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An assessment of the level of awareness of sustainable design strategies among architects in Lagos state, Nigeria.

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ABSTRACT

Sustainable design is a term that has been poorly defined by professionals in the building industry. These terms mean different things to different people and many issues have risen as pertaining to its adoption. Majority of architecture and engineering firms claim they practice sustainable design or say that at some point they have done a few buildings but it can be argued that most professionals have little or no understating of the intricacies of sustainable design. The purpose of this study is to examine the level of awareness of sustainable design strategies among architects in Lagos state, Nigeria. The study sampled 296 architects which was gotten using the Cochran formula. Data was collected with the use of questionnaire administration and analyzed using the statistical products for services and solutions (SPSS) software. The data gotten was interpreted using content analysis. It was revealed that most of the respondents were aware of the sustainable design strategies. This study concluded that although the level of awareness among the architects is high, there is need to ensure it stays that way by ensuring that knowledge of these strategies be mandated for all young professionals going into practice. This can be achieved by introducing it to the school of architecture at all levels. Also, there should be a balance on the information spread on the environmental Importance and benefits of this strategies as this is important for proper application and adoption.

Keywords: Sustainable design, Sustainable design strategies, Architects, Level of awareness.

1. Introduction

Bodewing, (2001) describes the most basic understanding of a sustainable design as being able to minimize resources and energy consumption throughout the life cycle of the building that is from planning to construction, its use to subsequent renovation and eventually its demolition. The most important concept of sustainable architecture is making your design have little or no negative impact on the environment (Hariwan & Rojhat, 2016). It is therefore important to achieve a high level of sustainability in buildings by implementing sustainable design strategies. There have been several studies conducted to identify what these strategies are and how to implement them. However, it can be noted that research done in Nigeria has shown that buildings are becoming more aesthetically pleasing that sustainable as a result of excessive energy that is used in running the building (Nwofe, 2014). Which indicates that emphasis has been placed on aesthetics rather than how sustainable the buildings are.

Therefore in recent days the act of promoting sustainable design is seen as a priority and this is because the advancement of developing countries that has led to rapid increase in population growth and environmental impact (Ibem, et al 2019). Hence, there is need to investigate the use and application os sustainable design based on geographical location but this study focuses on investigating the level of awareness of the Architects in Lagos state about sustainable design strategies.

2. Literature review

2.1 Sustainability

The term "sustainability" was coined to define a resourcefulness-based strategy that aids in the preservation/continuation of things for future generations. (Poodineh, 2017). Sustainability, as a visionary and forward-thinking development paradigm, emphasizes a positive transformation trajectory based primarily on social, economic, and environmental considerations (Mensah, 2019). According to Maywald & Riesser, (2016) The term “sustainability” has been applied to many products and activities in recent years.

According to Godwin, (2011) the term sustainability can be split into three groups that cover social, environment and economic requirements, it involves creating a synergy between these overlapping aspects. Ortiz, Castells, & Sonnemann, (2009) also said that in the scheme of

sustainability, enhancing the quality of life of people which allows them live with improved economic, social and environmental conditions in a healthy environment is the main idea. The three

central issues of sustainability are economic growth, environmental conservation, and social equity (Legrand, 2021).There are three different sectors where sustainability can be applied, effected and enhanced. They are environmental sustainability, economic sustainability and social sustainability (Maywald & Riesser, 2016). In the building industry there is a strong need for solutions that provide benefits for the three sectors. Therefore, sustainability involves a three-way interaction of the environment, the economy, and society. As a result, the principles of sustainability are broadly classified into three frameworks: economic, environmental, and social. A sustainable building is good for the environment because it reduces solid, air, and liquid pollutants while also preserving nature and biodiversity.

According to Akadiri, Chinyio & Olomolaiye, (2012) the building industry is a key element in any economy and has a major impact on the environment. They explained that due to the magnitude of construction it is one of the largest consumers of energy, water, resources and is also a great environmental polluter. Abidin, (2010) said that there is a growing agreement among organizations that are committed to attaining environmental performance goals that are needed to make buildings more sustainable. Hence, sustainability is a broad and complex concept that has become one of the major concerns in the building industry.

Therefore, in the world of today, professionals are looking for ways to live more environmentally conscious (Rostami *et al.,* 2009). It is the practice of creating and using more resourceful and efficient models at the different stages involved in building design. These stages include construction, renovation, operation, maintenance and demolition.

2.2 Sustainable design

Sustainable design skillfully makes use of natural resources, and at the same time brings us a new concept of living. This is a concept of Design with Nature (Wu *et al*, 2020) this means that sustainable design factors in nature and the ecosystem at large in order to influence, restore and preserve the ecology of the environment. As a result,

this helps reduce the carbon footprint of buildings and makes them appear as one with the environment.

Sustainable design basically is understanding eco-friendly architecture in all its diversity, classifications and this enables it have universal acceptance (Bureu, 2015). Micheal G. Smith observed that it depends on geology, local ecology and the climate. It also depends heavily on the peculiar characteristics of the building site as well as the unique personalities of the builders and the users (Smith, 2002).

Sustainable architecture is a contribution to sustainable design (Bielek & Bielek. 2012). This means that it is a required step to achieving a sustainable design as most of its principles and elements are stemmed from the principles and elements of sustainable design as literature has shown.

Bielek & Bielek, (2012) stated that sustainable design is a synonym for the image of the future world. They further said that the aim of the movement is to put man, nature and technology into a consistent equilibrium. Bielek and Bielek (2012) broke it down further by stating that sustainable design as a movement or development would help the contemporary and future generations maintain their basic life needs, preserve the ecosystem as well as decrease the variety of nature. This further confirms that sustainable design is being able to satisfy the needs of the contemporary generation without limiting or affecting the ability of the future generation to satisfy their own basic needs. This basically means that sustainability means having no negative impact on the environment.

2.3 Sustainable design strategies

Sustainable design strategies are basic precepts of sustainable design that help designers in creating high-performance buildings with minimal environmental impact (Gil-Mastalerczyk, 2016).

Akadiri *et al.*, (2012) suggested the adoption of several multi-disciplinary approach covering a number of features in order to achieve a sustainable future in the building industry. These features include but are not limited to improved use of materials, energy saving, pollution and emission control, material waste minimization and so on.

They proposed three strategies through which sustainability in buildings can be achieved.

They are:

1. Resource conservation: This basically looks at sustainability from the lenses of achieving more with less (Akadiri *et al.*, 2012). It is the management of the human use of natural resources to provide the maximum benefit to current generations while maintaining capacity to meet the needs of future generations. The resources to be managed are Energy, Material, Water and Waste.
2. Cost efficiency: This looks at the aspect of sustainability that deals with promoting utmost efficiency while reducing financial cost. Buildings serve as a large and long lasting investment financially and in order resources or terms. (Akadiri *et al.*, 2012). They also said that improving the cost effectiveness of a building is beneficial to the user, owner and

society as a whole. The entire costing of a building is divided into three stages the initial cost, cost in use and recovery cost.

3. Designing for human adaptation: This looks at sustainability from the angle of providing a comfortable and healthy environment for human activities. A building must be able to accommodate activities for which it was built (Akadiri *et al.*, 2012). This means that the building must provide adequate and appropriate floor space, room volume, lighting, shelter and other basic amenities required for working, living and so on.

Sustainable design strategies help provide the ability to use resources effectively and makes construction of buildings more favorable to the health of the people and to reduce operating costs while creating a favorable environment (Zhigulina & Ponomarenko, 2017). Sustainable design technologies are basically the engineering systems, methods and technologies that increase the efficiency of resources (energy, materials and water).

3. Research method

The research method adopted for this study is the quantitative method. This is a form of data collection in which data is numeric in nature and mathematically computed. It is based solely on the analysis of empirical data in order to achieve the goal of the project.

Architects have been chosen as the study population so as to understand to what extent they are aware of sustainable design strategies. The total number of architects to be investigated, according to ARCON (2017) registration, is limited to one thousand, two hundred and seventy-nine (1279).

For this study, registered architects in Lagos, Nigeria, were chosen at random.

The Cochran (1977) equation, which was shown to be the most accurate, was used to calculate the sample size.

According to (Asika, 2005), the Cochran formula is given as follows to account for a smaller study population:

$N = n0/[(1+\{1+\{n0-1\}/N)]$ I

$n0 = [(Z2pq)/e2]$ II

Where N=actual sample size, n0=required

sample size;

N=study population; z=1.96 (gotten from a 'z' table); p=0.5

(proportion of population with characteristics);

q=1-p=0.5; e=.05 (margin of error based on 95% confidence level)

n0= (1.9622X0.5x0.5)/0.052=384.16 substituting n0 =384.16-1/1279}] =295.62=296.

As a result, with a research population of 1279 registered architects in Lagos, the acceptable sample size to survey for the study is 296. (296).

A total of 296 questionnaires will be distributed to registered architects in Lagos, Nigeria.

4. Results

A total of 296 questionnaires were shared and a total of 187 were retrieved.

This data presentation and interpretation show the level of awareness of the respondents on the various selected sustainable design strategies that make for environmental sustainability. This looks to determine the level of awareness of architects in the study area on sustainable design strategies that make buildings environmentally sustainable.

4.1 Level of awareness of sustainable design strategies.

Table 1 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are unaware were ranked third (3rd), respondents that are undecided were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 1 showing the respondents' level of awareness of preserving native vegetation and landscaping

Preservation of native vegetation and landscaping	Very unaware	Unaware	Undecided	Aware	Very aware
Number of respondents (f)	21	48	21	66	31
Points (p)	1	2	3	4	5
f(p)	21	96	63	264	155
Ranking	5th	3rd	4th	1st	2nd

Table 2 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are

unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 2 showing the respondents' level of awareness of retaining about 30% of trees on site

Retaining 30% trees on site	Of	Very unaware	Unaware	Undecided	Aware	Very aware
Number respondents (f)	Of	10	20	20	98	39
Points (p)		1	2	3	4	5
f(p)		10	40	60	392	195
Ranking		5th	4th	3rd	1st	2nd

Table 3 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are unaware were ranked third (3rd), respondents that are undecided were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 3 showing the respondents' level of awareness of setting aside a percentage of buildable site to be left undisturbed

Set aside a
Very
Unaware Undecided Aware Very aware

percentage	Of	Unaware				
buildable site to be left undisturbed						
Number of respondents (f)		21	48	21	66	31
Points (p)		1	2	3	4	5
f(p)		21	96	63	264	155
Ranking		5th	3rd	4th	1st	2nd

Table 4 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 4 showing the respondents' level of awareness of the installation of erosion control devices or measures

Installation erosion	of control	Very unaware	Unaware	Undecided	Aware	Very aware
devices or measures						
Number of respondents (f)		20	39	30	68	30
Points (p)		1	2	3	4	5
f(p)		20	78	90	272	150
Ranking		5th	4th	3rd	1st	2nd

Table 5 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are undecided were ranked

second (2nd), respondents that are very aware were ranked third (3rd), respondents that are unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 5 showing the respondents' level of awareness of the use of pervious materials for at least a third of the total area for driveways, walkways and patios

Using	Pervious	Very	Unaware	Undecided	Aware	Very aware
materials for at least unaware are a third of the total area for driveways,						
walkways and patios						
Number of respondents (f)		20	20	49	88	10
Points (p)		1	2	3	4	5
f(p)		20	40	147	352	50
Ranking		5th	4th	2nd	1st	3rd

Table 6 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are undecided were ranked second (2nd), respondents that are very aware were ranked third (3rd), respondents that are unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 6 showing the respondents' level of awareness of the installation of vegetated roof systems to reduce impervious surface

Installation	of	Very	Unaware	Undecided	Aware	Very aware
vegetated	roof	unaware				

systems to reduce impervious surface

Number of respondents (f)	20	30	50	67	20
Points (p)	1	2	3	4	5
f(p)	20	60	150	268	100
Ranking	5th	4th	2nd	1st	3rd

Table 7 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are very unaware were ranked fourth (4th) and the respondents that are unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 7 showing the respondents' level of awareness of the use of non-toxic outdoor materials for landscaping e.g. plastic, least treated wood etc.

Use of non-toxic

Very

Unaware Undecided Aware Very aware

outdoor materials for landscaping e.g. plastic, least treated wood etc.	unaware				

Number of respondents (f)	30	10	20	88	39
Points (p)	1	2	3	4	5
f(p)	30	20	60	352	195
Ranking4th		5th	3rd	1st	2rd

Table 8 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 8 showing the respondents' level of awareness of optimized building orientation

Optimized building orientation	Very unaware	Unaware	Undecided	Aware	Very aware
Number of respondents (f)	10	10	20	108	39
Points (p)	1	2	3	4	5
f(p)	10	20	60	432	195
Ranking5th		4th	3rd	1st	2rd

Table 9 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 9 showing the respondents' level of awareness of integrated landscaping

Integrated landscaping	Very unaware	Unaware	Undecided	Aware	Very aware
Number of respondents (f)	10	20	30	88	39
Points (p)	1	2	3	4	5
f(p)	10	40	90	352	195
Ranking5th		4th	3rd	1st	2rd

Table 10 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy

Table 10 showing the respondents' level of awareness of high performance building envelope

High performance

Very

	Unaware	Undecided	Aware	Very aware	
building envelope	unaware				
Number of respondents (f)	10	20	50	68	39
Points (p)	1	2	3	4	5
f(p)	10	40	150	272	195
Ranking **5th**		**4th**	**3rd**	**1st**	**2rd**

Table 11 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are very aware were ranked first (1st), respondents that are aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware and very unaware were ranked fourth (4th). This means that most of the respondents are very aware of the strategy.

Table 11 showing the respondents' level of awareness of utilizing daylight

Very unaware		Unaware	Undecided	Aware	Very aware
Number of respondents	20 (f)	10	40	58	59
Points (p)	1	2	3	4	5
f(p)	20	20	120	232	295
Ranking	**4th**	**4th**	**3rd**	**2nd**	**1st**

Table 12 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are very aware were ranked first (1st), respondents that are aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware and very unaware were ranked fourth (4th). This means that most of the respondents are very aware of the strategy.

Table 12 showing the respondents' level on window shading devices

Window shading devices	Very unaware	Unaware	Undecided	Aware	Very aware
Number of respondents (f)	20	10	50	48	59
Points (p)	1	2	3	4	5
f(p)	20	20	150	192	295
Ranking	**4th**	**4th**	**3rd**	**2nd**	**1st**

Table 13 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware and very unaware were ranked fourth (4th). This means that most of the respondents are very aware of the strategy.

Table 13 showing the respondents' level on centrally located heating/cooling system

Centrally	located

Very

	Unaware	Undecided	Aware	Very aware	
heating/cooling system	unaware				
Number of respondents (f)	20	10	39	68	50
Points (p)	1	2	3	4	5
f(p)	20	20	117	272	250
Ranking **4th**		**4th**	**3rd**	**1st**	**2rd**

Table 14 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are very unaware were ranked fourth (4th) and the respondents that are unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 14 showing the respondents' level of awareness of installed thermostat

Installed thermostat	Very unaware

Unaware Undecided Aware Very aware

Number of respondents (f)	20	9	50	68	40
Points (p)	1	2	3	4	5
f(p)	20	18	150	272	200
Ranking	**4th**	**5th**	**3rd**	**1st**	**2rd**

Table 15 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are very aware were ranked first (1st), respondents that are aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware and very unaware were ranked fourth (4th). This means that most of the respondents are very aware of the strategy.

Table 15 showing the respondents' level of awareness of the use of clerestory for natural lighting to reduce electric lighting

Use of clerestory for natural lighting to reduce electric lighting	Very unaware	Unaware	Undecided	Aware	Very aware
Number of respondents (f)	20	10	39	49	69
Points (p)	1	2	3	4	5
f(p)	20	20	117	196	345
Ranking **4th**		**4th**	**3rd**	**2nd**	**1st**

Table 16 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are undecided were ranked second (2nd), respondents that are very aware were ranked third (3rd), respondents that are unaware and very unaware were ranked fourth (4th). This means that most of the respondents are aware of the strategy.

Table 16 showing the respondents' level of awareness of the installation of LED lighting

Installation of LED lighting	Very unaware	Unaware	Undecided	Aware	Very aware
Number of respondents (f)	20	10	49	79	29
Points (p)	1	2	3	4	5
f(p)	20	20	147	316	145
Ranking **4th**		**4th**	**2rd**	**1st**	**3rd**

Table 17 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1^{st}), respondents that are very aware were ranked second (2^{nd}), respondents that are undecided were ranked third (3^{rd}), respondents that are unaware were ranked fourth (4^{th}) and the respondents that are very unaware were ranked fifth (5^{th}). This means that most of the respondents are very aware of the strategy.

Table 17 showing the respondents' level of awareness of the presence of a renewable energy source

The presence of a renewable energy source

Very unaware

Unaware Undecided Aware Very aware

Number of respondents (f)	30	10	29	59	59
Points (p)	1	2	3	4	5
f(p)	30	20	87	236	295

Ranking	**4th**	**5th**	**3rd**	**2nd**	**1st**

Table 18 shows the ranking of the level of awareness of the selected strategy and summarizes that respondents that are aware were ranked first (1st), respondents that are very aware were ranked second (2nd), respondents that are undecided were ranked third (3rd), respondents that are unaware were ranked fourth (4th) and the respondents that are very unaware were ranked fifth (5th). This means that most of the respondents are aware of the strategy.

Table 18 showing the respondents' level of awareness of the presence of smart/motion sensor lighting

Presence of smart/motion sensor lighting	Very unaware	Unaware	Undecided	Aware	Very aware
Number respondents (f)	19	20	30	79	39
Points (p)	1	2	3	4	5
f(p)	19	40	90	316	195
Ranking	**5th**	**4th**	**3rd**	**1st**	**2rd**

From the results above it can be seen that majority of the respondents are aware of the various strategy analyzed above.

5. Conclusions and recommendations

This study conducted an investigation to determine how aware the architects in Lagos state are aware of selected sustainable design strategies used in the building design. The results showed that majority of the architects were aware of the different strategies. This helps to understand that architects in Lagos state are generally aware of sustainable design strategies which is a good foundation for promoting the concept in Lagos state. This study recommends that more studies should be done to determine if these strategies have been adopted in order to evaluate the level of awareness and the level of adoption of the strategies. This will help determine if the concept of sustainability is in fact being adopted in Lagos state, Nigeria after it has been established as seen in this study that the architects are aware.

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