) and composites (like metal, concrete). Kelly and Hunter, (2019) recommend the utilization of the three R's (re-use, recycle & reduce) as a useful and necessary in choosing the best building materials.

Building materials ordinarily viewed as "green" incorporate materials which cannot be easily exhaustible for example, bamboo (since bamboo develops rapidly) and straw, processed wood from forests ensured to be reasonably overseen, biology blocks, dimension stone, reused stone, reused metal and different items that are nontoxic, renewable, recyclable and/or reusable (Shittu, 2014). The new materials and innovation

must be more adaptable, lighter, more grounded, simpler to utilize, more strong, more energy effective and must put less strain on the natural resources than those that are accessible if their utilization is to be vindicated which can use as industrial goods recycled, such as foundry sand, coal incineration products and demolition wreckages in construction developments were suggested by Environmental Protection Agency (EPA,2016).

Improving security and wellbeing isn't just essential as far as human to decrease recipients' concern, yet as an approach to likewise certify the achievement and sustainability of the buildings, their advancement through a more extended and better term. At the point when we plan or execute a development project, we should remember a high interest for nature protection, to regard change circuit matter and energy, which become compulsory and just practical in the event that we completely embrace and regard ecological enactment on the unique nature preservation (Cazacu, 2015). The effect of development on the environment is showed mostly high energy utilization and Co_2 emissions, causing a worldwide air contamination and global warming, water pollution, production of solid waste, noise and dust (Georgescu, 2015).

The traditional architecture inferred quite a bit of their structure from the constraints of traditional materials to the ideas of nearby environment. An advanced ecological architecture should react to the cutting edge setting which is route troublesome than the one inside which the traditional builders operated (Cazacu, 2015). To diminish the environmental effects inside the sector of buildings, reusing of building materials is on the increment (Sarvesh & Chouhan, 2013). Projects are executed on a few levels and are analysed judiciously based on the financial outcomes, notwithstanding, the real environmental impacts are seldom contemplated (Sarvesh & Chouhan, 2013).

Considerable environmental profits were derivative from use of clay blocks and roofing tiles in its place of new blocks and tiles. Recycle of these materials will help considerably reduce the environmental impact from a whole building (Sarvesh & Chouhan, 2013).

Green building utilises materials that are available traditionally for energy efficiency, sustainability and durability (Akshay *et. al.*,2015). Taking a gander at the available traditional materials, lime is one of such material that lessens the temperatures of room inside by 4^{o}C to 5^{o}C when contrasted with concrete in plastering work and the use of lime in construction can help retains carbon instead of discharging it which help to diminish unsafe effect on environment (Ashish, 2012).

Green building materials lessens results on climate to make proficient sustainable structure and furthermore, reduce the pollution content on the environment resources depletion, greenhouse gas emission, soil contamination, ozone depletion and health hazards. Subsequently, there is an inclination to utilize green building materials for the better tomorrow and healthy life of coming age (Gupta, 2016). Utilizing green structural materials and items advances protection of waning non-sustainable resources, which by coordinating these materials into development ventures can help alleviate the ecological effects related with the extraction, transportation, handling, creation, establishment, recycling, reuse and removal of construction industry source materials (Geeta *et. al.*, 2014).

Studies has shown that indigenous materials like stone, grasses, mud, cow composts, bamboo, leaves reeds among others were utilized for development of different structures in Nigeria and these materials are promptly accessible in large quantity yet their utilization has been on decrease because of preference for imported building

materials which are created with negligence for the climatic sustainability of Nigeria and higher price consequence (Odeyale & Adekunle, 2008). It is believed that living in timber, stone or brick structures denotes adverse poverty which brought about detestation for these green building materials and the thirst for civilized structures without bearing in mind our background has not helped us to view thing deeply and advance our home-grown building materials instead of looking for overseas materials (Odeyale & Adekunle, 2008). Bountiful stores of laterite, clay, lime, stone, wood, agro-industrial waste, glass sand and bitumen in their regular or normal state in Nigeria supplements the require the utilization of these green building materials for building development purposes (Kayode & Olusegun, 2013).

Investigations has exposed that these materials have been discovered valuable in the building construction industry (Kayode & Olusegun, 2013). It emphasised that the drawback found in giving lodging to the low income through their own endeavours was because of the higher expense of the building materials which can be followed to high rates of imported materials utilized for development that has pulled in much expense compared to the indigenous building materials (Kayode & Olusegun, 2013). There is varied alternative building material that can fill the need and need of the imported materials if legitimate information and consolation were given to the Nigerian resident by the government (Kayode & Olusegun, 2013).

Most of buildings within Northern part of Nigeria are still built with the use of sustainable old-style materials and techniques, materials such as bamboo and timber (Amal & Halil, 2017). In recent years, there has been an increase use of modern techniques for building development, driven by a scope of elements including demands for snappy development, the sustainability of development and deficiency of talented

work. Over the most recent fifteen years, there has been an upswing of interest in common and eccentric development materials (Amal & Halil, 2017).

GBM also referred to as sustainable traditional building materials cut the cost of the overall construction by an easier construction method, low transportation costs and lower economic demands. A structure that can be used for a very long time reflects a flexible design, which avoids the negative impact involved in tearing down an existing building and rebuilding a new one (Akeju, 2007). GBM are sustainable, renewable, cheap and available everywhere. Use of these materials in new construction techniques will enhance energy efficiency in sustainability and reduce cost of construction (Amal & Halil, 2017). Modernization and innovation implemented to meet current building standards and living conditions are posing threat to make the green building materials extinct but sustainable and green building awareness provides green building materials to be used as a result of locally accessible resources/materials that match the need of the local condition in a cost effective manner (Amal & Halil, 2017).

2.4.1 Available GBM within the NCI

1. Timber: Timber was and is promptly accessible and copious. All the more along these lines, bamboo and other timberland assets like ropes, forked wood for structures were in bountiful, consequently, the expense of backwoods building materials assets were generally less expensive. Redeemable was privately carried out, preparing was finished with the assistance of a couple and workmanship on that could without a doubt manage with them were promptly accessible and open (Horman *et al.,* 2006).

2. Stone: Stone is utilized for dividers, floors, curves and rooftops. Developing stones have high fortitude, strength, warm mass. It can without much of a stretch be reused. The utilization of stone as a enclosing substance was disagreeable in the Nigerian

Traditional Architecture in the pre-frontier period because of the way that instrument utilized for cutting and the holding materials for stone were not promptly accessible (Odeyale and Adekunle, 2008).

3. Clay and mud: as indicated by Odeyale & Adekunle, (2008) these were the boss and commonest walling materials of customary design. Mud is the most established normal structure materials. It comprises of a combination of earth, sand, and residue. It might likewise contain coarser particles (rock) or natural material. The most widely recognized approach to utilize earth in the development is as dirt blocks or mud through smashing.

4. Grasses: Grasses can be located in the North-central and core Northern area richly with the end goal of development in Nigerian Traditional Architecture. The sort of grasses accessible in a territory relies upon the climatic area, shrubbery and proximity to source of water. Southward of the North-central locale, elephant grasslands were normal; even in the Northern piece of Eastern, Mid – Western and South Western area; on the other hand in the North-central and Northern district, spare grasslands were exceptionally normal (Jolaoso,2001; Bourne,1981; Hendrickson, 2000; Encarta,2005).

5. Wild coconut tree: This stringy tree is discovered basically in the savannah area (Middle Belt) of Nigeria. It created great primary part for root, divider lintel, roof and extensions development. It is additionally utilized as overlay for latrine pits. In contrast to wood, it is a termite opposition primary and don't effectively rot except if exposed to significant stretch of clamminess (Oyegiri & Ugochukwu, 2016; Horman *et al.*, 2006).

6. Bamboo: This pole – like design was generally utilized in development primary individuals from divider, rooftops, floors and roof so additionally in fence development which was regularly found in South west piece of Nigeria. Bamboo has higher rigidity

than steel since its strands run pivotally. It is practical and simple to utilize. It is heat proof and has low weight. It additionally has high carbon sequestration limits (Oyegiri & Ugochukwu, 2016).

7. Leaves and back of trees: In the rainforest, some deciduous trees have expansive and huge leaves (like Gbodogi leaves and "Ebi–eni") and bark that could be utilized as rooftop coverSome leaves could be too be utilized for divider completes for example Indigo (Dmochoswki, 1987; Jolaoso, 1991).

2.4.2 Advantages of GBM

GBM are said to be materials that reduce the environmental impact due to construction activities thereby creating a balanced environment for living. The International Journal of Research in Chemical, Metallurgical and Civil Engineering (IJRCMCE, 2016) discussed the advantages of GBM as seen in table 2.1.

Table 2.1 Advantages of GBM

S/No	Advantages	Discussion
1.	Availability	GBM are bountiful in nature and these materials incorporate earth, stone, cover, coconut fiber. Earth building innovation includes the utilization of laterite and loamy soil that are accessible in bountiful stock on the whole piece of the mainland. Earth has been utilized by our dads and front dads to raise structures, here and there up to two story high without expansion of some other supporting materials and the vast majority of them are as yet remaining till date.
2.	Affordability	The significant explanation behind significant expense of imported structure materials in Africa incorporates

		significant expense of importation and general expansion. In light of significant expense of these imported structure materials, the low pay workers think that its hard to develop their own homes or even lease a good house. The accessibility of these GBM makes the value moderate and offers the low pay workers the chance to build their own homes.
3.	Energy Efficiency	Natural defensive measures guarantee decrease of operational energy in development. Studies as indicated by Iwuagwu and Azubuine, (2015) uncovered that the structure areas burn-through more than 33% of the world's energy, and add to an Earth-wide temperature boost. A GBM of earth emanates less ozone depleting substances, devours less energy, and keeps an undeniable degree of inner warm solace paying little heed to winning sun-oriented radiation outside (Iwuagwu and Azubuine, 2015).
4.	Ozone Friendly	The built environment contributes at last to a worldwide temperature alteration by its high paces of ozone depleting substances discharge through energy use (for cooling, warming, and lighting) and development. GBM projects a chance of all out decrease to a close to zero fossil fuel byproduct of structures. GBM are eco-accommodating, environment responsive and natural defensive measures to shield and also limit ecological effect. The warm protection, energy saving, etcetera of GBM decreases negative ecological effect. The vicinity of materials saves cost and lessens contamination by fuel consuming transportation.
5.	Reusability	Reusability is a component of the strength and age of a material. Entirely sturdy materials may have abundant helpful long stretches of management left when the

		structure in which they are presented is neutralized, and could be efficiently separated and reinstalled in an alternative site. Windows and entryways, even brick can be effectively reused. Lumber from old outer buildings has gotten popular as a recovered material for new development.
6.	Biodegradability	The biodegradability of a material refers to its competence to ordinarily disintegrate when discarded. Natural materials can return to the earth rapidly, while others, like steel, take a long time. A huge idea is whether the material being alluded to will convey dangerous materials as it breaks down, either alone or in blend in with various substances. GBM display this trademark and a portion of these materials incorporate earth, cover, bamboo, wood etcetera.

2.4.3 Challenges of GBM.

GBM mostly faces the following challenges as discussed by Onyegiri & Ugochukwu, 2016;

1. Acceptability: The eventual fate of any design relies upon the degree to which it is satisfactory to individuals for whom it is proposed. The thought that structures of GBM are unsatisfactory is the primary snag to the improvement of a real African engineering that is genuinely native to individuals. Maybe issue of agreeableness has brought annihilation of conventional qualities and their supplanting with outsider ones.
2. Durability/Low strength: The most widely recognized issue of houses worked with GBM was the low strength of the houses, inferring that the locally accessible materials have strength that is underneath standard when contrasted

and strength of the designs worked with ordinary materials like concrete, solid, steel, among others. The strength of each house is significant on the grounds that it decides the sturdiness and security of the house. This is reliable with the perspective on McIntyre *et al.*, (2009) that one of the disadvantages for utilizing earth alone as a material for development is its solidness which is firmly identified with its compressive strength. Reza et al., (2011) further clarified that most soil in their regular condition come up short on the strength, soundness and toughness needed for building development. This infers that the nearby materials for developing houses come up short on the ideal fortitude and improvement of their solidarity properties would be gainful to the clients.

3. Building tall: The nature and strength of these GBM make it incomprehensible for building tall. They support low ascent structures prompting over utilization of land. A huge number of sections of land of land in Africa have structures developed on them. For example, spread of structures require the development of new streets, waste, utility shafts, and other foundation, which lead to the obliteration territory, land aggravation and disintegration, natural contamination, an unnatural weather change among other.
4. Deforestation: The building materials sources in Africa add to reliable issue of deforestation on the mainland. At the point when lumber for development is reaped, by and large, trees are not planted to supplant the collected ones. Whenever replanted, the pace of substitution is far lower than the pace of utilization.
5. Civilization: Local and native societies have polished reasonable asset use because of their functional experience and human reliance on earth's life emotionally supportive networks. Conventional people group consolidated

structures into the regular habitat regarding satisfactory utilization of savvy and effectively assessable GBM for development and upkeep. Be that as it may, importation and the utilization of imported structure materials has put the African customary and feasible method of building and development measures in harm's way, subsequently consigning our engineering.

6. Frequent Maintenance: Frequent upkeep of houses worked with GBM particularly earth, is another test confronting African design. As per Rumana, (2007) there is high support needs for earthen plinth and dividers which are frequently put, particularly during the wet season. This is because of the low strength of the materials that make it a prerequisite for the successive upkeep to keep the building is acceptable condition for use. On the off chance that the houses worked with nearby materials are not looked after routinely, they will disintegrate in around couple of years after their development because of their weakness to climate like downpour and tempest.

2.4.4 Drivers of GBM uptake

With regards to green building, drivers are variable which inspire the appropriation of many green building practices and can incorporate the potential advantages or choices or activities which convince individuals to take part in execution of green building (Darko *et al.,* 2017). Drivers differs from region to region and they have positive and enabling effects on adoption of green materials (Andelin *et al.,*2015; Ayarkwa *et al.,* 2017)

Many drivers for change influence the move toward green materials uptake in the construction industry (Morgan and Krejere, 1970). Yudelson (2010) outlined drivers for green building materials, other than monetary performance to include:

i. Recruitment and maintenance of key workers,

ii. Marketing benefits, particularly for designers and building proprietors

iii. Utility cost investment funds for water and energy.

iv. Cost of Maintenance decreases.

v. Increased esteem from higher net working pay (NOI), because of higher fees and more noteworthy inhabitance in confirmed structures.

vi. Increased occupier profitability, because of improved soundness of occupants, and diminished non-attendance.

vii. Demonstration of obligation to manageability and ecological

viii. Public connection benefits, particularly for engineers, building proprietors, and directors.

Financial motivating forces have likewise been recognized as one of the drivers conquering the difficulties confronting the selection of sustainable construction (Oke *et al.,* 2019). It was recommended that the public authority ought to give motivations that are very much organized through the presentation of duty impetuses and sponsorships to development firms like shortage appropriations, monetary limits, and pre-charge credits to empower the development firms get together with green development rehearses (Shi et al., 2013; Oke et al., 2019). Wang et al., (2014) tracked down that public authority should give inspirations in executing green development rehearses. This can be through strategy improvement like standard enactment rules and appraisal frameworks. As indicated by Khalfan et al., (2015), the high beginning up costs of economic structures normally deter partners from leaving on ventures and using green materials.

The client plays a very critical role in the drive towards green construction (Abidin & Pasquire, 2005), thus, the utilization of GBM (client demands) are central to the implementation of green building materials (Häkkinen & Belloni, 2011). There is an unswerving connection between cost, knowledge, methods, supply and value with

client's demands (Oke *et al.,* 2019). Similarly, Niroumand *et al.,* (2013) and Udawatta *et al.,* (2015) uncovered that customers request and mindfulness are straightforwardly related to education and preparing in the search while in transit to tolerating Sustainable development rehearses.

In the investigation of the drivers of Sustainable Construction Practices in the Zambian Construction Industry, Oke et al., (2019) tracked down that the significant drivers of green and economical development are; connecting research to implementers, enactment/legitimate necessity, building guidelines, advocacy and mindfulness, creating administrative systems, and clients request. Oke et al., (2019) uncovered that financial motivator isn't positioned among the top driver, it actually has a high mean worth, which suggests that it is similarly significant in the pursuit of achieving reasonable development. Muhammad *et al.,* (2008) gauge the profitability benefits from ecologically feasible structure plans to be just about as much as multiple times the energy reserve funds from green efforts.

Wilkinson & Ang (2008), opined that regulation is the instrument government utilizes to drive the market in the direction of more energy-efficient buildings. There is a very solid environmental focus and sustainability policy by companies. His is at the focal piece of their business, that drives them to involve a green structure. Smith and Baird (2007) tracked down that "rising energy costs" is one of the vital drivers for manageable structures. In spite of the fact that as per the Green Building Council of Australia (2008), inhabitants have gotten less centered around investment funds in working expenses, and are setting a higher worth on the theoretical advantages, similar to efficiency, maintenance and staff fascination, non-appearance and diminished debilitated leave.

Table 2.2 is summary of the identified drivers of green building materials in the construction industry.

Table 2.2 Drivers of GBM

S/N	Drivers of GBM	Source										
		Oke *et al.*, (2019), Darko *et al.*, (2017)	Shi *et al.*, *(2013)*, Wang *et al.*, (2014)	Darko *et al.*, (2017)	Alsana. (2015), Darko *et al.*, (2017)	Häkkinen and Belloni, (2011)	Abidin and Pasquire, (2005)	Khalfan *et al.*, (2015)	Ang and Wilkinson, (2008)	Yudelson, (2010)	Oke *et al.*, (2019), Alsana, (2015) Darko *et al.*, (2017)	
1.	Advocacy and awareness	✓										
2.	Strengthening implementing mechanisms	✓										
3.	Economic incentives		✓									
4.	Planning policy			✓								
5.	Legislation / Legal Requirement	✓										
6.	Construction standards				✓							
7.	Creation of technologies to mitigate impacts	✓										
8.	Educational programs	✓										
9.	Creating regional centres of excellence	✓										
10.	Green design guidelines and					✓						
11.	Reputation / Image	✓										
12.	Knowledge sharing	✓										
13.	Building regulations	✓										
14.	Client Demand						✓					
15.	Cost reduction							✓				
16.	Changing the construction process											
17.	Attract and retain good employees											
18.	Clarification of roles and responsibilities											
19.	Benchmarking and assessment											
20.	Financial incentives		✓									
21.	Developing regulatory mechanisms								✓			
22.	Resource efficiency									✓		
23.	To reduce the lifecycle costs of buildings	✓										
24.	Competitive Advantage	✓										
25.	Educational programs	✓									✓	
26.	Linking research to implementers											
27.	Creation of technologies of the future										✓	
28.	Set rules and legislations				✓							

(Source: Literature Review)

2.4.5 Barriers to the adoption of GBM

The adoption and implementation of environmentally friendly constructions are usually hindered by a lot of challenges and barriers. It was submitted by Miranda and Marulanda (2001) that the major challenge of green construction adoption is increase in project cost, especially in Peru. This assumption may have been made without detailed evaluation of the lifecycle cost of the building, which is a 'lazy view' of the concept (Aghimien *et al.*, 2018; Aigbavboa *et al*., 2017). This view held in peru is usually common among developing counties with weak construction practices (Lowe & Zhou, 2003). Perceived high cost of going green has been top among the factors considered as hindering the green building material incorporation in buildings.

Economics and financial considerations have been blamed for the low pace or even non-adoption of green building technology in most countries, especially in Malaysia, and China (Kibert, 2008; Isa *et al,* 2013; Zhang *et al.*, 2011). Green buildings are feared to be more expensive and can amount to greater investment cost when associated to traditional construction (Hakkinen & Belloni, 2011). In Nigeria and Ghana, financial issues have been observed to be the main issues to the adoption of green building (Aghimien *et al.,* 2018; Ayarkwa *et al.,* 2017). Similarly, in South Africa, Seeliger and Turok (2015) revealed that developers are conscious of the short-term financial impact and implication of going green; but are optimistic that it has a long-term financial benefit.

Surprisingly, the barriers hindering green building construction is a menace to both developing and developed countries. For instance, in advanced nations, Ahn *et al*., (2013) in US, identified the five (5) major barricades or hindrances against green building to be extended reimbursement periods, first cost premium, propensity of sustaining existing applications, inadequate skills and knowledge of the subcontractors,

and much more expenses associated with green materials and products. Nkoli., (2011) acknowledged the most serious hindrances affecting Green building technology adoption in the United State as refusal to change, absence of awareness and knowledge, more expenditure on green buildings, nonexistence of expert opinion, and absence of government enticements. Similar finding was also reported by studies in the United State revisions on the hinderances to green building expansion and their reports where related and similar (Rodriguez-Nikl *et al.,* 2015; Darko *et al.,* 2017).

In Singapore, the critical barriers to green building project management as reported by Hwang and Tan (2012) and Hwang and Ng (2013) include; lack of research, higher prices of green equipment and materials, absence of interest and communication between project team members, lengthy preconstruction process, market demand and absence of curiosity from consumers, alongside vagueness of green materials and equipment. Furthermore, preliminary expenses and absence of government sustenance tops the 3 factors limiting going green in Singapore (Hwang *et al.*, 2017; Ofori & Kien, 2004).

Incorporating green specifications in construction have been limited by barriers accessibility of dependable green providers, additional expenses as well as delays instigated by green requirements, and inadequate knowledge in Kong Hong (Lam *et al*., 2009). In a similar but separate study in Hong Kong, Zhang *et al.*, (2012) identified the highest hindrances to wide-ranging adoption of green roof system as absence of government enticements and preferment as well as higher cost of maintenance. Higher upfront expenses, and absence of awareness, nonexistence of enticements and deficiency in education, are the common significant hindering factors to green building in Singapore and Hong Kong based on designer's views (Chan *et al.,* (2009). Studies

which focused on Hong Kong with similar findings on green buildings exist (Gou *et al.,* 2013; Qian *et al.,* 2015).

According to Ogunbiyi *et al.,* (2013); Love *et al*., (2012); Tagaza & Wilson, (2004), in Australia along with New Zealand, the key barriers to green building adoption and execution are; cost and absence of information, absence of knowledge and experience, absence of government incentives, nonexistence of building guidelines and codes, poor association amongst stakeholders, risks and uncertainties involved, higher costs of green materials, unfamiliarity with Green technology, long Green building execution time, lengthy planning and approval process for new green building technology.

Williams & Dair (2007) posits that the top five (5) of the twelve (12) impediments to sustainable building in England were price, absence of request from customers, absence of sustainable products and materials, deficiency of awareness and information, coupled with insufficient expert opinion. In Ireland, Winston (2010) discovered that derisory building guidelines and restricted information and expert opinion were blockades that hamper sustainable housing advancement. Major hindrances recognized by Chinese and Malaysian revisions involved, but were not restricted to, deficiency of expert opinion and knowledge, absence of market request, non-existence of green building guidelines and codes, absence of enticements, finally, absence of information and catalogues.

It is essential to better comprehend the hindrances facing Green building and materials acceptance and implementation in particular nations (Aktas & Ozorhon, 2015). Which is expected to support the hard work to checkmate the impediments and encourage the acceptance of green building materials in Nigeria. The Table 2.3 below shows the summary of the barriers to the adoption of green building materials in construction.

Table 2.3 Barriers to GBM Adoption

S/N	Drivers of GBM	Source																									
		Ahn *et al*., (2013), Chan *et al*., (2018), Love *et al*., (2012),	Hwang and Tan (2012), Chan *et al*., (2018),	Chan *et al*., (2018), Abraham and Gundimeda (2018)	Luthra *et al*., (2015), Winston (2010), Williams and Dair (2007).	Gou *et al*., (2013), Darko and Chan (2016), Djotoko *et al*., (2014)	Abraham and Gundimeda (2018), Shi *et al*., (2013), Hwang and Ng (2013).	Chan *et al*., (2018), Darko *et al*., (2017)	Bond (2010), Rodriguez-Nikl *et al*., (2015), Ogunka and Yang (2013), Bin Esa *et al*., (2011), Samari *et al*., (2013)	Chan *et al*., (2018), Darko *et al*., (2017)	Love *et al*., (2012), Darko and Chan (2016), Kubert *et al*., (2013), Chan *et al*., (2018), Abraham and Gundimeda (2018)	Winston (2010), Love *et al*., (2012), Luthra *et al*., (2015), Samari *et al*., (2013), AlSanad (2015)	Hwang and Tan (2012), Williams and Dair (2007), Winston (2010),	Chan et al. (2018), Darko *et al*., (2017), Abraham and Gundimeda (2018)	Du *et al*., (2014), Darko and Chan (2016), Abraham and Gundimeda (2018)	Abraham and Gundimeda (2018), Gou *et al*., (2013), Oladun., (2012)	Djokoto *et al*. (2014), Gou *et al*., (2013)	Ahn *et al*., (2013), Du *et al*., (2014), Chan et al. (2018), Darko *et al*., (2017), Abraham and Gundimeda (2018)	Zhang *et al*., (2012), Luthra *et al*., (2015), Abraham and Gundimeda (2018), Zhang et al. (2012), Samari *et al*., (2013), Djokoto *et al*., (2014), Abraham and Gundimeda (2018) Rics *et al*., (2010), Davies and Davies (2017)	Zhang et al. (2012), Samari *et al*., (2013), Djokoto *et al*., (2014), Abraham and Gundimeda (2018)	Chan *et al*., (2018), Darko and Chan (2016)	Lam et al. (2009), Shi *et al*., (2013), Gou *et al*., (2013)	Hwang and Tan (2012), Hwang and Ng (2013), Chan *et al*., (2018), Abraham and Gundimeda (2018)	Abraham and Gundimeda (2018), Chan *et al*., (2018)	Ahn et al. (2013), Abraham and Gundimeda (2018), Gou *et al*., (2013)	Djokoto et al. (2014), Shi *et al*., (2013), Darko *et al*., (2017), Davies and Robson, (2005), Chan *et al*., (2018), Zhang *et al*., (2011), Hwang and Tan (2012), Abraham and Gundimeda, (2018)	Love at al. (2012), Chan *et al*., (2003), Abraham and Gundimeda (2018)
1.	Absence of professional knowledge and proficiency in green building	✓																									
2.	Non-existence of local institutes and facilities for research and advancement (R&D) of GB		✓																								
3.	Absence of green building rating systems and labelling programs			✓																							
4.	High degree of distrust about GBTs				✓																						
5.	Absence of interest from clients and market request					✓																					
6.	Implementation of Green Building technology consumes a lot of time and causes project interruptions						✓																				
7.	Lack of demonstration projects							✓																			
8.	Absence of Green Building databases and information								✓																		

9.	Deficiency in awareness of Green building and its profits	✓
10.	Absence of government incentives	✓
11.	Absence of green building codes and regulations	✓
12.	Conflicts of interests between several stakeholders in adopting GBTs	✓
13.	Construction professionals are unfamiliarity with GBTs	✓
14.	Absence of importance attached to GBTs by senior management	✓
15.	Unavailability of Green building technology in the local market	✓
16.	Non-existence of green building technological training for project staff	✓
17.	Confrontation to transformation from the usage of native technologies	✓
18.	Absence of funding systems (e.g, bank loans)	✓
19.	Deficiency of Green building promotion by government	✓
20.	Higher rental and market charges of green buildings as a result from GBTs use instead	✓
21.	Unavailability of Green building technology suppliers	✓
22.	Compound and inflexible requirements involved in accepting GBTs	✓
23.	Risks & uncertainties associated in accepting new technologies	✓
24.	Lengthy remuneration periods from adopting GBTs	✓
25.	Higher costs of Green building construction	✓
26.	Inadequate knowledge with the usage of non-traditional procurement procedures	✓

(Source: Literature Review)

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Research Design

The research design is a defined strategy or a step by step plan on how the study will be executed. According to Okoko (2002), research design is a framework that guides researcher(s) in realizing the aim of the research. Research design is the validation, analysis and interpretation of data. For the purpose of this investigative study, the research design that was adopted was a mixed method design.

Johnson, Onwuegbuzie & Turner in 2007 opined that mixed methods research design is a kind of design where a researcher or group of researchers combine essential ingredients of qualitative and quantitative research approaches – "for example, use of qualitative and quantitative viewpoints, data collection, analysis, and inference techniques" to get a wide understanding and corroboration with breadth and depth. A significant advantage of mixed-method research is that outcome can be revealed (quantitatively) and explained why it was obtained (qualitatively). Quantitative data was gotten from descriptive survey research from 156 respondents that involves using questionnaires to try to find information from construction professionals in both private and public organisations. Qualitative data on the other hand was obtained from interviews conducted on 30 Construction Professionals in both private and public Organisations on the issue of appraising green building materials within the construction industry in Nigeria. Mixed method research design is considered appropriate with respect to this research since data was acquired from a large population and a group of people so as to aid the achievement of the research aim of appraising green building materials within the construction industry in Nigeria, with the view of suggesting a veritable strategy for its uptake in the construction industry of Nigeria.

3.2 Study Population

Population is the number of people, objects or occurrences that have similar observable features (Mugenda & Mugenda, 2003). In other word, it is the totality of the objects, individuals, and/or events; that meet the set criteria for inclusion in a research for the aim to be met (Oladun, 2012). Inferences are drawn from the characteristics of the population. For this study, the population are construction professionals both in public and private organisations in Abuja metropolis. Also, the property management experts (owners and managers) who are possess requisite knowledge on construction matters and understand the green process will be considered. These experts are registered Architects, Engineers, Builders, and Quantity surveyors practicing in public and private organisations in Abuja, Nigeria. Abuja is the administrative headquarters of Nigeria and there are several building development going on (Onyeagam *et al.*, 2019). Abuja is also one of the major metropolitan cities in the country having one of the largest construction based experts working either in consulting or constructing companies in the built environment (Saidu & Shakantu, 2016); Abuja is undoubtedly suitable for the study. The reason for considering property managers/owners is based on the fact that the efforts on green buildings and sustainable environment are targeted toward the housing sector, in which the populace are the beneficiaries. Thus, when they are aware of the drivers, barriers, and importance of incorporating green materials in their construction operations, sustainability and green housing would be achieved. The population of this study is 10,995 as shown in table 3.1

3.3 Sampling Frame

According to Cooper and Schindler (2014), an institution, professional, individuals, organisation, list of locations, associations, ministries/organisation and additional components from which samples are gotten is called Sample frame. A list of

construction professionals was gotten from the catalogue of the following professional associations in Abuja; Nigerian Institute of Building (NIOB), Nigerian Society of Engineer (NSE), Nigerian Institute of Architects (NIA), and Nigerian Institute of Quantity Surveyors (NIQS). The population of property owners/managers were determined through a preliminary study. The elements in Table 3.1 below shows the list of the professionals.

Table 3.1: Sample Frame of Respondents

Item No.	Respondent	Population
1	Architects (NIA)	600
2	Builders (NIOB)	606
3	Engineers (NSE)	7875
4	Quantity surveyors (NIQS)	1267
5	Property owners/ managers	647
	Total	**10,995**

(Source: Federation of Construction Industry, Nigeria 2018)

3.4 Sample Size

Samples size is a given portion of the population from which information for analysis are obtained (Nkolo, 2011). It has a relationship with the population, and large representative samples is better (Cooper & Schindler 2014). For this study, the sample size was gotten with the formula from Morgan and Krejcie (1970) with a confidence level of 95%, and it found to be 372

$$s = X^2 NP(1 - P) \div d^2 (N - 1) + X^2 P(1 - P) \quad (3.1)$$

Where;

s = sample size from finite population

P = Estimated variance of the Population (which is the average of the squared differences from the mean is given as a decimal (i.e., 0.5 for this study)

X = based on confidence level 1.96 for 95% confidence was used for this study

N= total populations, 10,995

d = Precision desired, expressed as a decimal (i.e., 0.05 for 5% used for this study

$$= \frac{1.96^2 \text{ x } 10{,}995 \text{ x } 0.5 \text{ x } (1\text{-}0.5)}{(0.05^2 \text{ x } (10{,}995 - 1) + 1.96^2 \text{ x } 0.5 \text{ x } (1\text{-}0.5))}$$

$$= \frac{10559.598}{(27.485 + 0.9604)}$$

$$= \frac{10559.598}{28.4454} \quad ;$$

s = 371.2234

Therefore, s = 372

Based on the sample size gotten, a total of 372 questionnaires were circulated as the study progressed, 161 questionnaires were retrieved from the total of 372 and the remaining 211 questionnaires were not retrieved due to absence and reluctance of the respondents. Out of the 161 questionnaires retrieved, 5 were discarded as a result of wrong and incomplete responses, thus making only 156 available to be analysed. This represents an effective response rate of 41.94%. The response rate is considered suitable as suggested by construction based studies. According to Moser & Kalton, 1999; Akintoye, 2000, “a response rate above 20-30% response rate is perfect for impartial construction based survey”. Thus, 41.94% is adequate response rate for this study.

3.5 Sampling Technique

Sampling technique is the strategy used to select respondents for the study (Oladun, 2012). It allows for studying a certain proportion of the population. According to Morenikeji (2006), the categories of quota sampling techniques include simple sampling, systematic, clustering random and stratified sampling. This study employed a

simple random sampling technique in the questionnaire administration of the and data collection. This method was employed so as to give the samples equal likelihoods of being chosen. Primary data used for the analysis were collected by means of well-structured questionnaires.

3.6 Data Collection Instrument

This study used questionnaires and well-structured interview for the collection of primary data from the target respondents. Structure interview was used solely for the purpose of having more information to back each objective. Questionnaire administration is an organized method used in obtaining data based on samples (Tan, 2011); and its being used generally to solicit views on surveys based on green building from construction professionals (Xue *et al.*, 2016; Zhu *et al.*, 2017). This questionnaire comprises a well-written structured list of questions to which corresponding responses were supplied by the respondents (self-report). The questionnaire was structured to reflect the main theme of the study interest, thus, relevant data for solving problem of the study. It comprises tables and checkboxes for easy choice making from available options to respondents. The questionnaire inquired on a Likert scale with 5-points were 5 was the highest of the ranking. According to Manu (2015), likert scale reduces uncertainty and it is easy to use (Section B of the Questionnaire).

3.7 Data Collection Procedure

The data used for the analysis were collected through self-administration of questionnaires using simple random sampling techniques. These questionnaires were administered to construction professionals in both public works organisations, private construction and consultant's organisations within the study area. Structured interview was used for this research which comprises of a sequence of pre-determined enquiries

that all interviewees responded to in the same order. In order to acquire the vital information, the researcher ensures that there is one on one conversation with the targeted respondents. Every interview question was guided to be an open-end question so as to let the respondents to liberally express their views.

The researcher ensured 3 Architects (NIA), 3 Builders (NIOB), 2 Engineers (NSE) and 2 Quantity surveyors (NIQS) were interviewed from both public and private construction firms, making a total of 10 interviewees with each participant partaking in the exercise three times in their individual offices. Each session lasted roughly 40 minutes. In order to acquire relevant information for the study, the researcher ensures that top official of all the construction firms are interviewed. The interview lasted for three (3) weeks to confirm adequate information is being retrieved from the respondent. The entire responses of interviewees were recorded and write out. Subsequently, the resulting information was qualitatively analysed

3.8 Pilot Study

Before the actual data collection, piloting of questionnaires was done in Gwarimpa area of Abuja using 20 respondents, the final draft founded on the response from the pilot survey. This was to find out and ensure that the respondents understand the contents of the questionnaire. The result shows a high level of awareness and adoption of green building materials.

3.9 Method of Data Analysis

The method used to analyse data collected was descriptive statistics. Descriptive statistics such as percentages, means item score, relative important index; were all used to present, analyse and rank the variables. Respondents' general information was analysed through percentage. Tables as well as charts were used to present the result of

the analysis. Mean item score and percentages with correlation were used to analyse and rank variables in objectives 1 to check if the awareness level and adoption of green materials within the Nigerian construction industry is adequate.

Mean item score formula used for this study is written thus

$$\text{Mean Item score (MIS)} = \frac{5n_5 + 4n_4 + 3n_4 + 2n_2 + 1n_1}{n_5 + n_4 + n_3 + n_2 + n_1} \quad (3.2)$$

Objective two (2) which is to determine the drivers of GBM adoption; Objective three (3) which is to examine the barriers to the adoption of GBM, and objective four (4) which is to propose strategies for improving the uptake of GBM were analysed by means of relative importance index (RII) find out if the afore mentioned objectives were achieved.

Zbigniew, (1990) posit that once the score gotten by the target respondents are added up, the relative importance index (RII) can be calculated using the Relative Important Index formula; written thus

$$\text{Relative Important Index (RII)} = \frac{\sum P_i U_i}{A \times N} \quad (3.3)$$

Where;

A = highest weighting (i.e. 5 used in this study)

N = Sample size

P_i = respondent rating of variables,

U_i = Number of respondents placing identical weighting/rating on variables

This study adopted the following limit point for establishing the level of importance, satisfaction, significance and / or severity of factors using relative frequency (or percentage) index:

1) (0-20%) - Very Low
2) (21-40%) - Low

3) (41-60%) - Average

4) (61-80%) – High, and

5) (81-100%) - Very High

Agresti A. (2016).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Basic Information of Respondents

Result of the investigation on the overall statistics about the respondents presented in Table 4.1 revealed that 60.26% of them work with private individuals or within private establishments on the other hand 39.74% work for public establishments and individuals. Representation based on profession, shows that, 19.87% are architects, 16.03% are builders, 28.21% are engineers, and 35.90% are quantity surveyors. In terms of their years of experience, they have an average work experience of 9.18%.

As regarded academic qualification of the respondents, 13.46% of them had a HND, 19.23% had a PGD, 33.97% had BSc/B.Tech, 30.13% had a Master degree, and only about 3.21% of them had a doctoral degree. Additionally, their professional status shows that, 16.03% are MNIA, 12.18% are MNIOB, 25.64% are MNSE, 31.41% are MNIQS and finally about 14.74% are either graduate members or probationer members. In terms of level of involvement in projects where green building materials were incorporated, 86.54% indicated ‘yes’ and 13.46% indicated ‘No’. The result displayed in this segment illustrates that the experience required was possessed by the respondents and were educated enough to take active part and give dependable information that will help achieve the aim of this study.

Furthermore, ten (10) interviewees based on their years of experience of at least 10 to 15 years, profession with registration with relevant/related professional association and possible involvement in sustainable construction were interviewed to provide appropriate/valid responses and to ascertain some findings gotten from the

Table 4.1: General Information of Respondents

administration of questionnaires. The general information on the interviewees is revealed in Table 4.2.

Category	Classification	Freq.	Percent(%)	Cumm. Percent(%)
Organizational category	Public organisations	62	39.74	39.74
	Private organisations	94	60.26	100.00
	TOTAL	**156**	**100**	
Profession of respondents	Architects	31	19.87	19.87
	Builder	25	16.03	35.90
	Engineer	44	28.21	64.10
	Quantity Surveyor	56	35.90	100.00
	TOTAL	**156**	**100**	
Years of experience	1 to 5 years	24	15.38	15.38
	5 to 10 years	67	42.95	58.33
	11 to 15 years	40	25.64	83.97
	16 to 20 years	11	7.05	91.03
	20 years and above	14	8.97	100.00
	TOTAL	**156**	**100**	
Academic Qualification	OND		0.00	0.00
	HND	21	13.46	13.46
	PGD	30	19.23%	32.69
	Bsc/Btech	53	33.97%	66.67
	Master degree	47	30.13%	96.79
	Doctorate degree	5	3.21%	100.00
	TOTAL	**156**	**100**	
Professional Membership	**None**	23	14.74	14.74
	MNIA	25	16.03	30.77
	MNIOB	19	12.18	42.95
	MNSE	40	25.64	68.59
	MNIQS	49	31.41	100.00
	TOTAL	**156**	**100**	
Involvement in project where green building materials where incorporated	Yes	135	86.54	86.54
	No	21	13.46	100.00
	TOTAL	**156**	**100**	

Table 4.2: General Information of Interviewees

Category	Classification	Freq.	Percent	Cumm. Percent
Organizational category	Public organisations	6	60%	60%
	Private organisations	4	40%	100.00%
	TOTAL	**10**	**100%**	
Profession of interviewees	Architects	3	30%	30%
	Builder	3	30%	60%
	Engineer	2	20%	80%
	Quantity Surveyor	2	20%	100.00%
	TOTAL	**10**	**100%**	

4.2 Reliability of Instrument

The Cronbach's Alpha Test for Reliability and validity was carried out on the collected data and the result is shown on table 4.3. Reliability of a research instrument is the measures of the accuracy and precisions of the adopted measurement procedure, this test gives the Cronbach alpha value which is not be less than 0.50 (Cooper & Emory, 1995; Binyam *et al,* 2016). For example, Zhou *et al.* (2009) was of the opinion that an alpha value of 0.7 and above implies better and higher reliability and consistency of the research instruments. The Cronbach's Alpha value of the variables established was sandwiched between the value 0.775 -0.881, with 0.823 as the achieved average, thus revealing the validity and reliability of the questionnaire and data acquired.

Table 4.3 Cronbach's Alpha Test For Reliability and validity

No	Variables Tested	Cronbach's	Nr. of

		Alpha	Items
1	Stakeholders Awareness Level And Adoption Of Green Building Material (Average Cronbach's Value reported)	0.831	20
2	Driver Of Green Building Materials Adoption In Construction	0.805	28
3	Barrier To Green Building Materials Adoption In Construction	0.775	26
4	Strategy To Improve The Uptake Of Green Building Materials	0.881	10

4.3 Stakeholders Awareness Level and Adoption of GBM in NCI

Findings on Stakeholders awareness level and adoption of green building materials were analysed as shown in Table 4.4. Under the materials from building and industrial waste: the respondents were of the view empty plastic bottles (MIS=4.66), and Worn out tyres (MIS=4.50) are prominent among the subcategory and that in terms of adoption, they are also commonly used as they were ranked first and second as shown in the table 4.4

Under the natural materials: the respondents were of the view that clay and mud (MIS=4.67) and grasses (MIS=4.06) are prominent among the subcategory and that in terms of adoption, they are also commonly used but grasses with (MIS=4.38) is ranked 1st, followed by clay and mud with (MIS=4.24).

Under the earth materials sub-category: the respondents were of the view that bricks (MIS=4.82), Stone (MIS=4.32) and Timber (MIS= 3.54) are commonly used among this subgroup. In terms of adoption, they are also of the view that the commonly used earth materials are Stone (MIS=4.31), bricks (MIS=3.88), and Timber (MIS= 3.42)

Under the criteria for materials selection; the respondents were of the opinion that waste reduction with (MIS=4.13), available and natural sourced with (MIS=3.28), and recyclability and reusability with (MIS=3.17) are the criteria for most of the selection of materials for green building. Under the adoption level, the respondents were of the view that available and natural sourced with (MIS=3.81), waste reduction with (MIS=3.63), and recyclability and reusability with (MIS=3.03) are the criteria considered for the adoption of green building materials.

Table 4.4 Stakeholders Awareness Level and Adoption of GBM in NCI

S/N	GBM and criteria for selection				
		MIS	RANK	MIS	RANK
A	**Materials from Building and**				

	industrial waste				
1	Empty plastic bottles	4.66	1st	4.40	1st
2	Worn out tyres	4.50	2nd	4.34	2nd
3	Fly ash	4.32	3rd	4.21	3rd
4	Cow dung	4.21	4th	4.01	4th
5	Rice husk	4.00	5th	3.89	5th
B	**Natural materials**				
6	Grasses	4.06	2nd	4.38	1st
7	Clay and mud	4.67	1st	4.24	2nd
8	Bamboo	3.75	3rd	3.63	3rd
9	Leaves	3.56	4th	3.51	4th
10	Coconut fibre	3.56	4th	3.47	5th
C	**Earth materials**				
11	Stone	4.32	2nd	4.31	1st
12	Bricks	4.82	1st	3.88	2nd
13	Timber	3.54	3rd	3.42	3rd
14	Trees	3.49	4th	3.40	4th
15	Lime	3.28	5th	3.20	5th
D	**Criteria for Materials Selection**				
16	Available and naturally sourced	3.28	2nd	3.81	1st
18	Waste reduction and durability	4.13	1st	3.63	2nd
17	Recyclability and reusability	3.17	3rd	3.03	3rd
19	Energy efficiency	2.68	4th	2.63	4th
20	Biodegradability and Ozone friendly	2.56	5th	2.46	5th

Correlation analysis was carried out to determine whether a significant relationship exist between Stakeholders awareness level and adoption of GBM as shown in Table 4.5. Pearson's (r) correlation was employed to achieve the correlation analysis; the strength of the relationship was specified using the r-value. Generally, a substantial connection between the variables tested was shown in the results, and in all Pvalue < 0.05.

Relationship between the awareness level and adoption shows a high correlation as the r-value as suggested by Olubunmi *et al*., (2012) in (Zhou *et al*, 2009), fell well within the range specified. A correlation coefficient (r) is noted as high when it ranges between 0.70 to 0.90 as it was suggested; and when it falls between 0.50 to 0.70, it is noted to be moderate. The correlation of the level of awareness with adoption is recorded as very high for the reason that (89.6%) suggests a positive high statistical connection amongst

the variables. Thus, as the level of awareness continues to increase, there also will be a corresponding growth in the adoption level of materials of green building. This implies that one cannot adopt a system he/she is not aware of.

Table 4.5: Simple Linear Correlation Between Adoption and Level of Awareness

	Level of Awareness	**Adoption**
Level of Awareness	1	.896**
Adoption	.896**	1

(Source: Researcher's Analysis, 2019)

** Correlation is significant at the 0.01 level (2-tailed)

Additionally, awareness level and adoption of green building was also clarified from the responses of the interviewees.

One of the Architect said:

"The green building material is significantly instrumental in the sustainability and renewability of construction work. Some of these GBM are naturally available in their locality and other places, and are well adopted especially stone, clay, bricks, bamboo, coconut shell and palm kernel shell for mixing with concrete in villages. Although the adoption of the green building has not yet been fully actualized in all construction process most especially in private construction firm. It is added that the rating of the adoption is best rank above average".

The opinion of the two builders and engineers are not far from that of the architecture, in corroboration of their opinion, they said:

"Green building material is believed to bring about sustainability as well as environment stability. Construction firm both private and public are not far from

actualizing overall adoption of green building material in their construction processes, more trending green building material are stone, clay, bricks, bamboo, coconut shell and palm kernel shell".

One of the Surveyor categorically said:

"The use of empty plastic bottles, worn out tyres, clay and mud, grasses, bricks, Stone and timber are trending in cities", more of the green building adoption will be of great beneficial and significance to the construction industry, house owner/client and general public because of its role in sustainable development". With these results, it can be inferred that the awareness level and adoption ranges from 'average to very high', with only a very few of the materials have little level of awareness and adoption. These results support the findings of Ameh, *et al.,* (2007), Glovic *et al.,* (2007) and Waniko (2014). Ameh *et al.,* (2007) confirmed that, the Nigerian construction professionals are knowledgeable about the principles of sustainability and that most sustainable information is derived from personal studies. Similarly, Waniko (2014) affirmed that the Nigerian professionals in the construction industry are cognisant of the practices and concepts of green building. However, the findings discovered are not in conformity with the finding of Susilawati and Al-Surf (2011) that contented that a good percentage of the masses lack knowledge and the awareness of the existence of green construction. Also, Glavic *et al.,* (2007) reported that the awareness level of green construction alongside sustainability is still at the 'moderate to good' range especially in the Kuwait Construction industry. The study suggested professional development should be emphasised as means of educating the stakeholders on green and sustainable construction, to intensify the knowledge and awareness level.

Construction stakeholders opined that the major criteria considered for the selection of these materials are; waste reduction and durability, available and natural sourced, and recyclability and reusability. This result supports the finding of Nduka & Odunsanmi (2015) and Sheth (2016). Nduka & Odunsanmi (2015) reported that the main consideration for green building materials adoption is anchored on the benefits derivable for the implementation. They found that the benefits of adopting green building are; renewable natural sources and pursuing active recycling, abating waste disposal and production thereby reducing health cost, averting global warming alongside conserving natural resources. There is a serious necessity to protect and prolong the environmental resources and conception and implementation green building is one of the vital solutions for developments which are sustainable (Sheth, 2016). Sustainable structure integrates many approaches during design, erection as well as operation of a building development and utilising materials that promotes green building while constructing is viewed as sustainable because the elements or materials used are friendly to environmental, in nature and helps mitigate negativities on the environment (Sheth, 2016).

Green building materials are special materials for green building construction and the adaptation of the system is sustainable compared to the conventional building (Sheth, 2016). In line with the growth of green development, green building materials industry is also developing (McIntyre, *et al.*, 2019). GBM (Green Building Materials) are environmentally responsible materials that helps in mitigating environmental issues. Ideal building materials have no negative effect on the environment and such components are expected to be recyclable and reusable infinitely and such material should be considered as a friend to the environment (Oyegiri & Ugochukwu, 2016).

4.4 Driver of GBM Adoption in NCI.

The results of the study of these drivers of green building components adoption during construction in Table 4.6 shows that the top ten (10) most important drivers of green building materials adoption in construction are; resource efficiency (RII=0.972), to reduce the lifecycle costs of buildings (RII=0.933), legislation / legal requirement (RII=0.904), financial incentives (RII=0.899), cost reduction (RII=0.895), reputation / image (RII=0.888), economic incentives (RII=0.868), thermal comfort (RII=0.850), competitive advantage (RII=0.841), and client demand (RII= 0.832).

The least six (6) drivers of green building materials adoption in construction are benchmarking and assessment (RII=0.655), linking research to implementers (RII= 0.655), creation of technologies of the future (RII=0.635), building regulations (RII=0.528), knowledge sharing (RII=0.524), and developing regulatory mechanisms (RII=0.473).

With a mean average RII of 0.763 (76.34%), this implies that all the identified drivers have high level of importance/significance in the implementation and usage of green building materials during constructions.

Table 4.6: Driver of GBM Adoption in NCI.

S/No	Drivers of green building materials	RII	Rank
1.	Resource efficiency	0.972	1st
2.	To reduce the lifecycle costs of buildings	0.933	2nd

3.	Legislation / Legal Requirement	0.904	3rd
4.	Financial incentives	0.899	4th
5.	Cost reduction	0.895	5th
6.	Reputation / Image	0.888	6th
7.	Economic incentives	0.868	7th
8.	Thermal comfort	0.850	8th
9.	Competitive Advantage	0.841	9th
10.	Client Demand	0.832	10th
11.	Construction standards	0.831	11th
12.	Changing the construction process	0.822	12th
13.	Green design guidelines	0.817	13th
14.	Set rules and legislations	0.788	14th
15.	Planning policy	0.762	15th
16.	Educational programs	0.756	16th
17.	Creation of technologies to mitigate impacts	0.750	17th
18.	Advocacy and awareness	0.744	18th
19.	Strengthening implementing mechanisms	0.714	19th
20.	Clarification of roles and responsibilities	0.697	20th
21.	Attract and retain good employees	0.674	21st
22.	Creating regional centers of excellence	0.667	22nd
23.	Benchmarking and assessment	0.655	23rd
24.	Linking research to implementers	0.655	23rd
25.	Creation of technologies of the future	0.635	25th
26.	Building regulations	0.528	26th
27.	Knowledge sharing	0.524	27th
28.	Developing regulatory mechanisms	0.473	28th

Interview revealed that on the question on ‘What do you think can be done to help the adoption of GBM?’ All the interviewees shared similar view on steps required to improve adequate adoption of GBM. They said.

“GBM adoption has call for campaigning for neater and safer environment and how GBM is expected to play a fundamental role in achieving that. Similarly, healthy and comfortable homes and houses requires GBM adoption, this is why Government need to make policies on it usage in every building, and also to enforce use of GBM in every building”.

The study revealed that the top most significant drivers of green structure or building materials adoption during construction includes; cost reduction, to reduce the lifecycle costs of buildings, legislation / legal requirement, financial incentives, resource efficiency, reputation / image, economic incentives, thermal comfort, competitive advantage, and client demand. This finding is in support of reports by (Oke *et al.,* 2019; Windapo, 2019; Darko *et al.*, 2017, Yudelson, 2010; Wang, 2014; Abidin & Pasquire, 2005); Häkkinen & Belloni, 2011). Oke *et al.,* (2019) found that the major drivers of green and sustainable construction include; legislation / legal requirement, linking research to implementers, evolving regulatory mechanisms, building guidelines / regulations, advocacy and awareness as well as client's demand. Oke *et al.,* (2019) identified that financial incentive is one of the drivers to mitigating the challenges confronting the adoption of Sustainable construction.

Gupta (2016) found that the major pushers of green building development include the need to have a competitive advantages and legislation, the green star score system of the industry as well as rising energy costs. Report of an international survey by Darko *et al.,* (2017) showed that major propellers of green development are need for; greater energy-efficiency of buildings, reduce the environmental effect of buildings, improve occupants' health and comfort and gratification, and good establishment reputation / image or as a marketing approach. Yudelson (2010) submitted that in addition to financial performance, the drivers of green building materials include: Fresh employment alongside retaining of key or major staffs, Publicising incentives, particularly for building owners as well as developers, Maintenance cost reductions and utility cost savings for water and energy.

Wang, (2014) maintained that government plays a critical part which will facilitate the execution of green building and sustainability within industry of construction. This will

be achieved through proper development of policies like standard legislation guidelines and systems of assessment. It was declared that client is the driving force and a key towards the implementation of sustainable construction. The attainment of sustainable environment is anchored on the patronage and vital role of the clients (Abidin & Pasquire, 2005; Häkkinen & Belloni, 2011). It was further confirmed that financial incentive coupled with appropriate regulations would help propel and quicken the acceptance of GBM practices by construction stakeholders (Pitt *et al.*, 2009).

4.5 Barrier to Green Building Materials Adoption in Construction

Results from data collected about the obstacles (barriers) against green building materials implementation during construction in Table 4.7 can be seen that the top ten (10) barriers are; higher costs of green building construction (RII=0.99), absence of expert proficiency and knowledge in green building (RII=0.94), nonexistence of importance committed by the senior administration to green building technology (RII=0.929), absence of funding systems (e.g., bank loans) (RII=0.928), absence of government enticements (RII=0.927), implementation of technology of green building consumes time and causes project interruptions (RII=0.922), application of GBTs leading to high rental charges and market prices of green buildings (RII=0.919), absence of green building labelling programs and rating schemes (RII=0.912), users of traditional technologies resisting change to GBT (RII=0.906), lastly, absence of local facilities and institutes for study and development of Green building (RII=0.905).

The least 5 (five) obstacles to green building materials implementation during construction are; nonexistence of technological training for project staff on green building (RII=0.75), acceptance of green building causing conflicts of interests amongst various shareholders (RII=0.65), rigid and complex requirements tangled in

implementing green building technology (RII=0.64), high level of cynicism on the topic of green building (RII=0.58), and lengthy repayment timeframes from implementing GBTs (RII= 0.50).

With an RII of 0.83 (83.23%), the identified obstacles to the implementation of green building materials during construction have very high level of influence on the adoption of the concept. Regardless of the ranking of the variables, they contribute to the low and moderate level of acceptance and implementation of the practices.

Table 4.7: Barrier to Green Building Materials Adoption in Construction

S/No	BARRIERS	RII	Rank
1.	Higher expenses of Green buildings construction	0.99	1st
2.	Nonexistence of professional knowledge & expertise on green buildings	0.94	2nd
3.	Nonexistence of importance committed by the senior administration to green building technology	0.93	3rd
4.	Absence of funding systems (e.g., bank loans)	0.93	4th
5.	Absence of government enticements	0.93	5th
6.	Implementation of technology of green building consumes time and causes project interruptions	0.92	6th
7.	Application of GBTs leading to high rental charges and market prices of green buildings	0.92	7th
8.	Absence of green building labelling programs and rating schemes	0.91	8th
9.	Users of traditional technologies resisting change to GBT	0.91	9th
10.	Absence of local facilities and institutes for study and development of Green building	0.91	10th
11.	Unavailability of Green building technology in the local market	0.88	11th
12.	Lack of demonstration projects	0.88	12th
13.	Absence of awareness of Green buildings and their benefits	0.87	13th
14.	Unfamiliarity of construction professionals with green building	0.87	14th
15.	Lack of Green building promotion by government	0.86	15th
16.	Unavailability of Green building technology suppliers	0.84	16th
17.	Inadequate involvement with the utility of non-traditional procurement approaches	0.83	17th
18.	Market demand and absence of interest from consumers	0.82	18th
19.	Absence of green building codes and guidelines	0.81	19th
20.	Lack of Green Building databases and information	0.79	20th

21.	Uncertainties and risks associated with accepting new technologies	0.78	21st
22.	Nonexistence of technological training for project staff on green building	0.75	22nd
23.	Acceptance of green building causing conflicts of interests amongst various shareholders	0.65	23rd
24.	Rigid and complex requirements tangled in implementing green building technology	0.64	24th
25.	High level of cynicism on the topic of green building	0.58	25th
26.	Lengthy repayment timeframes from implementing GBT	0.50	26th

Revealed from interview, one of the Architects said:

"One of the most pivot barrier to GBM adoption is the clients' attitude to accept GBM, most of the clients are ignorant of the important of GBM. The clients are always after using GBM for outdoor use like bars, joint and gardens".

In addition, one of the recommend Builders that:

"The professional bodies should engage the public concerning the relevance of using green building materials during the construction process and in their building properties, develop a framework for its adoption and senior managements should attach importance to green building technology to help implementation GBM".

The Engineers said:

"The barriers impeding the adoption of GBM cannot only be clients' attitude to the but also, higher expenses involved in green building construction, absence of expert opinion, proficiency and knowledge in construction of green building among others".

In conclusion, the study shows that the main obstacles to the implementation of green building materials during construction are; high expenses of Green building construction, absence of expert opinion, proficiency and knowledge in construction of green building, nonexistence of importance committed by the senior administration to

green building technology, absence of funding systems such as bank loans, non-existence of government enticements, implementation of technology of green building results in consumption of time and causes project interruptions, application of GBTs leading to high rental charges and market prices of green buildings, absence of green building labelling programs and rating schemes, users of traditional technologies resisting change to GBT, and absence of local facilities and institutes for study and development of Green building.

These results are inclined towards the discoveries made by (Chan *et al.,* 2009; Hakkinen & Belloni, 2011; Ahn *et al.,* 2013; Rodriguez-Nikl *et al.,* 2015; Darko *et al.,* 2017;). Ahn *et al.,* (2013) identified high expenses of green materials and products as one of the five main obstacles to green building. Chan *et al.,* (2009) reported that the most serious barriers affecting Green building technology adoption are lack of knowledge and awareness, hostility towards change, high expenses of green buildings, absence of expertise, and absence of government incentives. Hakkinen and Belloni, (2011) observed that Green building are viewed as being extra costly and can sum up to higher cost of investment when likened to local development. Seeliger and Turok, (2015) also revealed that developers are conscious of the short-term financial impact and implication of going green; but are optimistic that it has a long-term financial benefit. The financial aspect of green building materials adoption has been identified as being among the most critical barriers to green building implementation. It was reported that economics and financial considerations have been blamed for the low pace or even non-implementation of green building technology in most nations, especially in Malaysia, and China (Kibert, 2008; Isa *et al,* 2013; Zhang *et al.,* 2011).

The results of this study also support the findings of Bond (2010) and Love *et al.*, (2012) which was reported shows the main hindrances to green building adoption and execution are; absence of government enticements, cost and absence of relevance information, absence of general knowledge and relevant experience, poor association between stakeholders, absence of building codes and guidelines, high expenses of green materials, and risks and reservations involved.

4.6 Strategies to Improve the Uptake of GBM in the NCI.

The result of the examination of the statistics collected on the respondents' perception of the strategies to improve the uptake of green building materials in Table 4.8 shows that the top most important measures/strategies are; provision of incentives to encourage innovation in sustainable construction (RII=0.99), rigorous Green building promotion by government (RII=0.98), utility of machineries that permit the reprocessing of the building components and deconstruction (RII=0.95), adequate training centres with adequate funding of research and development (RII=0.94), and regular inspections and monitoring of works with set rules and legislations (RII=0.94).The least measures are; use of resources from more sustainable source (RII=0.74), and provision of sustainable materials selection Criteria (RII=0.70).

With an average RII of 0.87 (86.94%), this implies that all the strategies have very high level of importance to the acceptance of green building materials in NCI. All available strategies are vital to improve the uptake of green building materials in construction.

Table 4.8: Strategies to Improve the Uptake of GBM in the NCI.

S/No	Strategies to improve GBM uptake	RII	Rank
1.	Establishment of enticements to inspire invention in sustainable construction	0.99	1st
2.	Rigorous Green building promotion by government	0.98	2nd
3.	Utility of technologies that license the reprocessing of the building components and deconstruction	0.95	3rd
4.	Adequate training centres with adequate funding of research and development	0.94	4th
5.	Regular Inspections and Monitoring of works with Set rules and legislations	0.94	4th
6.	Appraisal of Building Code and Establishment of Sustainable Building code	0.86	6th
7.	Promotion of Sustainable Construction by the building industry	0.82	7th
8.	Employ Natural Resource Management Strategy	0.77	8th
9.	Use of resources from more sustainable source	0.74	9th
10.	Provision of Sustainable Materials Selection Criteria	0.70	10th

During the interview on question ‘Based on your experience, what other strategy can be adopted for improving the uptake of GBM?’, the interviewees suggests that:

“There is need for development of framework for GBM adoption as well as Government should lead by example by ensuring signed construction contract should be built using GBM, the Government should also support the masses in building and allocation of houses to the public built using GBM, and lastly, include green materials and environmental safety in building approval by approval authorities”.

The study revealed that the prominent strategies for improving the uptake of green building materials are; Establishment of enticements to inspire innovation in sustainable construction, Rigorous Green building promotion by government, utility of technologies that license the reprocessing of the building components and deconstruction, adequate training centres with adequate funding of research and development, and regular inspections and monitoring of works with set rules and legislations. It reports that all the strategies have very high level of importance to the uptake of green building materials in construction.

4.7 Summary of Findings

Table 4.9 shows the summary of key findings from the analysis carried out on the subject matter.

Table 4.9 Summary of Findings

S/N	Objectives	Findings
1	Stakeholders Awareness Level And Adoption Of Green Building Material	Construction stakeholders are aware of the existence and adoption of empty plastic bottles, worn out tyres, clay and mud, grasses, bricks, stone and timber. The awareness level and adoption of these materials ranges from 'average to very high'. There exist a very positive and strong correlation amongst the awareness level & adoption of GBM in NCI
2	Drivers of GBM adoption in NCI.	The major drivers of GBM adoption in NCI are; resource efficiency, to reduce the lifecycle costs of buildings, legislation / legal requirement, financial incentives, and cost reduction.
3	Barriers to GBM uptake in NCI.	Most of the barriers to GBM adoption in NCI are high expenses of Green building construction, absence of expert proficiency and knowledge in green building, absence of relevance devoted to green building technology by senior administration, absence of financing schemes such as bank loans, and absence of government incentives
4	Strategies for an improved GBM uptake leading to SCP in NCI	To improve the adoption of GBM and sustainable construction practices, also by emphasising green materials and environmental safety in building approval by approval authorities

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The research started with an aim of appraising green building materials within the construction industry in Nigeria, with the view of suggesting a veritable strategy for its uptake. Utilizing information gathered from construction professionals and stakeholders, the study was able to determine the awareness level and adoption level of green building materials, the drivers / barriers to the acceptance and implementation of green building materials in construction, and strategies for their uptake were also determined.

The study found that construction stakeholders are aware of the existence and adoption of empty plastic bottles, worn out tyres, clay and mud, grasses, bricks, stone and timber. The awareness level and adoption of these materials ranges from 'average to very high'. It was further revealed that major drivers of GBM adoption in NCI were; resource efficiency, reduction in the lifecycle costs of buildings, legislation / legal requirement, financial incentives, and cost reduction. Also, high expenses of green building construction, absence of expert proficiency and knowledge in green building, absence of relevance devoted to green building technology by senior administrators, absence of funding systems such as bank loans, and absence of government enticements are the main hindrances to the acceptance of GBM in NCI. Establishment of motivations to inspire invention in sustainable construction, rigorous green building promotion by government, utility of technologies that license the reprocessing of the building materials and deconstruction, and adequate training centres with adequate funding of research and development; were the strategies for improving the uptake of green building materials.

5.2 Recommendations

This research therefore, makes the ensuing recommendation from the results and deduction

1. Appropriate legislations ought to be put in place by the lawmaker and stakeholders so as to encourage the uptake, acceptance and implementation of green building best-practices within construction industry. Furthermore, there should be rigorous green building advancement by both state/leader and private sector and individuals to see that empty plastic bottles, worn out tyres, clay and mud, grasses, bricks, Stone and Timber are incorporated in some parts/sections of every public building of commercial/industrial nature.
2. The management of construction key players (clients/investors/developers) and even construction firms; should attached importance to the concept of green building and lend their support to ensure their adoption and implementation.
3. There should be provision of financial incentive to encourage green building uptake with adequate planning and budgetary provision should be made prior to mobilization and execution of green building construction.
4. Continuous seminars and workshops should be organized by professional bodies so that the benefits and importance of green building can be communicated to the masses to further grow the awareness level and to reduce or even eliminate resistance to new construction techniques and materials.
5. The use of Eco-friendly technologies that allows for the deconstruction and recycling of the building materials and components should be encouraged.

5.3 Contribution to Knowledge

The following contribution were made by the research to add to the body of knowledge based on the discoveries. They include following;

1. The thesis has contributed in deepening green construction and sustainability practices along with capturing the drivers and barriers of GBM adoption in NCI.
2. This study would aid decision makers and construction industry key players in making appropriate decision utilizing the suggested strategies' on how to achieve a sustained green construction practices and uptake.
3. The study would further encourage the NCI practitioners and stakeholders that are aiming to achieve sustainable construction in their future projects to implement green building technology
4. The research has also added more on green construction and sustainability within the NCI to the existing body of knowledge available.

5.4 Suggestions for Further Studies

On area for further research, the thesis makes the following recommendations;

1. A study that will compare the level of adoption and execution of green building materials during construction process between private and public clients should be carried out to see who tends to promote the adoption of GBM better.
2. A study that will advance an approach for the adoption and incorporation of green materials for construction in the construction of civil engineering projects should be researched so as to check the possibility of GBM yielding high performance than conventional building materials.

3. The application of public-private partnerships as a possibility in quickening the achievement of green building technology practices should be studied to enable the fast improvement in the uptake of GBM
4. A similar study that would assess use of eco-friendly green building materials in the oil and gas construction industry should be embarked on since there are a lot of environmental pollutions from that sector of construction industries.

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APPENDIX A: RESEARCH INSTRUMENT

Department of Building Department,
School Environmental Technology,
Federal University of Technology,
P.M.B. 65, Minna,
Niger State.
20th June, 2019

Dear Sir/ma

Questionnaire on Strategies for Green Building Material Adoption in Nigerian Construction Industry

You are valued as a construction professional/client in the Nigerian construction industry, and your opinions are important. There is an on-going research on **Strategies for Green Building Material Adoption in Nigerian Construction Industry (case study of Abuja)**, in partial fulfilment for the Master Degree in Construction Management, FUT, Minna. While appreciating your busy schedule, your participation in this survey is crucial to the success of this research.

Any information given shall be kept with ultimate confidentiality and shall be used strictly for academic purposes.

Yours faithfully,

SHITTU, A. Usman
Reg. No. MTECH/SET/2017/7309
07035305831

SECTION A: GENERAL INFORMATION OF RESPONDENTS

Please place a tick (√) where appropriate in box that corresponds to your response to questions from **1** to **6** below

1. What category do you belong to? Public organisation { } Private organisation { }
2. What is your profession? Architect { } Builder { } Engineer { } Quantity Surveyor { }

   Other, please specify…….
3. Years of experience in the construction industry: 1-5 { } 5-10 { } 11-15 { } 16-20 { }

   +Above 20 { }
4. Highest Academic Qualification: OND { }HND { } PGD { } B.Sc / B.Tech { } MSc/MTech. { } PhD { }
5. Professional Membership: None { } MNIA { } MNIOB { } MNSE { }

   MNIQS { }
6. Have you been involved in any project where green building materials where incorporated? Yes { } No { }

SECTION B: STAKEHOLDERS AWARENESS LEVEL & ADOPTION OF GREEN BUILDING MATERIALS IN THE NIGERIAN CONSTRUCTION INDUSTRY.

Please use your experience and level of understanding of green building/sustainable concept to attend to the questions contained in this section. Use the following scale: 1=very low, 2 = low, 3 moderate, 4= high, 5= very high

	Green materials	**Level of Awareness**					**Adoption**				
S/N		**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
A	**Materials from building and industrial waste**										
1	Empty plastic bottles										
2	Worn out tyres										

3	Rice husk										
4	Fly ash										
5	Cow dung										
B	**Natural materials**										
6	Grasses										
7	Bamboo										
8	Coconut fibre										
9	Clay and mud										
10	Leaves										
C	**Earth materials**										
11	Timber										
12	Stone										
13	Bricks										
14	Trees										
15	Lime										
D	**Criteria for Materials Selection**										
16	Available and naturally sourced										
17	Recyclability and reusability										
18	Waste reduction and durability					`					
19	Energy efficiency										
20	Biodegradability and Ozone friendly										

SECTION C: DRIVER OF GREEN BUILDING MATERIALS ADOPTION IN CONSTRUCTION.

Please use your experience and level of understanding of green building/sustainable concept to attend to the questions on the drivers of green building materials uptake, contained in this section. Please rate these drivers according to their level of significance, using the scale of 5 to 1. With 5 being very high, 4 being high, 3 being average, 2 being low, and 1 being very low.

S/N	**Drivers of green building materials**	**1**	**2**	**3**	**4**	**5**
1	Advocacy and awareness					
2	Strengthening implementing mechanisms					
3	Economic incentives					
4	Planning policy					
5	Legislation / Legal Requirement					
6	construction standards					
7	Creation of technologies to mitigate impacts					

8	Educational programs					
9	Creating regional centers of excellence					
10	Green design guidelines					
11	Reputation / Image					
12	Knowledge sharing					
13	Building regulations					
14	Client Demand					
15	Cost reduction					
16	Changing the construction process					
17	Attract and retain good employees					
18	Clarification of roles and responsibilities					
19	Benchmarking and assessment					
20	Financial incentives					
21	Developing regulatory mechanisms					
22	Resource efficiency					
23	To reduce the lifecycle costs of buildings					
24	Competitive Advantage					
25	Educational programs					
26	Linking research to implementers					
27	Creation of technologies of the future					
28	Set rules and legislations					

SECTION D: BARRIER TO GREEN BUILDING MATERIALS ADOPTION IN NIGERIAN CONSTRUCTION INDUSTRY

Please use your experience and level of understanding of green building/sustainable concept to attend to the questions on the barriers hindering green building materials adoption in construction, contained in this section. Use the following scale: 1=very low, 2 = low, 3 moderate, 4= high, 5= very high

S/NR	**BARRIERS**	**1**	**2**	**3**	**4**	**5**
1	Higher costs of Green building construction					
2	Lack of awareness of Green building and their benefits					
3	Lack of green building codes and regulations					
4	Lack of government incentives					
5	Lack of professional knowledge and expertise in green building					
6	Lack of local institutes and facilities for research and development (R&D) of Green building					
7	Lack of green building rating systems and labeling programs					
8	Lack of Green Building databases and information					
9	Long payback periods from adopting GBTs					
10	Lack of financing schemes (e.g., bank loans)					
11	Lack of Green building promotion by government					
12	High market prices and rental charges of green buildings resulting from GBTs application					
13	Conflicts of interests among various stakeholders in adopting green					

	building					
14	Unfamiliarity of construction professionals with green building					
15	Lack of importance attached to green building technology by senior management					
16	Unavailability of Green building technology in the local market					
17	Lack of green building technological training for project staff					
18	Resistance to change from the use of traditional technologies					
19	Adoption of Green Building technology is time consuming and causes project delays					
20	Lack of demonstration projects					
21	High degree of distrust about green building					
22	Lack of interest from clients and market demand					
23	Limited experience with the use of nontraditional procurement methods					
24	Unavailability of Green building technology suppliers					
25	Complex and rigid requirements involved in adopting green building technology					
26	Risks and uncertainties involved in adopting new technologies					

SECTION E: STRATEGY TO IMPROVE THE UPTAKE OF GREEN BUILDING MATERIALS

With your understanding about green building and development, please rate which of the following strategies will help improve the uptake of GBM. Using the following scale: 1=very low impact, 2 = low impact, 3 moderate impact, 4= high impact, 5= very high impact

S/N	Strategies to improve GBM uptake	1	2	3	4	5
1	Adequate training centres with adequate funding of research and development					
2	Provision of Sustainable Materials Selection Criteria					
3	Employ Natural Resource Management Strategy					
4	Provision of incentives to encourage innovation in sustainable construction					
5	Review of Building Code and Provision of Sustainable Building code					
6	Use of technologies that permit the deconstruction and recycling of the building components					
7	Rigorous Green building promotion by government					
8	Regular Inspections and Monitoring of works with Set rules and legislations					
9	Promotion of Sustainable Construction by the building industry					
10	Use of resources from more sustainable source					

SECTION F: INTERVIEW

1. What do you understand by green building materials (GBM)?
2. How available are these green building materials and their adoption?
3. What do you think can be done to help the adoption of GBM?

4. As a professional, have you in any of your construction adopted the use of GBM? If Yes, what was your observation(s) and recommendation(s)?

If No, why not and what was the barrier(s)?

5. Based on your experience, what other strategy can be adopted for improving the uptake of GBM?

Thank you.

APPPENDIX B. CRONBACH'S ALPHA TEST FOR RELIABILITY

Reliability: OBJECTIVE 1 - STAKEHOLDERS AWARENESS LEVEL AND ADOPTION OF GREEN BUILDING MATERIALS IN NIGERIAN CONSTRUCTION INDUSTRY

Scale: STAKEHOLDERS AWARENESS LEVEL

Case Processing Summary

		N	%
Cases	Valid	156	100.0
	Excluded[a]	0	.0
	Total	156	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.835	20

Scale: ADOPTION OF GREEN BUILDING MATERIALS

Case Processing Summary

		N	%
Cases	Valid	156	100.0
	Excluded[a]	0	.0
	Total	156	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.827	20

Reliability: OBJECTIVE 2 - DRIVER OF GREEN BUILDING MATERIALS ADOPTION IN NIGERIAN CONSTRUCTION INDUSTRY**.**

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	156	100.0

	Excluded[a]	0	.0
	Total	156	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.805	28

Reliability: OBJECTIVE 3- BARRIER TO GREEN BUILDING MATERIALS ADOPTION IN NIGERIAN CONSTRUCTION INDUSTRY.

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	156	100.0
	Excluded[a]	0	.0
	Total	156	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.775	26

Reliability: OBJECTIVE 4 -: STRATEGY TO IMPROVE THE UPTAKE OF GREEN BUILDING MATERIALS WITHIN THE NIGERIAN CONSTRUCTION INDUSTRY

Case Processing Summary

		N	%
Cases	Valid	156	100.0
	Excluded[a]	0	.0
	Total	156	100.0

. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.881	10