Implementation of Green Design Strategies by Architects in Southwest Nigeria

Anthony B. Sholanke, Isaac-Laughter O. Opeyemi

Abstract*: In proposing new structures and renovating existing ones around the globe, environmental impact is becoming a major consideration. Among architecture professionals and other stakeholders in the building industry in Nigeria and globally, it is also becoming a major discussion topic. This has therefore brought about a need for a compromise between quality buildings and environmental responsibility. One important way of achieving this compromise is the use of green design strategies which seek to reduce the negative impacts buildings have on the natural environment and the health of the building occupants, while also being economically responsible. This study aims to investigate the level of implementation of green design strategies by practising professional architects in southwest Nigeria, identifying areas for further improvement. The methodology employed centres around the pragmatic research philosophy that uses a mixed method research approach to gather and analyze data. Data collection was carried out by textual analysis of relevant literature and the use of structured questionnaires to collect data from 60 respondents made up of practising professional architects in southwest Nigeria. Qualitative data were analyzed by content analysis, while the quantitative data was put through inferential statistical analysis. The result is presented using a descriptive approach. The study identified various green design strategies for achieving environmental sustainability in the study area. The study also found that a high level of awareness of environmental sustainability concepts exists among practising architects in the study area and provided appropriate recommendations for encouraging the implementation of green design strategies in Nigeria.

***Index Terms*: Environmental Sustainability, Green Building, Green Design, Southwest Nigeria.**

I. INTRODUCTION

Sustainability and green design as answers to environmental issues are now being appreciated in emerging economies like Kenya, South Africa and Ghana. There is also ever-increasing support from the government of these countries for the development of infrastructure that has a focus on environmental responsibility and sustainability (Greening Africa Report, 2009). Green design as a vehicle for environmental sustainability has been a major talking point among professionals and stakeholders in the building industry in Nigeria, mainly due to the increasing awareness of global warming. A Building Energy Efficiency Guideline was issued in Nigeria in June 2016 by the Federal Ministry of Power, Works and Housing to serve as a veritable climate-appropriate guide for professionals in the building sector. According to the Ministry, the document was developed to enable the planning, designing and construction of buildings that are energy efficient for the benefit of both the environment and coming generations (Federal Ministry of Power, Works and Housing, 2016).

It is against this background that the study was carried out to investigate the level of implementation of green design strategies by practising professional architects in southwest Nigeria, in order to identify areas for further improvement. The southwest region in Nigeria was selected as the study area due to the relatively large number of architectural firms and architects situated in the region compared to other regions in the country (Adepeju, 2019). The study contributes to knowledge by providing empirical evidence on the implementation of green design strategies by architects in the study area, towards achieving environmental sustainability in Nigeria. This study creates awareness on the green design subject, bringing to light its importance and potential benefits. The research will be of benefit to students, researchers and educators as a database on issues relating to green designs for achieving sustainable environments. The study will also be useful for guiding policymakers and government officials in making appropriate and adequate recommendations that will enable the built environment to be developed to meet the green design requirements in Nigeria, in conformity with the global drive towards achieving sustainable environments.

Data used for the study was gathered and analysed between August 2018 and March 2019. The main structure of the paper is divided into the following six sections: introduction; literature review; methodology; result, analysis and discussion; conclusion and recommendations; and acknowledgements.

II. LITERATURE REVIEW

1.1 Impact of Buildings on the Natural Environment

According to the United Nations Environment Program (UNEP) (2008), the continent of Africa records the highest annual temperatures and consumes the largest amount of the world's biomass energy. Architecture accounts for 48% of all energy and raw materials consumed globally and 39.7% of global energy consumption (Attamann, 2010). 33% of global greenhouse gas emissions are produced as a result of buildings and this will increase as more infrastructural development takes place to cater for the needs of the ever-rising global population (International Panel on Climate Change (IPCC), 2007). Attamann (2010) identified three major contributing factors to the impact architecture has on the environment as overpopulation, complex

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construction processes and technologies and materials.

An increase in population always brings about competitive stress on the essential resources that sustain life such as food, shelter, energy, potable water and healthy air (Goudie, 2005). Global population has increased by more than 600% between 1800 and 2009 and has been foretold to rise by 37% to 9.2 billion in 2050 as shown in figure 1.

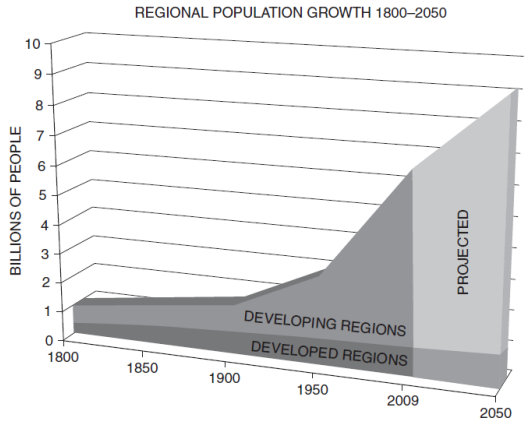

Figure 1: Population Growth Ratio Between Developed and Developing Regions
Source: Attamann (2010).

Figure 1 shows that there will be a big difference in the population growth ratio between developed and developing regions. In less developed countries like Nigeria, the projected population increase will bring about a lot of pressure on the existing infrastructure, which will, in turn, bring about a surge in infrastructural development in response to those needs (Attamann, 2010).

The concept of architecture does not just refer to the final building. Architecture involves a large variety of processes that have various levels of impact on the environment. These processes include extractive activities like mining, drilling, manufacturing, transportation, construction, maintenance, demolition and recycling as shown in Figure 2 (Attamann, 2010).

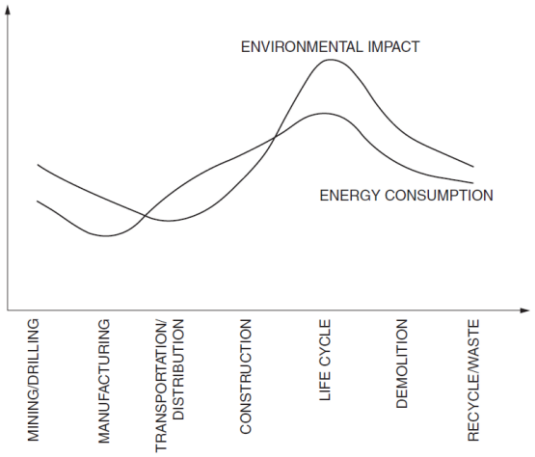

Figure 2: Levels of Impact of Architectural Processes on the Environment and Energy Consumption
Source: Attamann (2010).

Figure 2 indicates that the part of the construction process that has the most impact on the environment is the maintenance and lifecycle of the building, which is the process that goes on long after construction. It is a complex process that sees a constant flow of materials and technologies and the building's life span. The life span is an important factor in contributing to the building's impact on the environment and this is on average between 35 and 50 years depending on the building typology (Attamann, 2010).

Architecture, materials and technology have a close relationship that has been since the early beginnings of buildings as the materials serve as a means to complete the building and the process of building has always required technology of some kind. Attamann (2010) noted that as much as the creation and implementation of these materials and technologies have changed the built environment, their relationship has brought about ecological implications.

1.2 Green Design and Sustainability

1.2.1 Sustainability and Sustainable Development

The popularization of the concept of sustainability over the years has roots in the development of the concept of sustainable development. Since the 1980s, sustainability has been seen more in terms of mankind's relationship with the environment and it has brought about the most widely accepted explanation of sustainability. The explanation sees it as part of the concept of sustainable development which is described as the development that satisfies the requirements of current situations without giving away the capability of coming generations to satisfy their own requirements (United Nations, 1987)

Global Footprints (2009) define sustainability as "the process of maintaining change in a balanced fashion, in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspiration". Wandemberg (2015) defines sustainability as "a socio-ecological process characterized by the pursuit of a common ideal" while also arguing that the idea of sustainability is unattainable by meaning in any given period and space, but through a persistent and dynamic approach, the system gradually becomes sustainable.

Shaker (2015) asserts that sustainability should be viewed as the ultimate goal of humanity in terms of an equilibrium between human existence and the natural environment (homeostasis), while 'sustainable development' refers to the all-inclusive method and sequential procedures that will eventually end up in sustainability. In spite of the enlarged acceptance of the use of the term "sustainability", there have been questions over the likelihood that human civilizations will attain environmental sustainability especially in light of issues like climate change, environmental degradation, population growth, overconsumption and the global quest for limitless economic development in a closed system (WorldWatch, 2013).

1.2.2 Dimensions of Sustainability

The 2005 World Summit on Social Development identified three dimensions of sustainability as sustainable development goals. They are economic development, social development and

environmental protection (United Nations, 2005). The three pillars of sustainability are not exclusive of each other but can reinforce the impact of each other (Forestry Commission of Great Britain, 2009). The three pillars are inter-reliant and ultimately none of them can be without the others (Morelli, 2011).

1.2.3 Green Design as a Concept of Environmental Sustainability

One of the ways in which architecture can be environmentally responsible is through the application of concepts like green architecture, green design and sustainable architecture. Buildings that employ these concepts are usually referred to as green buildings. These buildings employ methods that curtail detrimental effects on human well-being and the environment, with an approach that looks to safeguard the natural environment by selecting eco-friendly materials and building practices (Madhumita, 2008). Green buildings are also designed to diminish the overall effect on the environment and human health by efficient use of energy, water and other resources, minimizing waste, and protecting the health of the building users.

Green design, green building and sustainable architecture are terms that have been used interchangeably, but they are intrinsically different. They are all used to describe environmentally responsive approaches to architecture that reduce harm to the users and the natural environment. Dublin Institute of Technology (2013) defined sustainable architecture as "the architecture that seeks to minimize the negative environmental impact of buildings by efficiency and moderation in the use of materials, energy, and development space and the ecosystem at large. Sustainable architecture uses a conscious approach to energy and ecological conservation in the design of the built environment". The United States (U.S.) Environmental Protection Agency (2013) defined green building as "the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition". According to Madhumita (2008) green design is "an approach to building that minimizes harmful effects on human health and the environment. "The green architect or designer attempts to safeguard air, water and earth by choosing eco-friendly building materials and construction practices".

In general, green design seeks to reduce the building's negative impact on the natural environment and the health of the building occupants while also being economically responsible. The benefits of green design range from environmental to economic to social. Implementing green solutions from the design, construction and day-to-day running of the building will reduce its potential effect on the natural environment, the running costs of the structure and the negative effects on the users and the communities that host the building. Green design can lead to significant savings in cost over the building's lifespan and improve the efficiency of the occupants of the building (Ries & Bilec, 2006).

Attamann (2010) proposed a framework for green building design that looks at the sustainability features, the ecological characteristics and the performative attributes that a building should have in order to be fully considered as a green building. The use of recycled and recyclable materials, sustainable site selection and development, resource (energy, water and materials) efficiency and conservation, ecological biodiversity and conservation, efficient waste management and improved indoor quality are the main pillars that green design is based upon.

1.2.4 Green Building Rating Systems and Leadership in Energy and Environmental Design (LEED)

Green building rating systems were developed as a partial response to the increasing concerns in the building industry. These systems propose measurable apparatuses to assess and quantify the extent of the performance of a building as it relates to the natural environment. In addressing an extensive variety of environmental matters (energy, construction, design, site selection, materials and technologies), more than a few countries fashioned their own standards of evaluation, building performance and systems of rating (Attamann, 2010).

Leadership in Energy and Environmental Design (LEED) is a green evaluation system governed by the United States Green Building Council (USGBC) established in 1998, which offers a "rating structure for the design and appraisal of high-performance green buildings. The system principally measures six categories namely: "sustainable site development, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design process". LEED makes use of a 69-point scale system that includes four ratings as follows: "platinum (52–69 pts), gold (39–51), silver (33–38) and certified (26–32)" (U.S. Green Building Council, 2018).

2.0 METHODOLOGY

The research philosophy adopted for the study is the pragmatic ideology which employs a mixed method research approach. In line with the mixed method research method, a combination of qualitative and quantitative research methods was used to carry out the research. Qualitative secondary data was gathered by textual analysis of relevant literature and analyzed using content analyses. The secondary data was helpful for the development of the survey instrument (structured questionnaire) used to gather quantitative data. The secondary data were extracted from related literature on the subject matter and employed to derive variables used to develop the questionnaire. The sources of the relevant literature include journals, government official reports, published and unpublished thesis, reports of expert meetings and workshops.

The study population consist of all the architects working in architectural firms within the southwest region in Nigeria. Their exact number could not be ascertained, because no reliable empirical record was found in this regard. Hence, to determine the sample size of respondents, the number of architectural firms based in the region was relied upon. The sample size is the number of responses a survey is expected to receive. It is called a sample, because it only represents part of the group of people or

target population whose opinions or behaviour a researcher is concerned about (SurveyMonkey, 2019). According to Adepeju (2019), there are 382 architectural firms in the southwest region of Nigeria. Hence, the study population of architects are first assumed to be grouped under their respective firms in the study area. The southwest region consists of six states with each state having three senatorial districts. To pick the sample size of architects for the study, the firms were further grouped under their respective states from where three firms were randomly picked from each state, with one firm assumed to represent a senatorial district. Therefore, 18 architectural firms constitute the sample frame for the study, while the architects working in the firms whose total number added up to 77 constitute the sample size.

A structured questionnaire developed for the study was used as the primary data collection instrument to retrieve needed information from the participants. The questionnaire was divided into three sections with closed-ended questions using variables that investigated issues relevant for achieving the aim of the study. The first section was designed to collect information on the personal characteristics of the respondents. The second was used to gather information on the respondents' knowledge and understanding of environmental sustainability concepts, while the third section was employed to gather data on the level to which the respondents make provisions for the implementation of green design strategies in their designs. Quantitative data was put through inferential statistical analysis with the help of IBM Statistical Package for Social Sciences (SPSS) version 21. The result is presented using the descriptive approach with the use of tables and charts.

III. RESULTS, ANALYSIS AND DISCUSSION

A total of 77 questionnaires were administered as earlier mentioned, out of which 60 was retrieved to record a retrieval rate of 78%. The retrieval rate recorded is considered reasonable as it is far more than half of the sample size selected for the study. The following section provides the respondents' profiles, which is an analysis of the data on the personal characteristics of the participants. The variables used are their gender, the number of years in practice, employment type and status in their firms.

2.1 Respondents' Profile

The respondents' profiles indicate the personal characteristics of the participants that participated in the survey.

2.1.1 Gender Distribution of Respondents

Figure 1 is a pie chart of the gender distribution of the respondents.

The data in Figure 1 shows that most (65%) of the respondents are males, some (30%) are females, while few (5%) preferred not to disclose their gender. This implies that architectural professionals in the study area are mostly male and the opinions presented in this study are predominantly that of male architects. This reinforces the observation of Fulani, Pase, Omeiza, Daniels, Alagbe, Aderonmu & Udiminue (2017) that architecture is a male-dominated field.

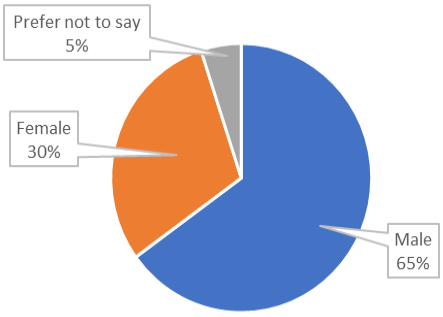

Figure 1: Gender Distribution of Respondents

2.1.2 Respondents' Number of Years in Practice

Figure 2 is a pie chart that shows a distribution of the respondents' according to their number of years in practice.

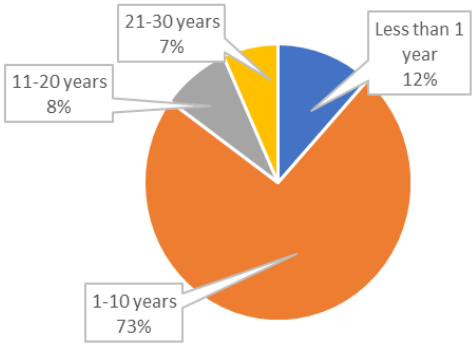

Figure 2: Distribution of Respondents' Based on their Number of Years in Practice

The data presented in Figure 2 indicates that the majority (73%) of the respondents have been in practice for between 1 to 10 years. Those who have been in practice for less than 1 year are few (12%). A fewer number (8%) have been in practice for between 11 to 20 years, while just 7% of the respondents have practiced for between 21 and 30 years. This infers that the opinion of architects who may be considered as young architects, based on their number of years in practice, dominate the views of architects presented in this study.

2.1.3 Respondents' Employment Type

Figure 3 is a pie chart of the distribution of the respondents based on their employment type.

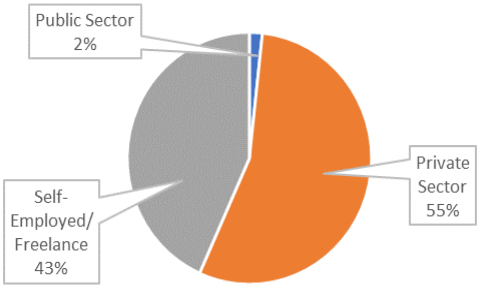

Figure 3: Distribution of Respondents' Employment Type

The result shown in Figure 3 indicates that most (55%) of the respondents are employed in the private sector, some (43%) of the respondents are

self-employed or freelance architects and just a few (2%) of the respondents are employed in the public sector. This goes to show that the majority of the architects in the study area are engaged in the private sector, which suggests that the private sector provides greater and better job opportunities for architects in the study area

2.1.4 Respondents' Status in their Architectural Firms

Figure 4 is a pie chart that shows the distribution of the respondents based on their status in their firms.

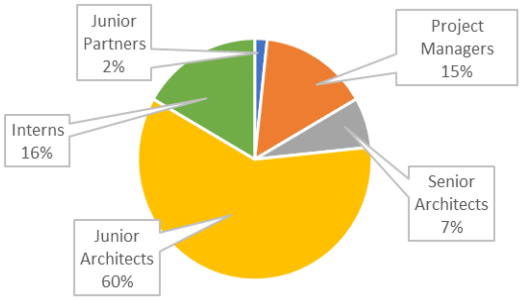

Figure 4: Respondents' Status in their Firms

As shown in Figure 4, the data indicates that majority (60%) of the respondents are employed as junior architects, 16% are employed as interns, 15% as project managers, 6.7% as senior architects, while few (1.7%) are employed as junior partners in the firms.

In general, the result on the profile of the respondents shows that a larger number of respondents are either under the tutelage of more experienced architects or are managing their own practice. This means that the implementation of green design strategies by a high percentage of the architects will most likely be influenced by the design philosophy of their firms or principals and the level of design freedom of expression they enjoy, as most of them are junior or young architects with between 1 to 10 years of experience.

2.2 Respondents' Understanding of Environmental Sustainability Concepts

A five-point Likert scale was used to ascertain the extent to which environmental sustainability concepts are understood by the respondents. The result obtained is presented in the bar chart shown in Figure 5.

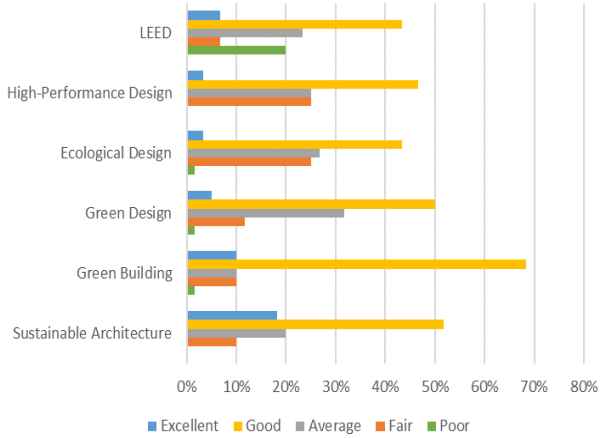

Figure 5: Understanding of Environmental Sustainability Concepts

The result shown in Figure 5 indicates that the concept of green building is the most understood by the respondents, with 68% of the respondents having a good understanding and 10% of them having an excellent understanding. Though there is a good understanding of all the concepts across the board, the LEED concept is the least understood with 20% of the respondents having a poor understanding of it. The respondents generally have an above average level of understanding of environmental sustainability concepts, but with an average of just 61% of the respondents having an above average understanding of the concepts, more needs to be done to integrate these concepts into the education and practice of architecture in Nigeria.

2.3 Respondents' Understanding of Environmental Sustainability Concepts

Again, a five-point Likert scale was used to ascertain the extent to which green design strategies are employed by the respondents.

2.3.1 Sustainable Green Design Strategies

Figure 6 is a bar chart presentation of the result obtained on the extent to which green design strategies are implemented in designs by the respondents.

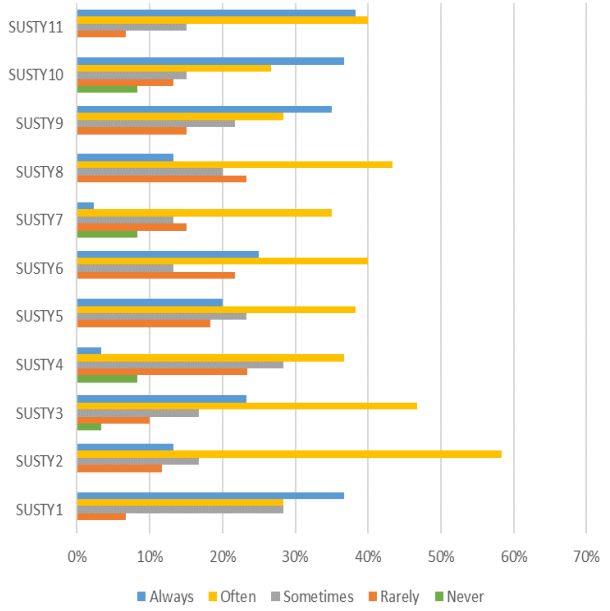

Figure 6: Level of Implementation of Sustainable Green Design Strategies

As shown in Figure 6, the result reveals that on the average, at least most (61%) of the respondents often employ sustainable green design strategies in their designs. This infers that the majority of them are conversant with the importance of the concept. Nevertheless, an average of 21% of the respondents employ the strategies sometimes, while just an average of 18% rarely or never makes use of sustainable green design strategies.

2.3.2 Ecological Green Design Strategies

The result obtained on the extent to which ecological green design strategies are implemented in designs by the respondents is presented in the bar chart shown in Figure 7.

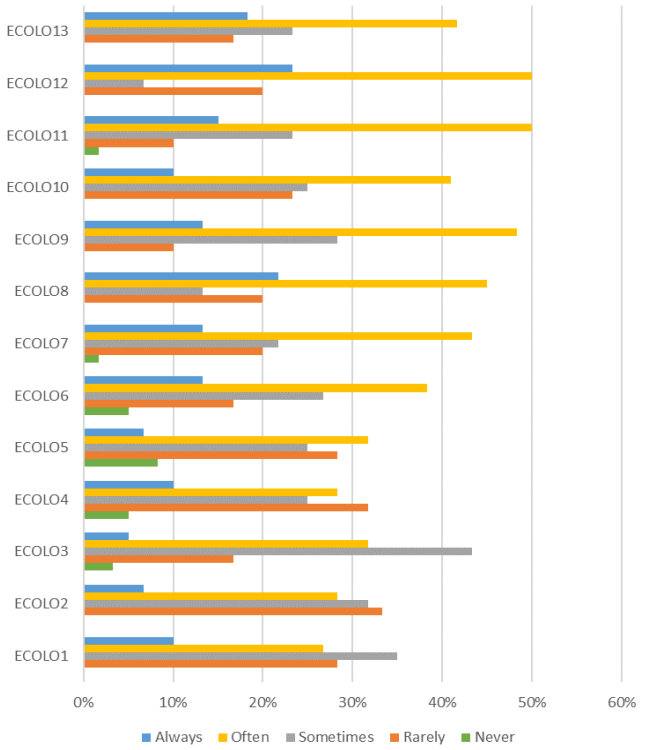

Figure 7: Level of Employment of Ecological Green Design Strategies

The result shown in Figure 7 reveals that an average of 52% of the respondents make use of ecological green design strategies to infer that the majority of them are familiar with its importance. However, an average of 26% of the respondents employ the strategies sometimes, while an average of 22% of the respondents rarely or never makes use of the strategies.

2.3.3 Performative Green Design Strategies

Figure 8 is a bar chart presentation of the result obtained on the performative green design strategies employed by the respondents.

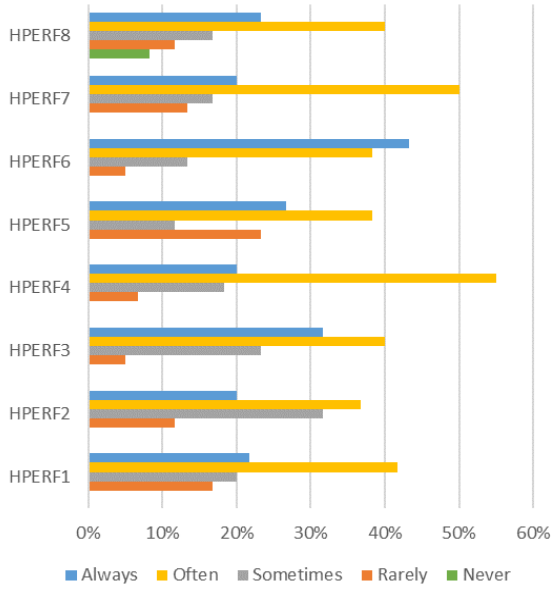

Figure 8: A clustered bar chart showing respondents' level of consideration/employment of performative green design strategies

As shown in Figure 8, the result reveals that an average of 68% of the respondents often makes use of performative green design strategies to indicate that they also consider them important strategies to employ in developing architectural designs. Nevertheless, an average of 19% of the respondents indicated that they only employ the strategies sometimes, while an average of 13% of them signify that they rarely or never make use of the strategies.

2.4 Reliability and Validity

To sustain rigour in the search procedure, there was a need to verify the validity and reliability of the results, as well as the credibility and relevance of the methods. This was obtained majorly by pretesting the questionnaires and subjecting the ordinal data to the reliability test using the Cronbach Alpha test. In this test, the closer the Cronbach Alpha value is to 1, the more likely it is that the variables are measuring the same thing, hence the more reliable the result is as shown in Tables and 1 and 2.

Table 1: Item-Total Statistics

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
GENDER	145.6833	669.068	.262	.	.963
YRSIND	144.9667	671.795	.127	.	.964
EMPTYP	144.6167	677.291	-.029	.	.964
ROLIND	140.2833	674.952	.015	.	.965
UNDST1	143.2833	646.918	.653	.	.962
UNDST2	143.3333	654.734	.490	.	.963
UNDST3	143.6167	649.461	.630	.	.962
UNDST4	143.8500	651.757	.520	.	.962
UNDST5	143.7667	650.284	.560	.	.962
UNDST6	143.9667	634.202	.631	.	.962
SUSTY1	143.1000	645.142	.634	.	.962
SUSTY2	143.3500	654.028	.504	.	.963
SUSTY3	143.2667	656.945	.355	.	.963
SUSTY4	144.0167	638.762	.696	.	.962
SUSTY5	143.4500	639.574	.718	.	.962
SUSTY6	143.4000	637.058	.701	.	.962
SUSTY7	143.4833	628.661	.723	.	.962
SUSTY8	143.6000	638.176	.733	.	.961
SUSTY9	143.2667	633.012	.784	.	.961
SUSTY10	143.3833	624.105	.769	.	.961
SUSTY11	143.0000	643.119	.703	.	.962
ECOLO1	143.8333	640.650	.716	.	.962
ECOLO2	143.9667	645.050	.636	.	.962
ECOLO3	143.8333	652.141	.544	.	.962
ECOLO4	143.9667	637.253	.688	.	.962
ECOLO5	144.0000	653.593	.395	.	.963

ECOLO 6	143.6500	640.570	.676	.	.962
ECOLO 7	143.6167	639.122	.715	.	.962
ECOLO 8	143.3667	635.287	.761	.	.961
ECOLO 9	143.4000	643.803	.736	.	.962
ECOLO 10	143.6500	639.316	.740	.	.961
ECOLO 11	143.4167	643.298	.697	.	.962
ECOLO 12	143.3333	635.243	.780	.	.961
ECOLO 13	143.4500	640.896	.704	.	.962
HPERF1	143.4000	651.634	.469	.	.963
HPERF2	143.4167	655.298	.419	.	.963
HPERF3	143.1000	639.753	.796	.	.961
HPERF4	143.2000	643.756	.771	.	.961
HPERF5	143.4000	631.702	.779	.	.961
HPERF6	142.8833	650.308	.560	.	.962
HPERF7	143.3167	638.051	.797	.	.961
HPERF8	143.4833	635.949	.643	.	.962

Table 2: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
.963	.961	42

2.5 Discussion

Based on the aim of this study, which is to investigate the level of implementation of green design strategies by architectural professionals in southwest Nigeria, the analyzed data indicates that the knowledge and understanding of environmental sustainability concepts among the architects is relatively high. The result infers that most of the respondents seem to understand the importance of implementing the green design strategies as over 60% of them indicated that they employ the majority of the green design strategies identified in the literature. However, quite a number of the respondents still indicated that they either employ the strategies sometimes, rarely or never. This could be as a result of the high number of respondents who work as junior architects that participated in the study. Some of such respondents may not have enough working experience or enjoy the needed freedom to fully implement the strategies in their designs. This is because the freedom to fully implement the strategies will to some extent be influenced by the level of experience of the architects and clients' demands and preferences.

IV. CONCLUSION AND RECOMMENDATIONS

The study identified various concepts related to environmental sustainability which include: green design, green building, sustainable architecture, high-performance design, ecological design and the Leadership in Energy and Environmental Design (LEED) green environment evaluation system.

On the level of implementation of green design strategies by architectural professionals in southwest Nigeria, the study found that though over 60% of the architects in southwest Nigeria have an above average understanding of these concepts, more still needs to be done in educating the professionals on the need to integrate the green design strategies more into their designs, as quite a number of them (18%) indicated that they rarely or never make use of the green design techniques in their designs.

To this end, building and environment development regulators and policy makers need to provide measures that will enable and encourage the conscious application of green design strategies more by architects in the study area, towards achieving environmental sustainability in Nigeria. Such measures will make for a reduction in the negative effects some buildings usually have on the natural environment and user's wellbeing generally.

In conclusion, the study was limited to investigating the level of implementation of green design strategies by architects in the study area, suggested areas for further studies include: to carry out a post occupancy evaluation to investigate how successful or effectiveness are the green design measures employed by the architects in achieving environmental sustainability, as well as investigating to what extent are the green design measures deployed by the architects are used as designed.

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