Full paper

International Journal of Real Estate Studies

INTREST

Improving Sustainability in University Environment: The Stakeholders' Viewpoints

Richard Jimoh[1]*, Hyluwa Lelle[1], Luqman Oyewobi[2], Abdulquadir Bilau[1], Momoh Sani[3]

[1]*Department of Building, School of Environmental Technology, Federal University of Technology, Minna, Nigeria*
[2]*Department of Quantity Surveying, School of Environmental Technology, Federal University of Technology, Minna, Nigeria*
[3]*Department of Architecture, School of Environmental Technology, Federal University of Technology, Minna, Nigeria*

*Corresponding author's email: rosney@futminna.edu.ng

Article history: Received: *3 March 2020* Received in revised form: *21 April 2020*
Accepted: *11 May 2020* Published online: *2 June 2020*

Abstract

Improvements on practices and materials have made it reasonable to do what might have been unlikely just few years ago; however, much remains to be done in order to reduce the environmental impact of our structures so as to achieve sustainable built environment. The study therefore assessed the sustainable practices in a university environment in North East Nigeria with a view to developing strategies that will improve sustainable construction in the built environment. This was done through the interview of six stakeholders who played active roles in the design, construction and occupation of the buildings. In addition, document analysis was carried out on the design and change orders. Findings indicated that users' need and sustainable resources were incorporated during the design stage; the use of locally sourced materials during construction stage was also evident. Several challenges were also encountered such as how to integrate sustainable and innovative materials and with the features that were obtainable in North-East Nigeria, incomplete design information and specifications because designers were United States based who had limited information on the terrain of the location. The strategies adopted were traceable to the design and construction stages of the buildings based on the lessons learnt from the 1st building. The study has been able to give several insights in terms of innovations adopted in the construction of two buildings using sustainable construction principles which could be leveraged on by other institutions of higher learning in terms of theoretical and practical perspectives for students and practitioners in the industry when they are engaged in similar projects.

Keywords: Nigeria, stakeholders, campus sustainability, sustainable practices, university environment

1.0 INTRODUCTION

Construction industries activities are major enhancers of global warming as the activities in construction produce greater percentage of toxic gases which are harmful to both humans and the immediate environment, especially from the usage of fossil fuels. Sustainable building materials and products such as reusable fabricated steel sections, energy efficient lighting, natural drainage system and other recycle materials are standard materials for green building construction (Acuff et al., 2005). Zhang et al. (2014) observed that construction activities exhibit greater consequence on the environment than other industries hence it is therefore germane to adopt sustainable development principles to construction industry practices. Sustainable development has significantly advanced in developed nations while in developing nations, is still at the stage of discovering and incorporating methods and research on sustainable design (DeSA UN, 2013). According to Yuan and Zuo (2013), limited universities in developing countries are making concerted efforts to reduce the negative impact of campus operations on the environment by incorporating sustainable practices into their systems. In a related development, Emanuel and Adams (2011) contended that the skill, knowledge of and commitment to campus sustainability are yet to permeate the academia. Aleixo et al. (2017) echoed the same thing in the context of higher education institutions in Portugal to the effect that environmental sustainability is the least developed among the tripod of sustainability.

Strategies and practical application of sustainability concept needs to be communicated across different backgrounds, cultures and disciplinary endeavours. Sanusi et al. (2011) stated that higher education institutions have a special part to play in dealing with the challenge of sustainable development and they need to focus not just on the theoretical aspects but the application in order to get our direction towards a sustainable earth, while at the same time, adapting to meet these long-term goals for robustness. Cole (2003) described sustainable campus as a community which protects and enhances the wellbeing of the environment and the human beings that inhabited it by taking cognisance of its local and global responsibilities. The university in the North East Nigeria (the object of the study) has a large number of staff, which are on a rise prevalently due to the rise in the number of students and staff, which creates a large work space deficit. This created an urgent need to construct a workplace that will accommodate about seven departments with about 260 staff. With the global quest towards sustainable development, this puts the university project team on its toes to make a sustainable design structure out of the

numerous containers that littered the University for many years. United Nations (DeSA UN, 2013) encouraged the implementation of sustainable development in educational institutions through good practice of sustainability in construction and management amongst stakeholders. Hence, Qdais et al. (2019) concluded that the society looks up to higher education institutions in propagating sustainability concepts because they are seen as major change agents in their communities. This leaves universities with active role of improving the environment through sustainable practices by improving the performance of their structures and displaying evidence to their environment and the next generation the best way to achieve ecological friendly future. In this context, the University under study is bridging the gap between these two requirements by the improvements made on its built assets as part of the active teaching and learning process to engage students with core principles of sustainability.

Iyer-Raniga et al. (2015) advocated that building evaluation should be carried across academic buildings in Australia based on their study. This is in the context of Australia; however, Nigeria cannot be left out especially now that the country is trying to key into the Sustainable Development Goals of the United Nations. Akanji (2016) challenged researchers that some advances have been made but much remains to be done if the environmental impact of the structures which we build is to be reduced to a point where sustainable built environment can become an achievable goal. According to Abdul-Azeez (2018), all the physical attributes in terms of infrastructure revolve around master plans, but the question is how sustainable are these physical attributes? To this end, Filho et al. (2015) asserted that many higher education institutions are becoming more aware of their impact on the environment, and are therefore making efforts to understand the environmental needs and implications of their operations. This awareness has made some universities to be incorporating sustainability principles into their activities, though environmental sustainability is still a new concept in campus sustainability. Based on these, the study assessed the sustainable practices in a university in North East Nigeria with a view to developing strategies that will improve sustainable construction in the built environment.

■2.0 LITERATURE REVIEW

2.1 Sustainable Concept in Building Design

Sustainable concept as a model in a building design tends to focus towards preserving and keeping the environment intact which is so important to manage, because it stands to be the main source and provider of resources in terms of materials, energy and water. A sustainable building will have the healthiest possible environment at the same time tends to be practically productive with less rate of disruptive utilization of land, water, energy and resources from construction to lifetime of operation of the building (Zeigler, 2012).

Improvements on practices and materials have made it reasonable to do what might have been unlikely just few years ago; designing structures that improve the environment as opposed to exploiting it (Water Furnace International, 2011). Sustainable building otherwise called green building is seen as a structure that is ecologically and resource-efficiently designed, built, renovated, reused and maintained. Green building is expected to exhibit certain attributes for example, ensuring inhabitant wellbeing, enhancing occupant quality of productiveness, efficient energy utilization, proper conservation of water, and the use of different resources proficiently. Also, to reduce to a great extent the adverse effect on the environment which has direct relationship with human health (California Urban Water Conservation Council, 2013).

Yudelson (2009) depicted a sustainable building as a property whose performance tends to be maximally utilized with less effect on natural domain and wellbeing of mankind. Zabihi et al. (2012) described sustainable building as those buildings with limited adverse effects on the built environment with regards to the buildings themselves, the environment surrounding them and the global setting. In a related development, Alshuwaikhat and Abubakar (2008) indicated that sustainable university campus entails striking a balance among economic, social and environmental goals when formulating policy in terms of long-term perspective with regards to the actions committed presently on campus. Faghihimani (2012) asserted that over the years, there have been series of declarations (for example, The Kyoto Declaration of the International Association of Universities) for sustainability whereby universities are expected to be model of environmental sustainability such that priorities will not be on teaching, research and community services but also on governance. Therefore, Filho et al. (2015) and Abubakar et al. (2016) emphasised that it is not out of place to see examples of environmental initiatives such as recycling, water conserving fittings and energy efficient lighting from a number of universities across the world. According to the United States Environmental Protection Agency (2008), sustainable construction is the process of constructing a building by using techniques that are environmentally responsible and resource efficient from inception, planning, design, development, operation, maintenance, re-use and deconstruction of the building, which entails the entire life cycle of the structure.

2.2 Basics of Sustainable Construction

The essential part that attracts consideration in readdressing the accessible definitions for sustainable construction is the distinctive elements or basics of sustainability that many literature and research have centred on. These focused components of sustainable construction can also be called the Triple Bottom Line (TBL) or the practical framework of sustainability which is Environmental, Economic and Social lines of sustainability (Rogers & Hudson, 2011). Sustainable development elements when carefully studied is simply a matter of which element matter the most (Gibson, 2001). For instance, Gibson (2001) asserted that in sustainable development arguments, environmentalists usually support a two-pillar approach as these spots measure up to equivalent significance on the environment issues and expansion by human. On the other hand, three or five pillars versions were stretched by the international development programmes in order to place significance on the alternate elements towards long haul development. Conversely, the reason behind having some specific elements and ignoring others in sustainable construction is not clearly stated. For instance, four components were considered by Hill and Bowen (1997), which are social, financial, bio-physical and technical elements without coming up with details on how to choose those specific elements. In some definitions by few authors, specifically van Bueren and Priemus (2002), Huovila and Richter (1997) and UNEP (2003), they described sustainable construction as essentially an environmental issue, but essentially designing

sustainable building yields the following advantages; economical, environmental and social benefits (Tennessee Department of Environment and Conservation, 1999).

■3.0 RESEARCH METHODS

Structured interview and document analysis were adopted for the study. Interviews, according to Willis (2007) and Hesse-Biber and Leavy (2011), are concern with a conversation between the researcher (interviewer) and the interviewee which requires the asking of questions and listening by the interviewer. The widespread use of the interview method, as stated by Haigh (2008) may be connected to its flexibility as it ranges from the structured to the open ended interviews. Structured interviews, according to Haigh (2008), involve the interviewer asking the interviewee a list of predetermined questions, hence, the same questions are asked from all the people that will be interviewed. This approach enhances the reliability of the results and the conclusions that will be reached, due to the standardisation of questions asked (Haigh, 2008). In a related development, Hesse-Biber and Leavy (2011) are of the opinion that standardising the interviews ensures comparisons to be made between the interviewees.

In determining the number of stakeholders to be interviewed, purposive sampling was used. This sampling technique is a non-probability sampling procedure which is usually used in qualitative research that has to do with selecting the people to be interviewed based on the interviewer's knowledge on the appropriateness and typicality of the sample selected (Teddlie & Yu, 2007). Eisenhardt (cited by Meyer, 2001) stated that the logic of the sampling is different from statistical sampling because the idea is to select cases that are replicable or be able to further the emergent theory. Yin (2009) suggested that 2 or 3 cases could be selected for literal replication whereas 4 to 6 cases can be used to study theoretical replication (predicting contrasting results).

Interview were conducted on six stakeholders that played active roles from design, construction and occupation of the two admin buildings which were the Project Manager (Quantity surveyor), the Executive Director Project Department (Architect), Project Supervisor (Architect), Quantity Surveyor, the Consultant (Civil Engineer) and the Senior Director Project Office (Admin and Accounts). The interviews took about 20-50 minutes and were conducted between June-July 2017 at the interviewees' offices except for the Consultant Civil Engineer who was in the United States of America when the interview was conducted but was done via telephone. All interviews were tape recorded and later transcribed; this made available all records of what was said and guarded against being biased (Pontin, 2000). Interview questions focused mainly on achievements made during the project, challenges encountered and the lessons learnt for future construction projects.

In addition to the interviews conducted, project documents were also analysed to give better perspective to the study. According to O'Leary (2014), these documents can be public records, personal documents or physical evidence which will be interpreted by the researcher to give voice and significance around the research objectives. To ensure comprehensiveness, document analysis was used to point out questions unanswered and observation that needed to be made (Bowen, 2009). The documents analysed for the research included designs (drawings), change orders and item list.

Plate 1 Aerial view of the two buildings with solar car park

4.0 RESULTS OF INTERVIEWS AND DOCUMENT ANALYSIS

4.1 Results of Interviews

The demographic information of the interviewees is represented in Table 1 below.

Table 1 Demographic information of interviewees

s/n	Rank	Qualification	Years of experience
1	Project Manager and Assistant Director Projects	BSc Quantity Surveying	18 years
2	Executive Director Projects	MSc Architecture	24 years
3	Project Supervisor	Higher National Diploma (HND) Architecture	15 years
4	Principal Project Quantity Surveyor	HND Quantity Surveying	12 years
5	Consultant Civil Projects	BSc Civil Engineering	30 years
6	Senior Director Projects	MSc Project Management	20 years

4.1.1 Perceptions on What Constitute Sustainability

The first section of the interview focused on the perception of the stakeholders on sustainability in construction, most of the stakeholders laid their emphasis on recycling, use of natural and clean process without contamination and pollution in handling construction works. The consultant who had a lot of experience in modern day project with sustainability approach responded to the question of sustainability in higher institution by saying that

"Sustainability is now an essential part of modern and efficient construction. It is expected by any client that is serious and educated because without sustainable practices the project will not be efficient. It is very important. However, the challenge in Nigeria may be the understanding by the clients and the willingness to invest in sustainable features if they do not really understand the cost benefit".

The stakeholders felt it was a substantial achievement to have such buildings that adopted sustainable practices most especially being an institution. *Since higher institutions are research based, this will stand as a model to the communities and the industry to follow and societies to benefit from,* as stated by the Quantity surveyor.

4.1.2 Success Criteria

The method of procurement adopted as explained by the two Quantity surveyors was focused on the best and most capable materials and solution which went through one of the following; competitive bidding method, selective competitive bidding, negotiation bidding systems and direct procurement system with manufacturers of products like tiles, furniture etc. The process included having at least three different contractors for each specified trade; for example, the electrical installation, air conditioned installation, foundation, steel works and roofing, plumbing etc. The estimated time for the first building (Admin 1) was nine (9) months but was completed in eighteen (18) months, while for the Admin 2 building, the estimated time was twelve (12) months but was delivered in fifteen (15) months. Delays encountered were due to the exchange rate which was a national issue at that time, shipping and clearing issues for imported items such as furniture, carpets, and High Volume Low Speed (HVLS) fans, incomplete working drawings as a result of so many changes made by the users along the line, lack of adequate understanding of what was required from the contractors and also internal inefficiency and bureaucracy.

The initial estimated cost for Admin 1 was 250 million Naira but around 430 million Naira was spent due to increase in building size and the solar car park introduced to service the building. In a related development, Admin 2 building was estimated to be 400 million Naira but about 500 million Naira was spent. This was because of the Naira devaluation; the budget was made in Dollars in January 2015 when the exchange rate was as low as N199 to $1 but foreign exchange rate got up to N400 to $1 around July 2016, which created rise in cost of materials like fittings, fixtures and equipment. As the QS stated *"it was a saving on the dollar side and loss on the Naira part"*.

In terms of quality, the Admin 1 building met about 60% expected quality because the building was an experiment at first; the idea was new to almost all the stakeholders. While the Admin 2 building met its expected standard up to 90% because the building skin was still an issue according to the Project Supervisor. But quality was achieved to a great extent as noted from the stakeholders through teamwork and common understanding of what was the acceptable quality for the institution, good supervision and project management, good design specifications, and good cost control mechanism to avoid cost overrun of the projects.

The method of communication in order to achieve the project management triangle: amongst the stakeholders was basically through periodic site visit, emails, open and shared work environment, shared items on construction Google drive which has the 'action item list' which was used to save all agreed information for all members of the team. Also, project meetings which could be physical with the on-ground team or through video conferencing such as Skype with the consultants and Architects based in the USA. The communication between the stakeholders and contractors basically were through emails, verbal site agreements, site meetings and signed documents.

4.1.3 Lessons Learnt and Challenges Encountered

The other session of the interview was on the lessons learnt and challenges faced during the construction of the two admin building projects. The first question sought to relate the admin buildings to a sustainable building by identifying traceable elements which the stakeholders listed as:

- The recycled shipping containers which eliminated the need for concrete structure, and its mud (laterite) skin finish (clay).
- Use of insulated roofing, exterior insulation of wall (Polystyrene or polyurethanes), ceiling and also insulated panel made from polystyrene and double-faced aluminium used for partition.
- Acoustic panels made locally (from scraps of clothes gotten from tailors).
- Use of skylights (solar tubes) for natural lighting and low energy lighting system (LED).
- Use of High Volume Low Speed (HVLS) fans to improve efficiency of Heating Ventilation and Air conditioning (HVAC)

The quantity surveyor highlighted that "*almost every element in the building is sustainable in its own way even the carpets used which is the carpet tiles which some has features of acoustics when walking on it, its maintenance is very easy since it comes in 0.25sqm and can be reused elsewhere".*

On the challenges during the design stage, the interviewees had similar answers which included; how to integrate sustainable and innovative materials and features that were obtainable in North-East Nigeria, incomplete design information and specifications because it was an experimental building. Designers which were United States based had limited information on the terrain of the location, examples included the adequate pitch for roof design, structural design parameters which was as a result of the design brief sent across to the designers. But the major challenge as stated by the consultant was the need to accept the new concepts which required people to learn and understood the need for sustainable practices and materials. Not everyone understood the impact that more efficient buildings have and the cost benefit of investing in sustainable features that reduces the operating cost of the building. Users needed to be educated on the new features of the facility they will occupy, and how everyone should play a part in conserving resources and reducing waste via proper behaviour, sensible use of resources, and teamwork.

At the construction stage, issues faced included; making sure stakeholders understood the evident features of the buildings and ensured they were fully implemented, getting the right people to key into the idea, that is, most contractors did not fully understand the idea and approach of what was required of them which led to high level of supervision and more time in making sure details were followed. For example, the roof design and installation was an issue because of the solar skylight installation, materials searching was not easy because the technology was not too common in Nigeria.

At the occupation stage, challenges faced in Admin building 1 included: educating occupants regarding proper usage and care of the building, furniture, installations, power, water, waste bins. In addition, users were not convinced with the idea of open office, which led to distractions at work due to constant greetings, also lack of confidentiality of keeping documents openly. Technical challenges which were highlighted by the Project Supervisor and Project Manager included maintenance of the roof in areas where skylight was installed, maintenance of the external skin of the building (made of red mud [laterite]), air conditioner design in Admin 1 was also a challenge but was noticed during occupation stage when the users occupied the building but was revisited and corrected.

The last part of the interview sought answers to the lessons learnt from Admin building 1 which were used during the construction of Admin building 2; the Project Manager and Consultant Civil Engineer provided answers to the issues raised. It was referred to as the area of improvement by the Project Manager and points highlighted included:

- Roof design: the truss design was upgraded and entrance canopy was improved upon in order to allow for drive through which has a covered drop-off area for the university shuttle bus for protection whenever it is raining.
- Cooling and ventilation system: in Admin 1, package unit air conditioner was used with HVLS fans while in Admin 2, HVAC with HVLS was used. The HVAC has provision for air exchanger which takes in fresh air into the building and expels contaminated air.
- Plumbing/External drainage: due to frequent maintenance reports of blockage in Admin 1 sewer lines, improvement in waste line by introducing easily accessible service duct which was difficult to access in Admin 1. In addition to this, there was the introduction of trap chamber with grills that intercepts and collect non-biodegradable waste in the treatment plant route in Admin 2. Also, the surface drainage lines were improved upon to a more sustainable way by the use of red bricks to replace concrete walls along the surface waterlines with collection points made in form of French drains to return the surface water back into the earth.
- Building skin and interior wall cladding: In Admin 1 building, padded polystyrene was used for the wall cladding (which was cumbersome) and plywood was used to finish the interior walls. In Admin 2 building, polyurethane which comes in liquid form was used for the cladding which is easy to install, provided more insulation and it glued perfectly to the walls of the container and for the interior, gypsum board (dry wall) was used which gave better finished surface.

4.2 Results of Document Analysis

4.2.1 Design

The number of shipping containers for the two buildings, their sizes and the number of occupants are shown in Table 2 below. Both buildings had the same concept of reusing shipping containers but with different design specifications and detailing. Some noticeable changes in the building design included the introduction of entrance canopy in Admin 2 which was missing in Admin 1, the extension of the eave projection from 1.5m in Admin 1 to 1.82m in Admin 2, the air conditioner design which changed from normal AC units to HVAC. The plumbing design which changed from using 100mm pipes for sewer lines in Admin 1 to 150mm pipes all through in Admin 2. Also, the insulation design specification for the external body of the building (container) in Admin 1(polystyrene) was changed in Admin 2 (polyurethane).

Table 2 Number of shipping containers used

Building	Number of shipping containers used	Size of building in sqm^2	Number of staff occupied
Admin 1	14	1750	130
Admin 2	18	1950	230

4.2.2 Change Orders

This was a folder that recorded all variations encountered during any project in the university. The change order always goes through an approval process using the capital project committee. Changes or variations encountered in Admin 1 building included the expansion of the project by reviewing the design after when the budget was already approved and signed, with three contractors selected and contracts signed. The civil works was affected, the containers works and structural steel works were affected and roof trusses/sheets installation with solar tubes (skylight) was also affected. Another noticeable change that occurred was the review of the air conditioning requirements in the Human Resources and Finance Departments open space office area. Three 4.0hp package units were added after occupation.

In Admin 2 building, changes that occurred during construction included external works/landscaping (additional walkway was made from the car park to the rear entrance of the building, main entrance stair case; granite finish was changed with the originally designed tiled finish, entrance canopy was finished with hardwood painted ceiling). The electrical works had some changes also which included provision of additional temporary lights for security reasons and late-night works, additional panel and earthing for HVAC. Other changes included extra windows due to incomplete supply of windows by the foreign vendor, reinforcement of aluminium panel walls used for partitioning with aluminium sections and conversion of a conference room into an executive office.

4.2.3 Item List

This was an excel format created in Google drive for the Construction Department. This list contained correspondences, meeting minutes, onsite/offsite agreements and issues pending that were discussed on site. Most of the changes made during projects were noted on the page with corresponding dates. The document contained list of all traits associated with the project with specific items that needed action, assignee, the person that made the action point, the action that needed to be taken, completion date, the follow up team and notes. When a number of actions have been completed, the whole team will be notified and thereafter deleted from the page.

4.3 Strategies for Better Sustainable Practices

The interview sought to find out strategies that could be evolved for better sustainable practice of future buildings within and outside the university. The Consultant Civil Engineer stated that,

"Education of decision makers at the time of making project decisions to incorporate sustainable practices as part of the process. Investment in sustainable features can payoff, it has to be illustrated to decision makers. And also, the designers should be versed in smart design so that the project can be a sustainable project"

In addition, the following points were highlighted by the interviewees. Design briefs should be collected with users' inputs before producing the drawings in order to save time and have clarity of what is required amongst stakeholders. Materials with less effects on the environment and occupants, cheap but efficient should be the basis of the concept, like the solar tubes, clay (laterite) and acoustic materials made locally. Processes and technologies that will reduce pollution and lifecycle cost should be adopted for example, the use of LED lights, timed and less water consuming plumbing fixtures, sewer treatment plant where the resulting effluent could be used for landscaping.

Looking at these buildings, strategies for implementation of sustainable practices in an improved measure can be adopted. These strategies can be traceable to the design and construction stages of the buildings. At the design stage user satisfaction and efficient utilization of available resources were the main strategy adopted. In line with the suggestion made by Asif et al. (2007), that construction design stage should cover all the areas of sustainability practices such as energy conservation, used of efficient materials, minimization of waste, pollution and discharge control etc., these were applied in the design stage of the admin buildings.

Strategy of reusing the available natural resources which is the *'reuse of available shipping containers'*, *'the mud (laterite) finish on the building skin'*, and *'red bricks for columns and drainages'*. Godfaurd et al. (2005) asserted that building products become more sustainable when materials gotten from natural environment are being used. The use of building materials sourced locally can help lessen the environmental burdens, shortens transport distances, thus reducing air pollution produced by vehicles. Often, local materials are better suited to climatic conditions, and these purchases support the local economies.

Furthermore, design briefs should aim to reduce maintenance and running cost by incorporating components and materials with minimum life cycle cost and service life (Emmitt & Yeomans, 2008). Also, benchmarking for material selection should include durable materials which Mora (2007) ascribed as materials which original condition can stand over time, and non-toxic which neither emit poisonous gas nor reduce air quality throughout the building lifecycle (Kim & Rigdon, 1998). This was applied in the buildings, for example, sky lights (solar tubes) and LED lights were specified for the buildings. Also, specifying High Volume Low Speed (HVLS) fans to enhance the HVAC for thermal comfort. The use of isowall for partition which does not require painting. Others were specifying waste treatment plant for the facility and the use of efficient timed plumbing fixtures to avoid waste of water, design of landscaping by specifying native plants with low water demand, use of structural steel for roof members which could stand the test of time.

The efficient use of the site by positioning the building strategically especially the Admin 2 in such a way that the vegetation around was not affected by avoiding cutting down of trees and shrubs but reusing them for relaxation areas, this was done to preserve the native trees around in order to preserve heritage and control against the use of trees that require lot of attention and watering (Morrish, 2007). The building was positioned properly so that the longer side facing the west and east for proper harvesting of sun light to power the solar, in

addition to this, the eave was constructed with longer projections and purloins as protection against rain and sunrays directly on the buildings.

Another strategy that evolved was the use of local indigenous contractors around the community, the use of native procedure to finish the building skin (red clay wall finish) and onsite production of red bricks, which served as employment opportunities for the citizens and conserving the heritage of the people. This was in order to achieve the social dimension of sustainability which Adetunji et al. (2003) emphasised as an obligatory responsibility of construction professionals.

Finally, the reuse and recycling of waste or materials was also adopted in accordance with Esin and Cosgun (2007) that pointed out that environmental effect of construction waste can be reduced to the point of being an economic advantage. This was achieved by the reuse of container body scraps that was cut out for window and door openings as toilets partitions, water fountain, and decorations around the buildings; use of tailored scrapes of cloths to make decorative acoustic panels, harvesting rainwater and reuse for construction works and landscaping.

■5.0 CONCLUSION

The paper examined the sustainable practices adopted in the construction of two buildings in a University in North East Nigeria using shipping containers with a view to throwing light on the sustainable principles used during the design, construction and occupation of the buildings. Challenges encountered, lesson learnt and strategies that were put in place were brought to the fore which could be leveraged on by other institutions of higher learning and professionals in the built environment when confronted with similar situations. The paper argued that it was appropriate to involve end users during the design stage in order to increase their satisfaction level during occupation and that a lot of sun could be harvested for solar energy when buildings are properly oriented. In a related development, the use of local contractors and local materials contributed to the social pillar of sustainability as these will improve the local economy and reduce capital flight. Finally, since Admin 1 served as 'guinea pig' project, it enabled many of the challenges encountered during occupation be rectified during the design and construction of Admin 2. Due to the limited number of these type of buildings in higher institutions in Nigeria, it is expected to serve as reference point in terms of adherence to the pillars of sustainability for some time to come.

References

Abdul-Azeez, I. A. (2018). Developing sustainable university campus index. *FUTY Journal of the Environment, 12*(2), 66-80.

Abubakar, I. R., Al-Shihri, F. S., & Ahmed, S. M. (2016). Students' assessment of campus sustainability at the University of Dammam, Saudi Arabia. *Sustainability, 8*(59), 1-14.

Acuff, Z., Harris, A., Larson, L., Magnus, B., & Pumpbrey, A. (2005). *Building green for the future: Case studies of sustainable development in Michigan*. Ann Arbor, MI: Urban Catalyst Associates, University of Michigan.

Adetunji, I., Price, A., Fleming, P., & Kemp, P. (2003). Sustainability and the UK construction industry - A review. *Proceedings of the Institution of Civil Engineers: Engineering Sustainability, 156*(4), 185-199.

Akanji, M. A. (2016, May). *Sustainable built environment and climate change: The challenge of post 2015 development agenda*. Welcome Address of the Vice Chancellor, Federal University of Technology, Minna at the School of Environmental Technology 1st International Conference, Federal University of Technology, Minna.

Aleixo, A. M., Azeiteiro, U., & Leal, S. (2017). The implementation of sustainability practices in Portuguese higher education institutions. *International Journal of Sustainability in Higher Education, 19*(1), 146-178.

Alshuwaikhat, H. M., & Abubakar, I. (2008). An integrated approach to achieving campus sustainability: Assessment of the current campus environmental management practices. *Journal of Cleaner Production, 16*(16), 1777-1785.

Asif, M., Muneer, T., & Kelley, R. (2007). Life cycle assessment: A case study of a dwelling home in Scotland. *Building and Environment, 42*(3), 1391-1394.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27-40.

California Urban Water Conservation Council. (2013). *Top 5 Actions*. Retrieved from http://www.h2ouse.org/.

Cole, L. (2003). *Assessing sustainability on Canadian university campuses: Development of a campus sustainability assessment framework* (Master's thesis). Royal Roads University, Victoria.

DeSA UN. (2013). World population prospects: The 2012 revision. In *Population division of the department of economic and social affairs of the United Nations Secretariat.* New York, NY: United Nations Publications.

Emanuel, R., & Adams, J. N. (2011). College students' perceptions of campus sustainability. *International Journal of Sustainability in Higher Education, 12*(1), 79-92.

Emmitt, S., & Yeomans, D. T. (2008). *Specifying buildings: A design management perspective* (2nd ed.). Amsterdam: Elsevier.

Esin, T., & Cosgun, N. (2007). A study conducted to reduce construction waste generation in Turkey. *Building and Environment, 42*(4), 1667-1674.

Faghihimani, M. (2012). A systemic approach for measuring environmental sustainability at higher education institutions: A case study of the University of Oslo (Unpublished Master's thesis). University of Oslo, Norway.

Filho, W. L., Shiel, C., & do Paco, A. (2015). Integrative approaches to environmental sustainability at universities: An overview of challenges and priorities. *Journal of Integrative Environmental Sciences, 12*(1), 1-14.

Gibson, R. B. (2001). *Specification of sustainability-based environmental assessment decision criteria and implications for determining "significance" in environmental assessment*. Ottawa: Canadian Environmental Assessment Agency.

Godfaurd, J., Clements-Croome, D., & Jeronimidis, G. (2005). Sustainable building solutions: A review of lessons from the natural world. *Building and Environment, 40*(3), 319-328.

Haigh, R. (2008). Interviews: A negotiated partnership. In A. Knight & L. Ruddock (Eds.), *Advanced research methods in the built environment* (pp. 111-121). Chichester: Blackwell.

Hesse-Biber, S. N., & Leavy, P. (2011). *The practice of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.

Hill, R. C., & Bowen, P. A. (1997). Sustainable construction: Principles and a framework for attainment. *Construction Management and Economics, 15*(3), 223-239.

Huovila, P., & Richter, C., (1997, August). Life cycle building design in 2010. In *Proceedings of the 11th International Conference on Engineering Design - ICED 97* (Vol. 2, pp. 635-643). Tampere: Tampere University of Technology.

Iyer-Raninga, U., Moore, T., Kashyap, K., Ridley, I., & Andamon, M. M. (2015, October). Beyond buildings: Holistic sustainable outcomes for university buildings. In *Proceedings of the 15th International Australasian Campuses towards Sustainability (ACTS) Conference*. Geelong: Deakin University.

Kim, J.-J., & Rigdon, B. (1998). *Sustainable architecture module: Qualities, use, and examples of sustainable building materials*. Ann Arbor, MI: National Pollution Prevention Center for Higher Education, University of Michigan.

Meyer, C. B. (2001). A case in case study methodology. *Field Methods, 13*(4), 329-352.

Mora, E. P. (2007). Life cycle, sustainability and the transcendent quality of building materials. *Building and Environment*, *42*(3), 1329-1334.
Morrish, G. (2007). *Street design guidelines*. New York, NY: Landcom.
Qdais, H. A., Saadeh, O., Al-Widyan, M., Al-tal, R., & Abu-Dalo, M. (2019). Environmental sustainability features in large university campuses: Jordan University of Science and Technology (JUST) as a model of green university. *International Journal of Sustainability in Higher Education*, *20*(2), 214-228.
O'Leary, Z. (2014). *The essential guide to doing your research project* (2nd ed.). Thousand Oaks, CA: Sage.
Pontin, D. (2000). Interviews. In D. F. S. Cormack (Ed.), *The research process in nursing* (4th ed., pp. 289-298). Oxford: Blackwell Science.
Rogers, K., & Hudson, B. (2011). The triple bottom line: The synergies of transformative perceptions and practices of sustainability. *OD practitioner, 43*(4), 3-9.
Sanusi, Z. A., Steele, R., Khelghat-Doost, H., Jegatesen, G., & Rosli, H. (2011). *Education for sustainable development: Issues, principles and practices for global application*. Penang: Centre for Global Sustainability Studies, University Sains Malaysia.
Teddlie, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. *Journal of Mixed Methods Research, 1(1)*, 77-100.
Tennessee Department of Environment and Conservation. (1999). *Green office guides.* Nashville, TN: Tennessee Department of Environment and Conservation.
UNEP. (2003). Sustainable building and construction: Facts and figures. *UNEP Industry and Environment, 26*(2-3), 5-8.
United States Environmental Protection Agency. (2008). Green communities: Basic information. Washington, DC: U.S. Environmental Protection Agency. Retrieved from http://www.epa.gov/greenbuilding/pubs/about/htm.
van Bueren, E. M., & Priemus, H. (2002). Institutional barriers to sustainable construction. *Environment and Planning B: Planning and Design*, *29*(1), 75-86.
Water Furnace International. (2011). *Green Building Report*. Fort Wayne, IN: WaterFurnace.
Willis, J. W. (2007). *Foundations of qualitative research: Interpretive and critical approaches.* London: Sage.
Yin, R. K. (2009). *Case Study Research: Design and Methods* (4th ed.). Thousand Oaks, CA: Sage.
Yuan, X., & Zuo, J. (2013). A critical assessment of the Higher Education for Sustainable Development from students' perspectives - A Chinese study. *Journal of Cleaner Production, 48*, 108-115.
Yudelson, J. (2009). What is a green building? In *Sustainable Retail Development*. Dordrecht: Springer.
Zabihi, H., Habib, F., & Mirsaeedie, L. (2012). Sustainability in building and construction: Revising definitions and concepts. *International Journal of Emerging Sciences*, *2*(4), 570-578.
Zeigler, P. M. (2012). *What is a green building? Fundamental principles of green building and sustainable site design*. Harrisburg, PA: Governor's Green Government Council.
Zhang, X., Wu, Y., Shen, L., & Skitmore, M. (2014). A prototype system dynamic model for assessing the sustainability of construction projects. *International Journal of Project Management*, *32*(1), 66-76.