ASSESSMENT OF THE UTILIZATION OF GREEN BUILDING IN BUILDING CONSTRUCTION PROJECT IN NIGER STATE

BY

JIYA Nma Mathias

2016/1/61856TI

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

FEDERAL UNIVERSITY OF TECHNOOGY, MINNA

MARCH, 2023

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A RESEARCH PROJECT SUBMITTED TO THE

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

FEDERAL UNIVERSITY OF TECHNOOGY, MINNA

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY DEGREE (B. TECH) IN INDUSTRIAL AND TECHNOLOGY EDUCATION

MARCH, 2023

DECLARATION

I **Jiya Nma Mathias**, with Matric No: 2016/1/61856TI an undergraduate student of the Department of Industrial and Technology Education certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other university

JIYA Nma Mathias _____

Name sign

CERTIFICATION

This project has been read and approved as meeting the requirements for the award of B. Tech degree in Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna.

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DEDICATION

This research is dedicated to the Lord God Almighty, who granted me with this opportunity and grace to see me throughout my undergraduate journey. This research is also dedicated to my parents, sisters, and friends for their support and prayers throughout this period.

ACKNOWLEDGEMENTS

My ultimate gratitude goes to God Almighty for his guidance and protection throughout this phase of my life.

This project came to a reality because of the contributions of some amazing personalities in terms of financial support, moral support and guidance.

I wish to sincerely acknowledge the invaluable contribution of my project supervisor Dr. Dauda Ibrahim whom in spite of his academic commitment and tight scheduled, devoted time, exercised patience, gave me guidance and advice propelling me to higher grounds.

My profound gratitude to my parent Mr and Mrs Joseph Kolo for their advice, moral and financial support. Also to my siblings (Patience, Justina, and Priscilla). I will like to appreciate my uncle Mr Stephen Yisa for his unwavering support, encouragements and guidance. I will also like to appreciate my friend, Ojonuba Goodness Enyo-ojo for his support to see through the success of this project, he has always carried me along so that I am not left behind.

Lastly, I want to thank the Department of Industrial and Technology Education Staffs for their support and guidance during my undergraduate study. Thank you all for your contributions and giving me the chance to earn this degree**.**

ABSTRACT

This project will assess the utilization of green building in building construction projects. It will explore the benefits of green building practices such as sustainable energy use, resource efficiency, and environmental friendliness in contrast to conventional construction methodologies. The project will also analyze the economic effects of green building practices and evaluate their impact on the construction industry as a whole, providing valuable insights into the benefits and challenges associated with the implementation of sustainable construction practices. The aim of this project is to promote the use of green building practices in construction projects and to encourage the adoption of sustainable building practices for a more environmentally-friendly and energy-efficient future.

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CHAPTER ONE

INTRODUCTION

BACKGROUND OF THE STUDY

The negative environmental impact of buildings on the environment has led to a clamour for improved practice. The challenge of implementation of ecological principles to the entire construction projects lifecycle is as a result of such clamour and it has been linked to the evolution of a relatively new and evolving concept termed “green building”. Green building has been recognized as an essential practice for improving negative environmental outcomes of buildings. The building sector has been accounted to be responsible for about 25- 40% of energy usage, 30- 40% of material resources consumption, 30-40% of waste production and 30-40% of green house gases released to atmosphere globally (Umar and Khamidi, 2012). It is further revealed that about 30% of recently built or retrofitted buildings suffer from sick building syndrome which in turn exposes occupants to unhealthy environmental conditions. However, the imperative of environmental performance of building calls for systems that can assess the environmental impact of buildings.

Green building rating system is a concept that emerges in the construction industry in the early 1990’s. According to Portalatin et al. (2010) the idea of green building rating system emerged in the United Kingdom known as British Research Establishment Environmental Assessment Method (BREEAM) in 1990.This was followed by Leadership in Energy and Environmental Design (LEED) in the United States. Green building rating system has been defined as voluntary mechanisms used to rate and certify the environmental performance of buildings (UN-

HABITANT, 2010). It also provides benchmark against which a building is rated and also offers a score or descriptive rating for the building (Adegbile, 2013). The importance of green building assessment tools have been documented in various studies (Ali and Al Nsairat, 2009; UNHABITANT, 2010; Portalatin, et al. 2010; Adegbile, 2013) among others. In particular, Ali and Al Nsairat (2009) emphasied on the need of developing technical services and resources for determining the 'greenness' of a building based on appropriate green rating system thereby making green building practices easier to implement. It is thus important for project stakeholders to consider green building assessment as construction project moves through design and construction phase in order to prevent high energy consumption, solid waste generation, global green house emission, environmental damage and resource depletion. Green building rating systems are developed to prevent the above problems from occurring. Also, different sustainability and green building literatures (Ali and Al Nsairat, 2009; Portalatin, et al. 2010; Adegbile, 2013) have documented further benefits of green building rating systems in terms of raising awareness of buildings negative environmental impact to players in design and construction sectors; setting benchmarks for building environmental practices to safeguard the minimum performances standard; inspiring new designs, ideas and technical solutions; creating healthier and more productive places, and reducing building operations cost. Some of these benefits could also be harnessed in construction projects in Nigeria if green building rating systems and practices were to be integrated into our construction system. Fortunately, construction professionals are gradually becoming aware of the concepts of green building principles. Several studies (Ameh, Isijiola and Achi, 2007; Nwokoro and Onukwube, 2011; Abolore, 2012 and Waniko, 2014) on sustainability have been conducted in Nigeria by some

researchers. These studies focused in assessing the level of awareness of green building practices and its accruable benefits in construction projects in Nigeria. A recent study of (Waniko, 2014) also revealed that construction professionals are aware of green building concepts and rating systems but do not have a documented corporate philosophy for dealing with green building issues in their organizations. These results suggest a non existence of rating system for implementation of green building principles in projects, which is a cause for concern.

The study of Otegbulu (2011) decries the Nigerian designers and contractors negligence in incorporating green concepts, sustainability and environmental issues when designing a new building or retrofitting existing one. The report reveals that First bank office located in Marina, Lagos was designed and constructed without considering the tropical climatic condition of Lagos, Nigeria. Lack of natural ventilation and lighting in the building makes the entire working space uncomfortable when power from main grid fails or when electricity generators develops operational challenge. Furthermore, the survey reported a short fall in users satisfaction, functional space planning and service type in institutional, residential and commercial buildings. The present study has therefore been undertaken to investigate construction professionals' perception on awareness of green building rating systems and the accruable benefits in construction projects in Nigeria. The objectives of the study are to determine the awareness status of green building rating systems as well as the most preferred rating system for possible adoption in Nigeria. This study is significant in that it provides to current literature and knowledge on sustainability practice.

1. 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 Niger State?

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 assessing the utilization of green building in building construction project in Niger state 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 Niger State.

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 Niger State.

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 CONCEPTUAL FRAMEWORK

2.1.1 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).

2.1.1 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.

CONCEPTS OF GREEN BUILDING RATING SYSTEMS IN CONSTRUCTION PROJECTS

Building design, construction, operation and maintenance require innovation in both engineering and management dimensions. The lifespan of a building consists of series of interrelated actions starting from initial conception, through construction and the maintenance operations to eventual deconstruction .Within these cycles, significant requirements are generated, from considerations of economic, environmental and social issues for efficient savings in building systems, compliance with building codes and standards. In lieu of the above,

building assessment schemes are gaining popularity to serve as a standard to evaluate the environmental performance of new and existing building design. Documentations on green building suggest that green building has been used worldwide. According to Reed, Bilos, Wilkinson, and Schulte (2009) developments on green building practices are traceable to UK's Building Research Establishment (BRE) that pioneered the first assessment scheme called Building Research Establishment Environmental Assessment Method (BREEAM) in the year 1990 followed by USA Green Building Council's Leadership in Energy and Environmental Design (LEED) in 1996.

As this concept has taken a global phenomenon, most developed and developing countries have resulted in adopting it of which Nigeria is no exception. Research conducted in the Nigeria suggests that Nigeria is faced with the challenge of evolving performance standards, systems, codes and the regulatory means to mitigate, forestall and to develop the built environment (Adegbile, 2013). Nwokoro and Onukwube (2011) study identified the prevailing laws promulgated by Federal Government of Nigeria to safeguard the Nigerian environment. These laws include: Federal Environmental Protection Agency Act of 1988 (FEPA), National Policy on Environment (NPE) of 1989 and Environmental Impact Assessment Act of 1992 (EIA Act). Also, there were concerted efforts by professional bodies and private organizations indicating their commitments towards sustainable buildings. Shaba and Noir (2014) document the existence of Green Building Council of Nigeria (GBCN) at prospective membership level with World Green Building Council. The report revealed that the newly established council is yet to produce any rating tool thus necessitating willingness by Green Building Council of South Africa (GBCSA) to allow the adoption of Green Star SA in rating Nigerian buildings pending when Green Building

Council of Nigeria (GBCN) will establish and has the capacity to develop and operate its own rating system.

UN-HABITANT (2010), highlights several countries that have instituted green rating standards and tools to include Building Research Establishment Environmental Assessment Method BREEAM (UK); Leadership in Energy and Environmental Design LEED (USA); Green Star (AUSTRALIA); Green Mark (SINGAPORE); Green Globe (CANADA); Greenship (INDONESIA); Comprehensive Assessment System for Building Environmental Efficiency CASBEE (JAPAN); Greenhomes (INDIA) and Hong Kong Building Environmental Assessment Method HK-BEAM (HONG KONG). These rating schemes identified have different criteria and assessment which depends on critical issues emanating from the country of origin and regulations. Furthermore, the Green Building Council (GBC) permits the use of existing tools in other countries with minimal changes to reflect their local context or create new customized tools specifically for its market. Nwokoro and Onukwube (2011) highlights the lack of established institutional structures that promotes green building awareness on the part of clients, tenants, professionals in construction industry and other stakeholders, professional capacity to incorporate green building issues and opportunities and financial resources to undertake green building design, construction and upgrade.

In the African continent, only South Africa has established green building council known as Green Building Council of South Africa (GBCSA) and a rating system, Green Star SA. Portalatin et al (2010) also identify the four (4) most prominent rating systems to include: Building Research Establishment Environmental Assessment Method (BREEAM). Leadership in Energy and

Environmental Design (LEED), Green Globe and Green Star and eleven (11) additional rating systems used around the world namely; Building Environmental Assessment Method (HK-BEAM), Ecology, Energy Saving, Waste Reduction and Health (EEWH), Green Building Certification System (GBCS), Comprehensive Assessment System for Built Environment Efficiency (CASBEE), Green Mark, Green Building Standard SI-5281, LiderA, Haute Qualité Environnementale (HQE), 3-Star, Green Rating for Integrated Habitat Assessment (GRIHA), German Sustainable Building Certificate. Furthermore, Adegbile (2013) undertook a study on assessment and adaptation of an appropriate green building rating system for Nigeria where some of the assessment schemes were selected as the well known green building rating systems. This study provides insight into the strengths and weaknesses of various rating system. The identified rating system include: Building Research Establishment Environmental Assessment Method (BREEAM); Comprehensive Assessment System for Built Environment Efficiency (CASBEE); Green Star, IGBC Green Homes Rating System; Hong Kong Building Assessment Method (HK BEAM) and Leadership in Energy and Environmental Design (LEED). Adegbile (2013) draws on Nguyen & Altan, (2011) and WBDG sustainable committee (2009) suggestions on various rating system currently in use and this study aligns with the seven (7) identified rating systems by Adegbile (2013) for its investigation. Data obtained represents the perspectives of stakeholders to green building rating systems on construction projects in Nigeria.

AWARENESS ON GREEN BUILDING PRACTICE IN CONSTRUCTION PROJECT

According to Umar and Khamidi (2008) awareness on green building refers to ideal strategic model and promotion exercise which aids people to understand why a particular issue is essential and the desires of goals and what is necessary to accomplish a task. Furthermore, Abolore (2012) infers that awareness of green building depends on the understanding of the individual actions, quest for knowledge and absolute involvement and commitment to the principle. The primary meaning of awareness in the communication industry is to create a base audience for a product, service or issue. Hence, the primary goal of awareness is to achieve enlightenment to the people. In advertising and communication industry, it has been shown that people must be exposed to messages several times before the message becomes successful. The innovation in technology has contributed in a positive means of delivering and collecting information for example, the internet, sign and print media.

However, the green building concept must be disseminated in layman's terms to assist in general public acceptance. Formal knowledge and awareness for built environment professionals is an important mechanism for developing green building knowledge and skills, a number of studies (Ameh, et al. 2007; Alnaser and Flanager 2007; AlSanad, Gale, and Edward 2011; Susilawati and Al-Surf 2011; Waniko, 2014) have being conducted by researchers on awareness of green building in the recent time. The study of Ameh, et al (2007) affirm that built environment professionals in Nigeria are aware of sustainability principles and sources of information on sustainable building practices are mostly drawn from personal research. Alnaser and Flanager (2007) focused on implementing building –integration PhotoVotaic (BIPV) or Wind

energy (BIWE) in the kingdom of Bahrain. This indicates the willingness of decision makers to set legislation for sustainable buildings. It was pointed out that policy makers are more concerned about the possible reactions from investors as they do not have adequate knowledge and awareness of positive impact of building-integration PhotoVotaic (BIPV) or Wind energy (BIWE) on the long term. In the same hand, Architects and Contractors in Bahrain are also interested and keen in sustainable building project but require more knowledge and training in building–integration PhotoVotaic (BIPV) or Wind energy (BIWE) installation.

AlSanad, Gale, and Edward (2011) explore the present knowledge, level of awareness and acceptability of the Kuwait's construction industry stakeholders to adopting the concept of green building. This study found out that the level of awareness of sustainability and green construction is considered to be in the 'moderate to good' range. However, the study recommends that more actions are required to be taken by the stakeholders through education programmes such as training courses, conferences, seminars, study tour, public announcement and workshops in order to increase the level of awareness and knowledge. Similarly, Susilawati and Al-Surf (2011) investigate public knowledge and public awareness regarding this issue in the Kingdom of Saudi Arabia where a higher percentage of the respondents are not fully aware of green building practices.

Conversely, Waniko (2014) assess Nigerian built environment professional's familiarity with green building (Architects, Quantity surveyors and Engineers). It is reported in this study that a higher percentage of the respondents are aware of the green practices.

PERCEPTION OF GREEN PRODUCTS

Essoussi and Linton (2010) stated that the process of buying green is still difficult to understand. Generally, consumers express a concern for the environment, but their attitudes do not always translate into a purchasing behavior. Further, attitudes in relation to concern for the environment have not been explicitly analyzed and the relationships between green attitudes and values and behavior are still ambiguous. (do Paço, Alves, Shiel, & Filho, 2013). Understanding the mechanism of perception of green products is useful for a number of reasons: from the consumer perspective, a product that is environmentally preferable relative to comparable products is a green product (Bonini & Oppenheim, 2008; Chen, 2001; Hopkins & Roche, 2009; Tseng & Hung, 2013), similarly for building design – a green building is environmentally preferable relative to comparable conventional buildings. Perception of green products has long been studied in the field of marketing which eventually established a sub discipline known as green marketing. In building design and construction practices, perception of green building has received little attention in the literature; instead, numerous studies discuss the users' satisfaction and comfort in green buildings through post occupancy evaluations (Altomonte & Schiavon, 2013; Baird & Field, 2013; Hitchings, 2009; Huang et al., 2012; Lee & Guerin, 2009; Liang et al., 2014).

Mehrabian and Russell (1974) propose the S-O-R model to demonstrate the effect of environmental factors on the behavior of consumers in a purchase situation (Chang, Shu, & King, 2014; Joseph-Mathews, Bonn, & Snepenger, 2009; Vieira, 2013). The environment within which the decision is made serves as a stimulus to the decision maker. Mehrabian and Russell

propose that the environment could be positively loaded (i.e. novel, surprising) or negatively loaded (uninspiring, usual, dull). The environment has the potential to create arousal on the part of the individual (Richardson, Jain, & Dick, 1996). A positive load would result in pleasureful arousal. This would manifest itself through feeling good, joyful or happy. On the other hand, a negatively loaded environment would lead to feelings of disappointment, lack of fulfilment or a sense of loss. In green buildings, we argue that positively or negatively loaded environment will have similar effects on laypeople, these effects will influence the approach or avoidance behaviors toward sustainably designed buildings. Studying the design of green buildings in light of S-O-R model could help in fostering more positive attitudes and behaviors to sustainable environments.

Peattie (2001) explains the purchasing behavior of green consumers in a matrix, he introduced an alternative approach to understanding green consumer behavior. This matrix brings together two key variables that affect the likelihood of any purchaser being influenced by environmentally related criteria when considering a purchase: the degree of compromise involved and the degree of confidence in the environmental benefits of a particular choice. Many green purchases involve some form of compromise over conventional purchases. The compromise can take a variety of forms including: Paying a green premium, accepting a lower level of technical performance in exchange for improved ecoperformance, or travelling to non-standard distribution outlets (Peattie, 2001).

In green buildings, the compromise can also take a variety of forms including: accepting lack of personal control on indoor air temperature due to the automated HVAC systems required for

energy saving purposes, also accepting the look of certain types of recycled finishing materials to conserve the natural resources, or having the location of the building in a reclaimed site for the sake of sustainability. The second dimension, confidence, concerns the certainty that people have that their actions or the actions of others are making a difference. While many products make some sort of green claim, consumers also have an underlying cynicism towards green product claims. For example, hotels will ask consumers to hang up their towels to reduce the environmental footprint, but the astute and cynical hotel guest will question how much of a difference this really makes and whether the hotel's motivations are environmental or more likely financial.

Therefore, according to Peattie (2001) confidence stems from whether the issue is a real problem, that the offering from the company is better than competitors, and that buying the product will make a material difference. Certification systems are often used as a device to raise confidence and counter consumer skepticism towards green products and service. A pervasive understanding of the level of confidence perceived and degree of compromise offered by laypeople in a green building is crucial to architects and engineers while making sustainable design decisions.

CHAPTER THREE

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 usingquestionnaires 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.

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 wellstructured 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 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.

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

Table 4.1 General Information of Respondents

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%**	

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.

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

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 theconstruction 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 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.

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