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Factors Influencing the Use of Low Carbon Emissivity Features and Strategies in Office Buildings

E. M. Erebor[1] F.M.Adedire[2]
1. Architecture Department, Ajayi Crowther University, Oyo, Oyo State, Nigeria
2. Architecture Department, Lead City University, Ibadan, Oyo State, Nigeria
*E-mail of corresponding author: emokpaee@yahoo.com

Abstract
This study identified the factors influencing adoption, integration and use of low carbon emissivity strategies including features in office buildings which professional outfits and consultants who were responsible for conceiving the designs which involved 16 green office buildings located within Central Business District area of the FCT North Central Zone of Abuja, Nigeria. This was with a view to adopting them and making solid contributions on enhancing office user's comfort within the office buildings studied. Key factors investigated were 26 and they included *nature of the client, availability of skill sets by the respective vendors and the sizes of the office buildings facilitated*. A quantitative research methodology was adopted which included administration of the research instrument which had eighty professionals in construction and design responding to structured questions on their understanding of the subject matter. Data obtained from the field was analyzed descriptively using the SPSS software for analyzing data by social scientists. The statistics obtained from the field reveals that mean scores attributed to the individual factors which were 26 ranges from 2.72 and 3.76. Ranked in the order of influence of each of the 26 factors, the results further show that the three top most influential factors with mean values of 3.76, 3.60 and 3.51 were nature *of the client*, *availability of skill in the firms to handle the design features and strategies* and *sizes of the buildings* in the selected office buildings. Further analyzing the data indicates a majority of the 26 factors investigated had influence on applications of these low carbon emissivity reducing products in the buildings investigated in the research. It is believed that understanding these factors will contribute towards adopting more of these carbon emissivity reducing products in future office construction projects within the city of Abuja thereby enhancing further mitigation of the effects of the further release of the harmful carbon elements by the constructed offices into the cities landscape. That way, climate change and its effects on the built environment will be further understood in the context of the research thereby enhancing office buildings users' comfort.
Keywords: Low Carbon, Emissivity, Energy, Efficiency, Design, Strategies, Design Features, Buildings
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1.0 Introduction

There is an urgent need for improving office buildings energy consumption and importance due to the huge stocks of such edifices in Nigerian urban centers. According to (Mustaffa, Isa, Ekundayo and Joseph 2022), a societies awareness levels of issues surrounding global warming and climate change infers that the society is on the path of transitioning to minimizing the environmental impacts of construction projects on the built environment. Energy challenges which has arisen due to huge surges in urban population figures has further exacerbated changes in user needs which are having devastating consequences on the environmental sustainability of the environment thereby further contributing to the effects of buildings on climate change (Omoragbon, Al-Maiyah and Coates 2023). It was further observed that energy consumption in buildings depends on two major conditions which affect building energy use according to (Akram, Hasannuzaman, Cuce and Cuce 2023).These authors further believe that these multiple conditions are categorized further namely factors directly linked to the environment and factors relating to design parameters. While the earlier conditions are directly linked to the effects of the sun, humidity, outdoor temperatures and wind, the former conditions are linked to form, building orientation and distances between buildings. Designing and constructing Low carbon emissivity office buildings have been highly recommended by (Kozusznik, Maricutoui, Peiro, Virga, Soriano and Mateo-Cecilia 2019) and it can be inferred by the authors that buildings which use energy efficiently are buildings which use minimal energy consumption and also improve the comforts of the occupants within the buildings. Other authors like (Li, Peng, Cai, Cao, Wang, Li and Ma 2023) have also defined minimal energy usage by buildings as a process which uses minimal energy consumption in achieving a purpose which arrives at a common purpose which could firstly be saving environmental harm to the environment and secondly a reduction in greenhouse gases emissions. According to (Lin and Zhai 2023), usage of energy by buildings arises from the buildings configurations, which include the envelopes of the, buildings occupants' and their behavior and the quality of the indoor environment. For quite a long time now, buildings have utilized and consumed 60% of global electricity according to (Zoure and Genovese 2023). These levels of energy consumption have had

adverse effects on the built environment and have contributed immensely to environmental degradation. According to (Amaobeng, Opoku, Boahen and Obeng 2023) globally, energy usage within the building stock consume about 35% of total energy use while also releasing 25% of greenhouse gas emission into the environment. The authors further believe that arising from the adverse effects of harmful gases released into the environment, the need has arisen for the acceleration of research into the development and discovery of efficient and mitigating strategies to reduce further damage to the environment which aligns with one of the goals of the SDGs of ensuring access to affordable, reliable, sustainable and modern energy at all levels. (Amaobeng *et al* 2023) identified that there have been efforts by the Nigerian Government to accelerate the standards for buildings to be energy efficient which have been in the form of drawing up policies through agencies like the Nigerian Energy Support Programme and the Federal Ministry of Power Works and Housing. The authors further observed that these have been in the form of well compiled documents including the Building Energy Efficiency Guidelines (BEEG) and the Building Energy Efficiency Code (BEEC) which have been published as part of efforts geared to encouraging energy efficiency and managing energy inefficiency in the Nigerian building sector.

In their study on usage, consumption and the quality of the environment in Africa, (Jinapor, Suleman and Cromwell 2023) observed that there is a theoretical relationship between the two terms of energy efficiency and the environment and this theory emanates from the ecological modernization theory. This theory states that environmental concerns due to economic activities can be mitigated by improving energy efficiency measures through technological innovations and green practices that harmonise environmental and economic performance. Furthermore according to (Badeche 2022), reductions in building energy consumption and carbon dioxide emissions are two of the most critical challenges facing the building industry today and as a result, more research needs to be employed in finding lasting solutions that will make office buildings more comfortable and less harmful to the environment thereby enhancing energy efficiency and user comfort within them.

Due to how important the study of energy studies has been in the global terrain, it is believed currently that worldwide and in sub-saharan africa, (Hafeez, Sadi, Safa-Gamal, Taufiq-Yap, Alrifaey, Seyedmahmoudian and Mekhilef 2023) are of the opinion that enhancing energy studies and usage in the building stock of both new and old ones, there is the tendency that progress will be achieved within the shortest possible time at finding a lasting solution to the setbacks thereby promoting growth and development within the region which the construction industry has the tendency to enhance. The authors further believe that in addressing these three pronged issues towards achieving usage of energy in the building stock, environmental impacts will reduce through energy performance benchmarking. Secondly, the economic impacts of buildings will also be minimized in savings relating to cutting of costs and reducing the operating cost (hard and soft cost). On the other hand, they also believe that in reducing social impacts, new local rating systems need to be innovated.

Several research works have been carried out on the critical success factors that determine the integration of energy efficiency design strategies and features in office buildings both internationally and in sub Saharan Africa. Some of these studies are discussed here. Firstly, in their study on a review of critical success factors for green building projects in several countries due to a systematic review of publications from 2005 to 2018, (Li, Yuanyuan, Song, Sang, Chen and Liu 2019) identified that “communication and cooperation between project participants”, “effective project planning and control”, “owner's involvement and commitment”, “setting of clear goals and objectives” and “project manager's performance are key critical factors towards the integration and implementation of energy efficiency design strategies. On the other hand, (Maqbool and Jowett 2022) are of the view that organizational culture, project management success factors, stakeholders and integrative technologies and policy factors are core critical factors also influencing their integration. In another research conducted by (Palm and Bryngelson 2023), the authors identified ten key success factors towards the implementation of energy efficiency design features and strategies in building construction projects. These factors include building regulations that force actors to implement energy efficiency, environmental and building certification’s, internal education, be part of an industry network as some of the critical success factors. Others are engagement of electricity utility companies providing information, supportive top and site managers, competition between construction sites, the existence of a plan, checklists or project database, back-office support and client demand for energy efficiency implementation in their design as other key critical success factors. Further research work by (Tunji-Olayeni, Kajimo-Shakantu and Ayodele 2023) in a research conducted in South Africa identified attitude and perceived behavioral control of construction industry players as key factors which will influence low carbon emissions of buildings into the built environment.

It can therefore be implied from earlier studies that there is a lack of literature on the determinants of the use of design strategies that enhance low carbon emissivity of office buildings into the built environment by Architects and allied professionals that are involved in design and construction in the Nigerian Building Construction space. Furthermore, it has also been observed that there are no advanced forms of knowledge regarding attempts by building professionals in Abuja in understanding factors that allow for integration and implementation of these design strategies and features and by direct implications knowing the advantages the

adoptions of these features will have towards enhancing office users total comfort in the buildings designed and constructed. The implications of these low levels of understanding suggests that there is inadequate research work being carried out on this contemporary area of research that affects the built environment since global warming and its other associated risks need to be controlled and reduced from the Nigerian building stock. This has been further obscured because of a lack of understanding of the contributions which construction professionals in the Nigerian construction terrain have contributed to the current discuss. This has in no small measure affected one of their key mandates of attaining the eleventh goal of the SDGs dealing with developing sustainable cities and communities. Therefore, this lack of understanding has further created a vacuum which has necessitated the investigation of this study on determinants of the use of low carbon emissivity materials and tools in Abuja, Nigeria.

Abuja was strategically selected as a study area because during the last few years, Abuja has been adjudged the fastest growing urban city in Sub-Saharan Africa as a result of developmental projects within the city for the past three decades of its formation. Secondly, Abuja has a high volume of office building in the urban city scape that fits very well for this contemporary research on energy efficiency and by direct implication on the vastness of the landmass of the city. Thirdly, due to the fast pace of its developmental tendencies from revenues generated by the Nigerian government in terms of its huge oil reserves, it has become the first area of choice to earn a very comfortable income. Fourthly, Abuja is centrally located as a model city with a lot of design and construction firms pitching their tents of practice there and this makes for different construction stakeholders to practice their concepts with ideas that make for a harmonious cityscape. The scope of the research was targeted at Architectural and Engineering firms referred to as green practices that are at the top of the practice of Design and construction in the study area. These firms were selected because of the high premium they place on sustainability. Abuja's CBD location primarily from the mega cities master plan has been strategically allocated the zone of principal focus for housing state of the art office buildings. Emphasis was placed on the 26 factors that influence the implementation and integration of 29 low carbon emissivity strategies and 29 low carbon emissivity features studied. Further work is documented to include sub groups like review of literature, research methodology, data analysis, presentation of results, discussions and conclusion.

2.0 Literature Review

2.1 Advantages Associated with Building Energy Efficiency and Energy Studies

Energy Conservation and Energy Studies have evolved in the research domain within the past two decades and as a result of their embodied advantages, the drive and push for sustainable designs in the building construction industry have recently been advocated for. According to (Okoye, Okolie and Odesola 2022), construction and its associated deliverables constitutes a lot of risk on the built environment due to construction products and materials and by direct inference have a greater potential impact on sustainability and sustainable built environments. Based on the expected opportunities and the desired long term benefits associated with this mind set tending towards this world view, (Hor and Rahmat 2018) believe that the associated effects of greening office buildings in developed and developing economies have a tremendous effect on the developmental strides and targets of low carbon emissivity set by their governments which when adhered to increases the level of productivity of workers within the office spaces and the built environment at large. Greening the environment also makes for huge reductions in buildings costs in terms of energy provisions within them and also reducing running costs in the short and medium term. While this reductions in running costs of buildings due to a deliberate attempt at greening the built environment by local builders where these buildings are domiciled, (Musa and Abdullahi 2018) also believes that on the world scale, techniques such as these could also serve advantageous purposes since greening buildings have embodied energies that could drop down global building energy consumption by as much as 30 percent. These huge energy demands which are associated with buildings since they emit carbon and its associated harm to the built environment, the authors further believes that it is the construction professionals that have the principal roles of enforcing greening within the design and construction industry since the principal focus is to achieve office building energy efficiency and sustainability because buildings have the tendency of polluting the environment. On the other hand, (Rauschen, Ikaga and Thomas 2020) continues to suggest further advantages associated with greening buildings which they have subdivided into long term profits which they also suggest are quantifiable and measurable. They strongly suggest that vendors involved in the supply of products associated with building energy efficiency should be given cost incentives that would encourage them to further engage in the supply and production of such green products. Secondly, they also strongly believe that Governments at all level should be involved in enlightenment campaigns towards educating clients and would be office building developers intimating them of the multiple benefits of greening buildings which enhances office users comfort within them which has been a source of great concern to employers since office employees often call in sick during working hours. Sick building syndrome and its associated inconveniences will be mitigated if all these processes are strictly adhered to. Greenhouse gas emissions and its adverse environmental impacts continue to be a source of worry and concern to international

organizations like the UN Habitat since such organizations place emphasis on sustainable cities and effectively controlling the source of carbon emissions into the environment will make for more sustainable environments and livable cities. Due to the huge constructions costs associated with developing a building project, it is very important at the onset to consider all energy efficiency and energy related issues that may arise and a result, it is suggested that Integrated Design processes that connect all professionals be considered at the design phases of the project. This is so that considerations of renovations and demolitions of building projects will not arise during design, construction and eventual demolition of the building which also has the tendency to also harm the built environment.

Table 1: Identified Benefits Derived from Energy Efficiency in office Buildings

Benefits	Sources
1) There is a statistically significant and rather large premium in rent and market for energy efficient office buildings	(Eichholtz et al,2019;Reed et al,2005;)
1) Appreciable benefits for the health of residential occupants, office workers, and many other groups 2) Energy affordability 3) Access to energy services 4) Greenhouse gas emissions reduction	(Ryan et al,2012; Morrissey et al,2011; Rahdi, 2008;Xu et al,2015;Maidment et al,2014;
1) Modernizes buildings and bring operations in line with best practices (Building Energy Efficiency Retrofit (BEER).	(Xu et al, 2015;Reed et al, 2005;Liu et al, 2018;Ardente et al,2011;Darwish et al,2017; Kumbaroğlu et al,2012;Ma et al,2012;Ascione et al,2015; Amstalden et al,2007; Zahiri et al, 2018;Jang et al,2015)
1)Improvements in comfort levels within buildings that have poor insulation	Kamal et al, (2019)
1) Increased workforce productivity	Szumilo et al, (2017)

Source: Compiled by Researcher

It therefore can be implied from table 1 that there exists a multiple range of advantages of implementing and integrating efficient strategies and features in the office building stock. Buildings that fall under this category have a very high premium and they enhance the comfort of office building users within them. Workers work and productivity is enhanced and they ensure a further reduction in greenhouse gases which have proved harmful to the built environment over a long period of time.

2.2 Barriers to the Integration of Energy Efficient Design Strategies in office buildings

In a research conducted by (Yimprayoon 2012), the author is of the view that energy efficient buildings use less energy to operate, but still provide the same services and functions that satisfy building occupants in less efficient buildings. The author made it clear that energy efficiency design strategies can be divided into three main categories. First are the architectural components which consist of increased insulation levels, use of high performance glazing's, addition of external shading devices above glazing façade, inclusion of passive solar strategies such as using thermal mass and day lighting. Secondly, are the application of building systems that have to do with high efficiency air conditioning and heating systems and switching from gas-based systems to electricity-based systems. Lastly are building management systems that have to do with thermostat set point temperature and setback temperature

An examination of the existing literature on the barriers to implementing energy efficient design strategies in office buildings has resulted in a delineation of four primary categories as presented by (Tomkiewicz 2011). These include market Perception, information gaps, infrastructure issues and finally implementation issues.

Market Perception as a major barrier to the implementation of energy efficiency design strategies in office buildings is the misplaced perception that there is no consumer demand for products that enhance energy efficiency in office buildings. Secondly, it is believed by designers and those in the construction industry that adopting energy efficient design strategies are an expensive alternative to conventional designs in buildings. On the other hand, regarding information gaps, there is a paucity of information available to developers, architects and building professionals on the costs, benefits, performance and health data of energy efficient design features in buildings. In addition to this is also a lack of information on the costs and energy savings potentials that are available when energy efficient design strategies are adopted in the building construction industry.

Furthermore, infrastructure issues are focused on existing standardized systems, conflicts with permits, code compliance, appraisal and financing which impedes alternative energy efficient design strategies as explained by (Tomkiewicz 2011). There are also implementation issues, which are related to certification programs that are intended to ease the implementation and guide trade professionals through the complexities of building functional, efficient, healthy and sustainable structures through the use of energy efficient design strategies. However, integrating these strategies into the design and construction process requires hours of training: time,

effort and investment to gain the prerequisite knowledge base to successfully do this.

2.3 Enablers of Integration of Energy Efficiency Building Design Features and Strategies

(Wandahl, Lassen, Jacobsen and Poulsen 2014) observed that development of building projects are influenced by innovations which drives economic growth of any economy and helps in making construction firms competitive in the market. Therefore, in some climes, the building sector is the last to adopt a new technology and also the fear of being innovative exists. There is a National Energy Policy (2013) guideline that emphasizes the need for effective use of energy and proposes areas that need to be considered for energy efficiency and conservation. Key strategies believed to have certain capabilities, forces and resources that contribute to the success of the integration of energy efficiency design features and design strategies in office buildings are highlighted in the document which is presented in table 2 and include:

Table 2: Enablers of Integration of Energy Efficiency Building Design Features and Strategies

S/n	Enablers of Integration of Energy Efficiency Building Design Features and Strategies
1.	Existence of standards and codes that promote energy efficiency in Nigeria.
2.	Collaborations formed with neighboring countries. Strong national, regional and international collaboration on energy efficiency and conservation
3.	Data availability on energy use in all sectors of the economy
4.	Introduction of comprehensive audits in terms of energy usage
5.	Public enlightenment campaigns on the importance of energy efficiency in general
6.	The establishment of Energy Services Companies (ESCOs)
7.	Initiation of a national Demand-Side Management (DSM) initiative
8.	Provision of economic, fiscal and financial incentives to promote energy efficiency in all sectors of the economy
9.	Research grants availability for research and development on energy efficient systems
10.	Reward incentives to encourage the use of energy efficient materials
11.	Availability of green electricity by 1 per cent every year on Year-To-Date (YTB) basis compared to 2012 level
12.	Setting and enforcing targets about energy efficiency and conservation
13.	Introduction of awards for compliant companies
14.	Increasing share of green electricity by 1% every year on Year-To-Date (YTB) basis compared to 2012 level
15.	Setting and enforcing targets about energy efficiency and conservation
16.	Establishment of necessary guidelines and regulation on energy efficiency, conservation, consumption, technology, fuel mix, information gathering, etc.
17.	Reduction of electricity generation, transmission and distribution losses from the current level of 15-40% to less than 10% by 2020
18.	Establishment of an appropriate energy efficiency regulatory and legislative framework
19.	Establishment of guidelines for energy efficiency best practices in all sectors of the nation's economy
20.	Development of Minimum Energy Performance Standards (MEPS) for equipment and appliances
21.	Existence of appropriate mandatory labelling for all energy consuming appliances
22.	Certification and accreditation of energy auditors and energy efficiency practitioners
23.	Integration of energy efficiency and conservation studies into curricula of educational institutions in Nigeria
24.	Replacement of all incandescent light bulbs in every home, industry, institution and establishment in Nigeria with LEDs and other energy saving lamps by the year 2025
25.	Establishment of a broad range of equipment energy efficiency standards and labelling by 2025

Source: Compiled by Researcher

2.4 Regulatory Framework

It is suggested that regulations and frameworks need to be established by government so that energy efficiency standards in office buildings can be strictly adhered to. This will go a long way in ensuring that costs are saved and effectiveness of reductions in energy use are attained. Therefore, it was observed from literature that the key components of regulatory frameworks are as follows as highlighted from table 3:

Table 3: Regulatory Framework

S/n	Regulatory Framework	Description
1.	**Legislation: Compliance and Enforcement Framework**	The building energy efficiency code of (2006) in Nigeria was the first step adopted by government at attaining energy efficiency since it specified the minimum requirements for achieving this. This has the capacity to achieve a minimum cost reduction capacity of 40 percent in office buildings. As a means of encouraging building stakeholders to achieve these set down codes and standards, a reward system is encouraged for compliance.
2.	**Availability of appropriate and cost-effective materials for construction and operation**	There are enormous challenges facing the country in terms of meeting the energy efficiency requirements within the buildings sector. This is as a result of the fact that Nigeria's construction sector is fast growing and has the potential to be one of the largest in the world. As a result, new materials and products of construction need to be acquired in meeting energy efficiency in office buildings. Therefore, construction companies that are innovative have a lot of opportunities to benefit from if they are able to innovate in terms of energy efficiency in building construction.
3.	**Qualified workforce for energy efficient building design, construction and operation**	It has been identified that Africa and Nigeria in particular lacks the skilled workforce on the technologies that make for energy efficiency in the construction sector and as a result, it has been recommended that training of professional's with adequate skills is required in this deficit identified.
4.	**Quality assurance**	The process of checking that what has been designed by the construction professional and certified energy efficient are actually constructed on the construction site is referred to as quality assurance. These are normally carried out by regulatory agencies that have been mandated to do quality assurance checks on energy efficient materials like the green building council of Nigeria.
5.	**Market demand for energy efficient buildings**	There is a huge market currently for delivery of energy efficient office buildings due to rapid population growth world over. Again, the international pressure mounted by western economies on countries to reduce greenhouse gases emissions into the environment also plays a key role. Recently, the Central Bank of Nigeria has been at the forefront of ensuring that construction stakeholders are compliant with the energy efficiency drive in Nigeria.
6.	**Access to finance**	Since construction projects are capital intensive, there have to be means whereby construction stakeholders can fund construction projects. Therefore, collaborations are encouraged between housing providers and government arising from a partnership between both sides.
7.	**Stakeholder involvement and acceptance – Moving forward together**	All stakeholders in the construction value chain must be interested in the same goal of achieving energy efficiency. These stakeholders include the Architect, Builders and Engineer and other regulatory bodies in Nigeria.
8.	**International experience-Network and benefit**	There has to be collaborations and co-operation between Nigerian research organizations and foreign counter parts so that there will be a cross fertilization of ideas on new and improved systems and processes of energy efficiency.

Source: Compiled by Researcher

2.5 Positive Impacts of Greening and Energy Efficiency in Office Buildings.

The United Nations has been at the forefront in promoting energy efficiency and energy studies since the world came to the understanding that buildings have a huge impact on the environment thereby contributing towards the noticeable change as a result of climate change and their associated effects on the built environment. It is as a result of these glaring realities that (Lee and Yik 2004) and further educated the world at the UN conference on climate change held in Japan in 1997 on steps to be taken towards reducing greenhouse gas emissions into the built environment. The measures they suggested to be adopted in realizing this were firstly negotiations of legal terms and agreements and treaties to be signed and agreed to by all nations present at the assembly. Other measures suggested were introduction of regulatory instruments by attending nations, regulatory instruments,

voluntary instruments, management and leadership related factors, skills and knowledge factors and finally market factors all in a bid to reduce greenhouse gases from the environment. While hoping that regulatory frameworks set up by attending nations will act as interventionists measures within the societies where these are implemented, other positive gain are expected to be realized. Measurable gains could be in the form of placing bans and restrictions on the importation of harmful building materials into the markets where these buildings are domiciled. Penalties for non-adherence could be in the form of monetary penalties and sanctions imposed on defaulting organizations. Again having an effective building code which should be worked with could be other positive measures enforced. Building codes that place emphasis on greening the environment and reducing carbon emissions are effective regulatory measures within the built environment.

It is also suggested that skills set of design professionals in their fields of endeavor could also stop future violations by developing economies as highlighted at the conference in france.

3. Research Methods

Data which was used for this study was collected from the field by the administration of a structured questionnaire being a research instrument used to source information from respondents in the field of study by design professionals that designed and constructed the sixteen selected office buildings. Further emphasis of the research was on energy efficiency and user comfort in office buildings. One of the principal objectives of the research from five objectives related to the study was to enquire about the key determining factors that influence the applications by design professional of energy efficiency design strategies and features in the design of office buildings. The research method adopted was a quantitative research method with the administration of structured questionnaires to the principal firms that designed and constructed the selected office buildings with key emphasis on Architects, Engineers and Engineering professionals domiciled within the firms.

Six sections were strategically captioned in the questionnaire designed but the results presented for this study is directly linked to section D of the research instrument in order to understand the fundamental factors that encourage adoption of the design strategies and features. Levels of agreement and disagreement were solicited from the respondents by a 5-point Likert type scale ranging from “1” that represents *Strongly Disagree* to “5” for *Strongly Agree.* This research spanned from February to July of 2020 with 80 questionnaires administered to the firms that designed and constructed the Sixteen Selected office buildings in the area of study. The data analysis method

4.0 Results and Discussion

4.1 Critical Success Factors of Integration of Energy Efficiency Design Strategies and Features

Critical success factors that determine greening and energy studies of office buildings are a critical aspect in determining the effectiveness of design measures integrated and implemented in office building design and construction. The selected buildings were documented and the instruments of data collection were administered as stated from the research design stage. 26 critical success factors were identified from literature which determine integration levels of the strategies and features. Table 4 is a representation of the critical success factors identified from existing literature.

Table 4: Critical Success Factors of Integration of Energy Efficiency Design Strategies and Features

Critical Success Factors	Extent of Agreement (N = 80)					Mean	Std. Dev.	Ranking
	Strongly Disagree n(%)	Disagree n(%)	Not Sure n(%)	Agree n(%)	Strongly Agree n(%)			
1. Nature of the client	2(2.50)	8(10.00)	10(12.50)	47(58.80)	13(16.30)	3.76	.93	1st
2. Availability of skill set	1(1.30)	28(35.00)	10(12.50)	19(23.80)	22(27.50)	3.60	.89	2nd
3. Size of the building	6(7.50)	35(35.00)	13(16.30)	14(17.50)	18(22.50)	3.51	3.69	3rd
4.Available Markets for Products	1(1.30)	12(15.00)	35(43.80)	16(20.00)	16(20.00)	3.42	1.01	4th
5.The need to meet clients' requirement	1(1.30)	28(35.00)	10(12.50)	19(23.80)	22(27.50)	3.41	1.25	5th
6.Cost of Products	0(0.00)	27(33.80)	12(15.00)	26(32.50)	14(18.80)	3.36	1.13	6th
7.Characteristics of the Design Features	1(1.30)	29(36.30)	5(6.30)	32(40.00)	13(16.30)	3.33	1.16	7th
8.Knowledge Base of Professionals	0(0.00)	25(31.30)	18(22.50)	22(27.50)	15(18.80)	3.33	1.11	7th
9.Availability of Products in the Market	0(0.00)	29(36.30)	12(15.00)	22(27.50)	17(21.30)	3.33	1.17	7th
10.Power supply situation	1(1.30)	29(36.30)	11(13.80)	21(26.30)	18(22.50)	3.32	1.21	8th
11.Management and Leadership Support	1(1.30)	34(42.50)	6(7.50)	20(25.00)	19(23.80)	3.27	1.27	9th
12.Availability of incentives	1(1.30)	13(16.30)	40(50.00)	17(21.30)	9(11.30)	3.25	.90	10th
13.Existing legislations	3(3.80)	16(20.00)	36(45.00)	14(17.50)	11(13.80)	3.17	1.02	11th
14.Associated Risks	0(0.00)	32(40.00)	13(16.30)	25(31.30)	10(12.50)	3.16	1.09	12th
15.Aesthetic requirements of the building	1(1.30)	37(46.30)	8(10.00)	17(21.30)	17(21.30)	3.15	1.25	13th
16.Greenhouse gases reduction	2(2.50)	36(45.00)	6(7.50)	20(25.00)	16(20.00)	3.15	1.26	13th
17.Extent of compatibility of energy efficiency design features and strategies	0(0;00)	36(45.00)	8(10.00)	25(31.30)	11(13.80)	3.13	1.14	14th
18.Location of the site	6(7.50)	28(35.00)	13(16.30)	14(17.50)	18(22.50)	3.13	1.19	14th
19.Attitude of the Society	1(1.30)	34(42.50)	13(16.30)	18(22.50)	14(17.50)	3.12	1.18	15th
20.Qualified Workforce	6(8.80)	28(35.00)	10(12.50)	19(23.80)	16(20.00)	3.11	1.32	16th
21. Complexity of energy efficiency design features and strategies	0(0.00)	36(45.00)	8(10.00)	25(31.30)	11(13.80)	3.11	1.14	16th
22.Structural requirements	1(2.50)	38(48.80)	4(5.00)	21(26.30)	14(17.50)	3.07	1.25	17th
23. Availability of Standards	4(5.00)	36(45.00)	9(11.30)	18(22.50)	13(16.30)	3.00	1.24	18th
24.Willingness of Clients to Purchase	26(32.50)	10(12.50)	4(5.00)	25(31.30)	15(18.80)	2.91	1.58	19th
25. Institutional and legal frameworks	5(6.30)	35(43.80)	13(16.30)	16(20.00)	11(13.80)	2.91	1.20	19th
26. Attitude of professionals	28(35.00)	14(17.50)	5(6.30)	18(22.50)	15(18.80)	2.72	1.58	20th

n=frequency, %=percentage

In this study, 26 factors that influence Greening and Energy studies identified in the field from the research instrument are presented. Table 4 shows critical success factors that determine the extent to which these design strategies and features are incorporated in office buildings as rated by the 80 building design professionals sampled in the survey

Results of the descriptive statistics reveals that the mean scores for each of the 26 factors ranges from 2.72 and 3.76 (Table 4). The results also reveal that of the 26 factors investigated, the building design professionals were in agreement that 22 (84.62%) of these factors ranked 1st to 17th actually have influence on greening and energy studies in office buildings, while three factors ranked 19th to 20th do not have any significant influence, while they were not sure on the influence of '*availability of standards* 'on greening and energy studies in office buildings when the design features are integrated and implemented in the office buildings. (Table 4).

Ranked in the order of influence of each of the factors, the results further show that the three top most influential factors with mean values of 3.76, 3.60 and 3.51 were nature *of the client*, *availability of skill in the firms to handle the design features and strategies* and *size of the buildings*, respectively. The factors considered to have the least influence are availability of qualified workforce (3.11), complexity of energy efficiency design features and strategies (3.11) and *structural requirements of the building* (3.07), respectively. Generally speaking, it can also be seen in Table 4 that factors ranked 1st to 6th with mean values of between 3.76 to 3.36 can be considered as having the highest influence in greening and energy studies in the office buildings; those ranked 7th to 10th with mean values 3.33 to 3.25 have moderate influence, while those ranked 11th to 17th position and have mean values 3.17 to 3.07 have the least influence on this. Others ranked 18th, 19th and 20th positions with mean values ranging from 3.00 to 2.72 are considered to have no influence on greening and energy studies within office buildings in the selected office buildings. These results generally show that 6(23.08%) of the 26 factors have high influence on greening and energy studies in the building constructed, another 6(23.08%) of the factors have moderate influence, while 10(38.46%) have low influence on this. However, 4(15.38%) of these factors have no influence on greening and building studies in the offices. Based on these, it can have inferred that a majority of the factors investigated have influence in greening and energy studies of the selected buildings as presented in Table 4.

4.4 Discussion

This research in the area of current contemporary discuss on the applications and effects of low carbon emissivity measures and strategies in office buildings which will play a significant role towards enhancing office users comfort within them has been in the academic domain for a very long time. It has further been observed that the subject matter of efficiency and energy studies in the built environment in Nigeria have been under reported by previous research works. There has been a lack of understanding on the part of the regulatory bodies, design and construction professionals on the availability of these products in the market and also enhancing their use. This can be attributed to the manpower resources in terms of insight into the advantages of the products within the building industry and the current state of development in Nigeria that began probably within the last five decades. Governments while being slow in implementing certain building guidelines and codes that will ensure standards and compliance within the set guidelines are still currently working on them. It is hoped that when these codes and guideline have been established by government gazettes, the desired standards and compliances to building efficiency and energy studies will begin to be implemented in the Nigerian Building construction space. It is believed that these building guidelines in the form of the Nigerian equivalent of the Green Building Standards and the Energy Conservation forms and format (2016) will go a long way in streamlining the activities of construction professionals when completed. Again in a research work conducted towards enhancing sustainability and sustainable buildings in meeting the standards set out by European Countries called the 20-20-20 targets, (Braganca, Mateus and Pinheiro 2013) suggested that Integrated Design process which is the common combined pooling of resources by all design professionals is expected to contribute to a common collaborative process. This has a lot of advantages and should be encouraged. Furthermore, the research suggests team members engaged in building design and construction issues be engaged in finding a way round efficiency and energy issues in buildings at project onset and all through the design process and also the operational phases of the building. Other researchers have established a correlation between building facades and efficiency and energy issues. While suggesting that building facades known to all design and construction professionals in the building team are one of the most technologically challenging components of a building (Halawa, Ghaffarianhoseini, Ghaffarianhoseini, Trombley, Hassan, Baig and Ismail 2018) believes that building facades could play a major role in understanding buildings users comfort and satisfaction within the buildings thereby enhancing adequate working environments within the buildings. Again they suggest a collaborative system between all building professionals. Facades to them play two principal roles which are firstly to enhance the buildings aesthetic value and secondly enhancing a buildings performance.

5.0 Conclusion

In this study, the factors that determine the levels of integration of energy efficiency design strategies and features in sixteen selected office buildings by building design and constructions firms in Abuja Nigeria were studied. The study identified three major findings. Firstly, it was observed that from the descriptive statistics, the mean scores for each of the 26 factors ranges from 2.72 and 3.76. Secondly, it was further revealed from this research that of the 26 factors investigated, the building design professionals were in agreement that 22 (84.62%) of these factors ranked 1st to 17th actually have influence on the integration of energy efficiency design features and strategies in office buildings, while three factors ranked 19th to 20th do not have any significant influence, while they were not sure on the influence of '*availability of standards* 'on the integration of these features and strategies in office buildings

From the research, it is evident that although the design professionals are aware of the factors that

determine integration and implementation of energy efficiency design strategies and features, the Nigerian Building industry is still at its infancy at embracing the advantages of energy efficiency in design and construction. In order to benefit fully from the findings of this research, it is suggested that building construction professionals in the country should organize awareness programmes towards highlighting the bountiful benefits. It is as a result of this it is being suggested that the regulatory bodies of registered professionals in Nigeria like the Architects Registration Council of Nigeria (ARCON), Council of Registered Engineers of Nigeria (COREN), and Nigerian Institute of Builders (NIOB) should begin to play leadership roles in embracing energy efficiency and sustainable designs in the Nigerian construction space.

While implementing this research to contribute to the body of knowledge, it was stated from the initial process that the scope for the research was limited to the Central Business District of Abuja which lies within the North Central Zone of the Federal Capital Territory. The city is constituted of a wet season that is warm, oppressive and overcast and the dry season is usually hot and cloudy all year round. This made the study quite unique for the kind of weather condition synonymous within the City Centre. Again, the scope was also focused on building construction firms in the city. These two major factors posed a certain limitation and proved not very sufficient for a complete conclusion in the Nigerian space. It is suggested that arising from these fundamental limitations in location and sphere of construction, further studies should be carried out on the other five geopolitical zones that make up the entity Nigeria which have varied types of weather conditions to have a complete picture of the desired subject matter. Further research should also be embarked upon in other climes of the world for a further comparison of results in the field of study. This research in the present context has added to the body of knowledge both locally and worldwide. It further enhances knowledge in the area of low carbon emissivity measures and features and their advantages to the built environment when used and applied. Energy efficiency is a contemporary issue in the international space presently and Nigeria should also play a leading role in enhancing compliance and mitigation of the harmful effects of office buildings on the built environment.

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