Facilities Improvement for Sustainability of Existing Public Office Buildings in Nigeria

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Abstract

The study examined the building design features of a cosmopolitan public office building in Abuja. The features were classified into *Spatial Plan*, *Structure* and *Facilities*, to determine which of the 3 variables requires urgent sustainable improvement from end-users' perspective in existing public office buildings in developing countries. A quantitative approach was adopted while the research strategy involved survey and direct observation. Post-Occupancy Evaluation was used to collect the survey data on a massive public office building in Nigeria, which reflected the quota system and federal character of the nation, as study area. A total of 339 useable questionnaires were retrieved from the respondents, and the analysis conducted revealed that *facilities* requires the most urgent improvement for sustainability. It was therefore recommended that *facilities* should be given priority for successful sustainable improvement of public office buildings above other design features.

Keywords: *Existing buildings, Facilities, Performance indicators, Sustainable improvement, Users' requirement.*

Introduction:

The improvement of old buildings from existing stock for sustainability is termed sustainable improvement (Mansfield, 2011); and it is an offshoot of Sustainable Development (SD), which was defined as man's "ability to make development sustainable to ensure that it meets the needs of the present users without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development - WCED, 1987). In a bid to reach an environmental sustainability goal, the United Nations (UN), during its 1992 Earth Summit in Rio de Janeiro, called on member States to adopt and integrate the principles of SD into their national policies and programmes within a 10-year target (i.e. to 2002). However over 20 years after (now nicknamed 'Rio + 20'), many countries especially those in the developing world, are yet to make significant headway in quest for SD of their built environment (Wood & Muncaster, 2012).

Brandon and Lombardi (2010) estimated that 87% of existing buildings will stand by 2050, which therefore goes without saying that existing buildings require effective sustainable improvement that will satisfactorily meet users' requirement, particularly in developing countries such as Nigeria with an estimated population of over 170 million people (National Population Commission, 2012), the 6th most populous country in the world, the most populous and largest economy in Africa (International Monetary Fund, 2016). Jiboye (2009) observed that despite efforts at both the local and international levels, current realities in Nigeria suggest that the goal of achieving sustainability is yet to be realized.

Arge (2005) classified building design features requiring improvement for sustainability into 3, namely: *Spatial Plan* (rooms and ancillary spaces layout/design); *Structure* (building elements, materials and finishing); and *Facilities* (facilities and services or utilities). The paper therefore evaluated the 3 variables to determine the most important for successful SD in existing public office buildings. The research question consequently addressed *"How best can public office buildings be sustainably improved in Nigeria, from end-users' perspective?"*

Literature review:

Scholars' perception of the concept of SD

Evolving from the SD definition, Mediawiki (2008) described SD as the process of building communities and living comfortably without consuming all resources, implying that SD is a way of conserving common resources not just about consumption, but includes change in culture to make conservation a way of life. Brandon (2012) also described SD as a process of change in which exploitation of resources, the direction of investments, the orientation of technological developments and institutional change are all in harmony, enhancing current and future potential to meet human needs and aspirations. However, in as much as SD is seen as a vision of progress that integrates immediate and longer-term needs, local and global needs, scholars still construe its meaning as complicated.

In a paper to the World Bank, Pezzey (1989) listed 60 published separate definitions of SD, observing that there was little agreement as to its meaning in practical or even theoretical terms. According to Mansfield (2011), despite the efforts of national governments to provide a cohesive policy to address the negative impacts of SD, there is still considerable difficulty in providing a consensus definition of the term. Gilmour and Banks (2011) also argued that SD is a complex issue that is not consistently definable in practical terms owing to its very expansive nature, while Lee and Huang (2007) assumed SD as the most challenging and controversial issue with respect to its interpretation and application.

Slessor, cited in Abley and Heartfield (2001) suggested that the definition only serves as a starting point and hardly sufficed as an analytical guide or policy directive. Hartshorn, Maher, Crooks, Stahl and Bond (2005) opined that a particular difficulty with the considerable disagreement over its precise meaning is that it combined unresolved political, philosophical and technical issues from the 'environment versus growth' debate. Nonetheless, McLennan (2004) believes that SD is an improvement philosophy that seeks to maximize the quality of the built environment. This paper thus adopted the WCED (1987) definition of SD on its face value, that "it meets the needs of the present without compromising the ability of future generations to meet their own needs" and relates it to the ability to conservatively meet users' requirement in existing public office buildings.

Suggested practical approach to SD

Strzelecka (2008) presented SD as a universal challenge in which practical responses can only be defined nationally and locally. Accordingly, the application of SD principles is structured to the local environmental settings, which will include ethnic origin, culture, class, gender, population, etc. Nawawi and Khalil (2008) reported a research in which respondents differ in perceptions and expectations due to background, working experiences, general knowledge and technical skills in public buildings in Malaysia, in which Setiawati, Notodarmojo, Soewondo, Effendi and Otok (2013) also reported that the socio-cultural conjointly affect sustainability, because the occupants are the end-users and not the designer. There is harmony in literature that the same approach cannot be used universally to achieve SD; Rana (2009) observed that SD goals cannot be addressed the same way for all nations because of societal and cultural differences, especially in developing nations where urban population growth is unpredictable and even uncontrollable. This paper consequently approached SD within the local setting, i.e. considering end-users' requirements based on their ethnic, culture, class, gender, etc. in a federal public office building in Nigeria where *federal character* and *quota system* of the nation are well reflected, rather than straight adoption of global SD policies.

Sustainable improvement of existing buildings.

This paper examined existing buildings and their role to sustainability through the improvement of their standards. It adopted Marir and Watson (1995) definition of improvement as work carried out on existing buildings in an attempt to sustainably upgrade them whilst retaining their current use. Sodagar (2013) contended that sustainability cannot be achieved without addressing existing buildings as it is unlikely that new build alone would deliver a sustainable built environment in the near future. Wood (2006) argued that even if every new building is sustainable, their impact on sustainability as a whole will be insignificant after a while, since no building is an island, but rather relates one to another and to the infrastructure, which links and serves them and end-users. According to Nelson (2008), much of the buildings for the next century already exist and thus, to make a serious impact on SD, improvement of existing buildings should be duly considered, so that fewer resources may be consumed compared to demolition and rebuild.

Benefits of improvement highlighted in literature

(i) Reduces maintenance cost

The argument here is that a sustainably improved building considerably reduce maintenance cost (Wilkinson, Reed & Jailani, 2011). Douglas (2006) opined that, compared to rebuild, improvement of existing buildings would postpone, if not avoid the obsolete process of buildings and it will greatly enhance their performance. Kincaid (2002) reported a study carried out in the United Kingdom that post improved office buildings had lower operating costs than prior to improvement even if sustainability was not a priority, while Suzuki, Dastur, Moffatt, Yabuki and Maruyama (2010) suggested that the principles of SD take into account and carefully assess the operational costs after construction is completed so as not to burden in the future. Grigg (1998) argued that adequate building maintenance is one of the major factors affecting sustainability, because poorly managed infrastructures steadily deteriorate, become congested, or become unsafe and clearly are not sustainable.

(ii) Cheaper than demolition and rebuild

Another benefit of improvement of existing buildings is the growing perception that the improvement of existing building is far cheaper than demolition and rebuild. Ma, Cooper, Daly and Ledo (2012) observed that improvement is considered as one of main approaches to achieving sustainability in the built environment at relatively low cost and high uptake rates, although the choice of the most cost-effective strategy from a wide range readily available for particular projects "is still a major technical challenge". Shrestha, Yatabe, Bhandary and Subedi (2012) reported a major finding in Indonesia that cost of improvement is less compared to the cost of demolition and rebuild. The improvement option further saves cost as it is time saving and the downtime is less. According to Itard and Klunder (2007), the reasons why improvement is cheaper and inherently sustainable are because it involves less resource consumption, less transport energy, less energy consumption and less pollution during construction. Shipley, Utz and Parsons (2006) opined that improvement is potentially cheaper inasmuch as the structural components already exist, and the cost of borrowing is reduced, as contract periods are typically shorter.

(iii) Environmental friendliness

The weight of enlightened opinion also considered improvement of existing buildings a safer strategy as it reduces the amount of disturbance due to hazardous materials, contaminated ground and the risk of falling materials and dust. Improvement offers a more efficient and effective process of dealing with buildings, as site work is more convenient as the existing building offers a work enclosure during extreme weather conditions (Bullen & Love, 2011). A greater transportation need for materials and waste is observed for building demolition, involving a polluting impact of particulates, thus improvement has notable economic, social and environmental advantages in comparison to demolition and rebuild (Gohardani & Bjork, 2012).

(iv) Effective SD implementation strategy

The improvement of existing buildings is also considered an effective SD implementation strategy for existing buildings. Bullen and Love (2011) opined that improvements provide the opportunity to link the performance of a building directly to the objectives of sustainability, while Newton and Bali (2008) argued that the challenge of achieving SD in the 21st century will be won or lost in the urban areas with policy makers believing that improvement of existing buildings will deliver sustainability in the built environment.

Sustainable improvement of office buildings

Improvement has been seen as a means of conservation of resources compared to demolition and rebuild. In particular reference to improvement of office buildings, there are obvious economic, environmental and social benefits which advantage owners and occupiers, e.g. owners are said to benefit from lower running costs, higher rental and capital values (Reed & Wilkinson, 2005). Occupants in addition benefit from lower running costs, less employee absenteeism due to reduced building-related illnesses and improved occupants' health (Wilkinson et al., 2011).

Arge (2005) listed 3 improvement criteria related solely to physical design of buildings, and do not include, e.g. financial or contractual flexibility, namely: (i) Generality, i.e. a building and its space and services are designed for multifunctional use; (ii) Flexibility, referring to the built-in possibilities of a building to rearrange, take away or add elements and systems when the needs of the users change; (iii) Elasticity, the possibility of dividing the building into different functional units or to extend the building horizontally or vertically.

End-users' requirement and satisfaction

End-users are the people who use or occupy the building; they are not experts in managing it, but have knowledge and opinions, nonetheless, about its performance in relation to their own objectives (Pemsel, Widén & Hansson, 2010).

According to Jylhä and Junnila (2013), facilities management literature in recent years had discussed the shift from bricks and mortar to an end-user-driven mindset; the focus is no longer only on cost minimization and real estate operations but rather on supporting end-users thus suggesting that a change in improvement philosophy is needed. Jylhä and Junnila (2014) opined that the ultimate goal is to produce and deliver end-users' requirement, which only the end-users themselves can define.

Schipper and Swets (2010) also suggested that a creative solution from intensive research is required to determine and address what is important to the end-user, who will ultimately benefit from it. According to Black (2008), end-users and not technologies are the key to world-class facilities.

Importance of users' requirement

Karna (2009) defined users' satisfaction as when the quality of a service meets or exceed expectations; otherwise, they are not satisfied. From this perception, an important attribute of users' requirement that could serve as a measure of performance is the reference to the user as a key determinant of quality. Therefore, every quality improvement needs to be directed towards ensuring that facilities fulfill the requirements and specifications assigned from end-users' viewpoint (Kim, Oh, Cho & Seo, 2007).

The most important factor as a benchmark for a building improvement to meet sustainability objectives is the level of users' requirement incorporated in it (Birkeland, 2012). Haynes (2008) argued that a sustainably improved office can have direct impact in increasing job productivity and is a crucial factor in job satisfaction, staff recruitment and retention.

According to Sinou and Kyvelou (2006), comfort is an essential parameter, since the building should not be perceived as an object separated from its users, thus end-users, their perception of the environment and their participation during the initial planning and design phases should play an important role in the process of sustainable improvement. Shika, Sapri, Jibril, Sipan and Abdullah (2012) observed that in order to achieve sustainability objectives in office buildings, a coherent strategy and action plan is needed to address end-users' requirements in existing buildings.

Key Performance Indicators (KPIs) in office buildings

According to Cohen, Standeven, Bordass and Leaman (2001), periodic feedback about a building performance is vital for continuous and consistent improvement. Amaratunga, Baldry and Sarshar (2000) argued that there is need to identify the core indicators of performance for each building type from the broad list of available KPIs, while the selection will depend primarily on the type of users, the nature of the organization (private or public), performance assessment focus (i.e. financial, functional or physical), and current trends and demands in the industry. The variables that affect the core performance indicators identified as relevant to this study are those affecting the comfort of the occupants; comfort was defined by the absence of unpleasant sensations, which has a positive effect on well-being (Feige, Wallbaum, Janser & Windlinger, 2013).

Previous studies from the end-users' standpoint indicated that emphasis on occupants' well-being and health are collectively the 2 factors which constitute users' satisfaction and are a measure of users' requirement (Roulet et al., 2006). What factors cause discomfort is subjective and vary from person to person; however, it is possible to define factors which are perceived as unpleasant for most people. Comfort can be affected by different variables, but are mainly linked to the technical and functional performance requirements (Hassanain, 2008):

(i) Technical performance requirements

These include visual comfort, thermal comfort, acoustical comfort, indoor air quality, and fire safety (Hassanain, 2008).

Thermal comfort

Thermal comfort is achieved by the balance of heat exchange between the occupant and the environment and is a function of the occupant's activity level. A human being is said to be thermally comfortable when he or she cannot express whether a cooler or warmer surrounding environment would be preferred (Hassanain, 2008). Extremes of temperature have been found to have a negative impact on job productivity; decreases in job productivity to the order of 30% have been found in buildings experiencing extreme temperature conditions (Oseland, 2001).

Visual comfort

The optimal design of lighting involves providing a comfortable and healthy visual environment that supports the activities of the occupants. The benefits include providing enough light to permit safe accomplishment of tasks, avoid eye strain and headaches, and enhance social interaction (Lim, Kandar, Ahmad, Ossen & Abdullah, 2012). Day-lighting indicators include lighting quality and quantity, glare and access to a view, while electrical lighting should not compensate for natural daylight. Day-lighting has become a significant part of the environmentally friendly building design (Kim, Lim, Lim, Schaefer & Kim, 2012), and had been linked to a 15% reduction in absenteeism in office environments; increases in productivity of between 2.8% and 20% attributed to increased luminance levels, and 50% savings in electricity bills due to an integrated day-lighting design that harmonized layout, orientation, window placement, type of glazing, light shelves and ceilings (Thayer, 1995).

Franta and Anstead (1994) reported that appropriate day lighting in work places had been associated with higher productivity, lower absenteeism, fewer errors, positive attitudes, reduced fatigue, and reduced eyestrain. Van Bommel and Van den Beld (2004) also reported that occupants in day-lit and full-spectrum office buildings have reduced headaches and increased general wellbeing. Galasiu and Veitch (2006) opined that a strong preference for daylight in workplaces is associated particularly with the belief that daylight supports better health. Edwards and Torcellini (2002) also argued that increasing daylight and fewer glares lead to greater focus and higher achievement, while natural light had been proven to be superior to artificial light as it is helpful for people's work, eyesight protection, psychological well-being and improvement of work efficiency (Boyce, Hunter & Howlett, 2003). Leslie (2003) however reported that although mainly beneficial, daylight can also cause visual discomfort through glare and distraction, such as reflections or shadows.

Acoustical comfort

In work places, noise mainly originate from activities in adjacent spaces, and primary to providing quiet environment are walls, floors, windows, and doors providing adequate reduction of sound from adjacent activities. There are strong indications that point to the importance of ensuring appropriate noise levels in offices; Loewen and Suedfeld (1992) reported improvements of 38% in the performance of simple tasks and 27% for complex tasks when working in an environment with reduced noise. According to Leung and Fung (2005), excessive noise can also cause hearing loss, high blood pressure and can negatively affect working performance. The Noise Reduction Coefficient (NRC) and Sound Transmission Class (STC) of building components are very important because they affect the building's acoustic quality as a whole. Crocker (1998) reported that the NRC scale is from 0 to 1 while the STC scale is from 1 to 100 and that in both cases, the higher the number, the better.

Fire safety

Fires are among the main causes of life and property loss in buildings. Possible types of 'fuel' that could be found in the offices include furniture, books and papers. The provision and regular upkeep of fire safety systems in offices is an essential concern to ensure the safety of occupants. Purkins and Li (2014) classified the elements that relate both to life or property safety within a structure into 5 design concern categories - (a) control of ignition; (b) control of means of escape; (c) fire detection and control; (d) control of spread; and (e) prevention of structure collapse.

Indoor Air Quality (IAQ)

IAQ indicators have a profound impact on job productivity as they are responsible for health, comfort, absenteeism, lower motivation, decreased productivity and safety of building occupants (Kats, 2006). Occupants in buildings with IAQ problems suffer from symptoms such as eye, nose and throat irritation, dry skin and mucous membranes, fatigues, headache, wheezing, nausea and dizziness resulting in discomfort (Boyce, Hunter & Howlett, 2003). In addition, adverse indoor atmosphere may increase absenteeism and reduce job productivity, which may have business as well as financial implications (Fowler, Solana & Spees, 2005). American Society of Heating, Refrigerating and Air-Conditioning Engineers (2007) defined acceptable IAQ as air in which there are no known contaminants at harmful concentrations, which a substantial majority (80% or more) of the people exposed express dissatisfaction. Fisk and Rosenfeld (1997) reported a decrease in health problems ranging from 13.5% to 87% due to improved IAQ thereby enhancing job productivity. Lin, Chow and Tsang (2007) also reported that door openings significantly affect airflow pattern, especially the displacement of CO_2.

(ii) Functional performance requirements

These comprise the interior and exterior finish systems, spatial layout, support services, efficiency of circulation (Hassanain, 2008) and provision for the disabled (Preiser & Wang, 2006).

Interior and exterior finish systems

The systems include the elements that users interact with, such as exterior walls, interior finishes and floor surfaces. Common performance problems associated with exterior walls are colour fading, moisture and wind infiltration, spalling, buckling, delamination, cracking, cleanability and erosion (Baird, Gray, Isaacs, Kernohan & McIndoe, 1996).

Spatial layout

The spatial distribution helps to facilitate a number of functions in a relatively small space, including comfortable working environment, relaxing, socializing and refreshing. The office must give out a sense of privacy and security, with good lighting and ventilation, and a reasonable view. In addition, the occupant should be able to control his indoor environment (heating, cooling, lighting, etc.) and should be able to impose his own personality on the room without damaging it. Therefore, the spaces and conditions which should create an engaging, peaceful office environment must be given careful consideration (Pride, 2007).

Support services and utilities

Water closet systems and wash basins are usually designed to the minimum practical area, and should be in close proximity to the offices. Good ventilation should be provided to reduce the effects of condensation, while it is vital that all surface materials used in the toilets have moisture-resistance finishes (Ho et al., 2004). Water supply and waste discharge systems installation and maintenance as well as the overall water capacity within a building and the method of supply and distribution contributes to the quality of that building. Ho et al. (2004) reported that an unhygienic environment creates nuisances to occupants, and growth of micro-organisms which lead to the spread of infectious diseases; the cleanliness of common areas and immediate neighbourhood reflect the environmental hygiene conditions.

According to Kitawaki (2002), developing countries with poor water supply and sanitation systems have life expectancy which is far lower than in industrialized countries. He defined the major meaning of sanitation in developing countries as the management of human excreta. Greed (2004) noted that the sanitation standard is intended to ensure that employers provide employees with sanitary and available toilet facilities, so that employees will not suffer the adverse health effects that can result if toilets are not available when employees need them. Thus lack of adequate water supply is seriously linked with the management of human waste.

Parking lot is another support service and according to McDonald (2009) parking has often been reduced to the construction of the most minimal stand-alone parking lot without human, aesthetic or integrative considerations. This has given parking a poor public perception and has frequently disrupted existing urban fabric. The parking facility must foremost deal with the functional and operational requirements of users; for instance, the provision for safe and efficient passage of the automobile; security devices such as video, audio and emergency buttons that call into the local police station are also needed in parking lots (McDonald, 2009).

Internet and intranet are also support services in office buildings and the use of both can complement deficiencies in building designs and boost productivity among other things (Szarejko & Trocka-Leszczynska, 2007). Baby friendly office environment is another support service also being craved for in Nigeria; the first lady - Aisha Buhari, together with some state governors' wives, called on employers to create an enabling environment for mothers to breastfeed babies in workplaces, during the 2015 World Breastfeeding Week (Ibeh, 2015).

Electricity supply is also erratic in Nigeria as a support service, according to Aliyu, Ramli and Saleh (2013), only about 40% of the Nigerian population are connected to the energy grid and power failure occur around 60% of the time.

Personal control over local environment

Personal control over the mechanisms of comfort factors is a key way of both providing for exceptional quality comfort and delivering a message of autonomy and importance. This is related to how much control users have over their environment in key areas such as temperature, lighting and ventilation. Leaman, Stevenson and Bordass (2010) reported that the provision of personal control over the local environment has 2 main performance benefits:

Firstly, individuals are found to be more tolerant of fluctuations in interior comfort factors when they have control over them. If given control, occupants are likely to remain satisfied despite slightly lower building performance. Secondly, occupants have been found to value the sense of control which is provided by such responsive systems, and had been identified as a significant variable in perceived job productivity. Leaman and Bordass (2003) observed that the ability of users to rectify unforeseen discomforts (glare, draughts, etc.) through small changes can make positive effect on reducing dissatisfaction levels. In as much as it is often impractical to provide high levels of control in each office, designers should depend upon simple, robust control devices such as openable windows, radiator valves and window blinds; while particular attention should be given to control mechanisms for noise and cooling.

Provision for the disabled

Disabled persons should be able to access buildings and facilities as everybody else; this has to do with accessibility for the disabled and preparedness of the building to accommodate special needs of handicapped people (Preiser & Wang, 2006). According to Han, Kunz and Law (2002), design of buildings and facilities must comply with Disability Acts Guidelines; the intent of the handicapped accessibility regulations is to provide the equivalent access to buildings and its facilities for disabled persons (e.g. persons restricted to wheel chair or persons with hearing and sight disabilities) and persons without qualifying disabilities.

The Disability Acts Guidelines provides for clearance to allow transfer of a person from a wheelchair to a toilet and minimum lengths of grab bars associated with a toilet (Hans, Kunz & Law, 2002). WCED (1987) defined SD as humanity's ability to meet the needs of the present; therefore, ignoring the disabled in the built environment negates the concept. Jones and Tamari (1997) reported that persons with disabilities are among the most underserviced in the world in the built environment.

Efficiency of circulation

The interior layout of the building should be efficient in terms of the arrangement of offices on each level in the building, the width of the corridors for circulation inside the building, and the location and number of stairs in the building (Hassanain, 2008). Visitors should be able to easily locate offices in the building, while proximity to other facilities such as car parking should be located within short walking distance. Pickard (2008) gave a specification of a width of between 1.5m to 2m for primary circulation routes.

Methodology

The research design adopted the quantitative method, while the research strategy involved the use of survey and direct observation approach. The data analyses involved the use of SPSS v22 and MS Excel 2013, narrations and discussion. The diagnostic Post Occupancy Evaluation (POE) tool adopted for data acquisition has its working depth limited to the systematic evaluation of end-users' requirement in the study area through questionnaires, in order to assess the design feature that require urgent improvement for sustainability in public office buildings from end-users' perspective. Ornstein, Moreira, Ono, França and Nogueira (2009) reported that POE reveals design problems, thereby demonstrating the relevance of end-user knowledge to the evaluation of building designs. The Federal Secretariat Building, Bauchi Nigeria was adopted as study area. Eisenhardt (1989) suggested the use of one study area as more appropriate to confirm or address a rare or unusual situation. According to Yin (2013) study area is preferred when the focus is on contemporary phenomenon within real life context; this can provide information that can be compared for better understanding of the occupants' experience. The selection was thus based on non-probability judgmental sampling technique, which involves the researcher's opinion in determining the criteria for the selection of the study area (Babbie, 2011).

Thus the study area was adopted for the following reasons:

(a) It was designed and constructed in 1989, when sustainability was not a consideration (Miller & Buys, 2008);

(b) It has not undergone any major improvement work since its construction, as at time of study;

(c) It is a massive structure accommodating 26 different government parastatals with combined civil servants strength of 971, reflecting the federal character and quota system of the nation (Strzelecka, 2008);

(d) The building is still operational and not abandoned;

(e) Easy access to the building for collection of data (Yin, 2013); and (f) The researcher's in-depth local knowledge of the property (Yin, 2013). In addition, the signs of non-sustainability observed during reconnaissance survey include:

(I) Non-provision for the disabled in form of ramps, elevators, special parking spaces, toilet, etc.;

(ii) Congestion and thermal discomfort in offices;

(iii) Inadequate conveniences, creating social and environmental menace; and

(iv) Inadequate parking facilities, among others.

The 4-storey framed structure with non-loading bearing internal partitions also makes improvement more realistic in execution without much consideration for structural problem of overloading, or generation of much waste or debris. It therefore met the 3 Norwegian Building Research Institute improvement criteria of generality, flexibility and elasticity (Arge, 2005). All the occupants at the study area were adopted as the research sample size, to reflect the federal character and quota system of the nation (Strzelecka, 2008).

The evaluation options were based on a 5-point Likert scale of "very good", "good", "marginal", "poor" or "very poor", with each option allotted a score: very poor = 1 to very good = 5. Average values established for each variable which are >3 indicated that the respondents' perception of the variable was good, while those <3 suggested that the perception was poor (Haynes, 2008). Furthermore, the respondents' comments were grouped into the design variables as classified by Arge (2005), and were quantified and analyzed using the simple frequency distribution.

Results

(1) Respondents reflect the quota system and federal character of Nigeria

Table 1 shows that the respondents represent all genders, geo-political zones, major tribes, educational status, major religions and age groups prominent in Nigeria.

More so, the income distribution represents an ideal and common pyramid organizational structure usually found in offices (Charles, 2006), while their service years in public service and stay in present office is considerable. The study had therefore achieved the suggestion that the application of SD principles should be structured to the local environmental settings, which will include ethnic origin, culture, class, gender, population, etc. (Strzelecka, 2008; Setiawati et al., 2013; Rana, 2009).

Table 1: Demographic data from the study area (Field survey, 2014)

SN	Variable	Description	No	%
1	Gender	Male	271	80
		Female	68	20
2	Geo-political zones	North-Central	36	11
		North-East	137	40
		North-West	51	15
		South-East	37	11
		South-South	35	10
		South-West	43	13
3	Tribes	Hausa	224	66
		Igbo	72	21
		Yoruba	43	13
4	Age	21-30 years	4	1
		31-40 years	46	14
		41-50 years	132	39
		>50 years	115	34
5	Religion	Christianity	163	48
		Islam	176	52

SN	Variable	Description	No	%
6	Monthly income (₦)	Below 50,000	78	23
		50,001-100,000	157	46
		100,001-150,000	72	21
		Above 150,000	32	10
7	Service years	Below 10 years	122	36
		11-20 years	112	33
		21-30 years	93	27
		>30 years	12	4
8	Stay in present office	Below 5 Years	144	42
		6-10 Years	78	23
		Above 10 Years	117	35
9	Education	[illegible]	34	10
		OND cert.	76	22
		HND cert.	53	16
		First Degree	120	35
		Masters' Degree	54	16
		Ph.D. Degree	2	1

(2) Respondents' perception of the design feature variables

The respondents' perception of design variables from analyses is depicted in Table 2; Spatial Plan and Structure variables were deemed "Good" with mean scores of ≥ 3.00, while the Facilities variable was deemed "Poor" with a mean score of < 3 (Haynes, 2008).

Table 2: Respondents' perception of design feature variables (Field survey, 2014)

	Variables and components	Mean	Standard deviation	Response summary
i	Offices design	3.10	1.035	Good
ii	Offices Layout	3.24	0.982	Good
iii	Ancillary rooms' design	2.87	1.035	Poor
Iv	Ancillary rooms' layout	2.96	1.053	Poor
v	Building design	3.07	1.032	Good
	Spatial plan (overall)	***3.05***	***0.849***	***Good***
i	Wall	2.93	0.986	Poor
ii	Floor	2.87	0.965	Poor
iii	Windows	3.37	0.965	Good
Iv	Doors	2.95	0.981	Poor
v	Ceiling	3.07	0.992	Good
	Structure (overall)	***3.04***	***0.760***	***Good***
i	Water supply	2.69	0.949	Poor
ii	Electricity supply	2.50	0.946	Poor
iii	Internet facilities	2.53	0.952	Poor
iv	Security facilities	2.64	0.913	Poor
v	Other facilities	2.51	0.875	Poor
	Facilities (overall)	***2.57***	***0.746***	***Poor***

(3) Respondents' observations and requirements

Likewise, the respondents' comments were quantified and classified under the design variables, while the finding revealed that user's requirement was 77% for Facilities, 10% for Spatial Plan and 13% for Structure (Figure 1). This consequently suggests that the occupants are not as concerned about the Spatial Plan nor Structure, as they are about Facilities offered or put in place within and without office buildings, thus advocating urgent improvement Facilities as a major tool for sustainable development of existing public office buildings in Nigeria.

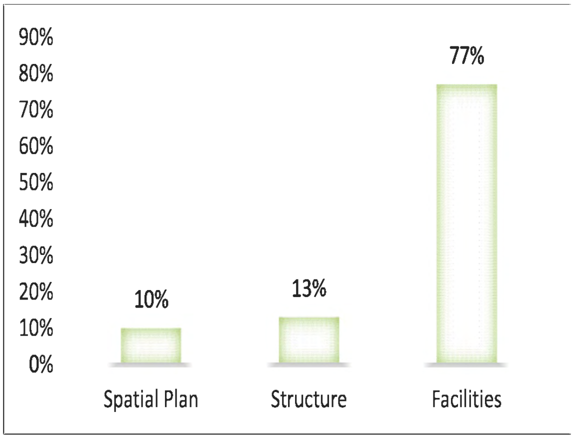

Figure 1: Users' requirement by design variables (Field survey, 2014)

Conclusion

The study embarked on determining the best approach for sustainable improvement of public office buildings from the 3 design variables of *spatial plan, structure* and *facilities*, from end-users' perspective.

The quantitative study adopted a survey strategy to acquire data from occupants as respondents at the study area, and the data analyses revealed that the design variable of *facilities* requires utmost consideration. This is consistent with Jylhä and Junnila (2014) who opined that the ultimate goal is to produce and deliver end-users' requirement, which only the end-users themselves can define. Furthermore, the respondents (who reflected the local setting of Nigeria) made some unusual facilities requests, which includes baby friendly, recently advocated by Nigeria's First Lady (Ibeh, 2015); recreational and laundry facilities in a strictly public office complex; these buttressed the views of Nawawi and Khalil (2008), Strzelecka (2008), Rana (2009) and Setiawati *et al*. (2013) that SD is a universal challenge in which practical responses can only be defined within the local environmental setting rather than straight adoption of global policies. The paper thus recommends that for successful sustainable improvement of existing public office buildings, *facilities* should be given more attention from users' perspective, than the other design variables.

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