Adaptability and Sustainability of Office Buildings.
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ABSTRACT
The aim of this study was to promote Adaptability and Sustainability in office buildings. The office building is one of the great icons and edifice of the twentieth century. Office towers dominate the skylines of cities in every continent as the most tangible index of economic activity, portraying social, technological, and financial progress, they have come to symbolize the advancement of Architecture in every city. This is true because the office building is the most visible reflection of a profound change in employment patterns, but the most common problem in office buildings remains in its adaptability and sustainability, most especially in the tropical regions like Nigeria considering the inadequacy of electricity, therefore, the promotion of adaptability and sustainability in office buildings is of great importance which is the central aim of this research. The researcher’s primary source or method of data collection was based on descriptive method of data analysis to evaluate the draw backs of existing office buildings. Studies has shown that most office buildings are not adaptable and sustainable most especially in developing countries due to the inadequacy of electric power to run these buildings. The Research gap here is that the Natural elements of the environment has not been fully harnessed in maintaining ecological balance in office buildings. To accomplish this development, the building must benefit from an integrated design approach that focuses on meeting a list of objectives through a tropical design that offers owners and users an increased working satisfaction and productivity, improved health, greater flexibility, enhanced energy and environmental performance at little or no cost.

Keywords: adaptability, environment, sustainability.
1. INTRODUCTION

The office building, an iconic edifice that has always beautify the skyline of cities, office buildings are great varieties of structures that plays a prominent role in the economic growth of urban centers, Francis (1997). This means anything from a two storey suburban building to a 100-storey urban high-rise. The building may be constructed purely on speculation, to house whatever tenants choose to locate in it, or it may be built to suit the specific needs of a corporate headquarters. Whatever its size or type, the office building is a complex building type and is affected by many forces. It’s most important role to provide accommodation for tenants, visitors and equipment, at same time facilitating office activities, however, its design greatly affects their performance, Stewart (1994).

The number of individuals and firms involved in the design of a speculative or corporate office building is significant. Obviously, office building is driven by user type, such as investment banks, professional firms, or high-tech companies Stewart (1994). The needs of these users normally dictate the floor size, concept and marketable location of the building. The need for office buildings to have more flexible spaces, adaptable office equipment and materials, built in services etc. is beginning to be a standard practice in the tropics and in developing countries since electricity might not be constant and sufficient to run most office buildings. Therefore, the need to make office building design environmental friendly is highly emphasized with the provision of alternate lightening solutions, proper ventilation system in buildings in case of power outage, incorporating open-office plans for increased office space flexibility. Zhang, Athalye, Hart, Rosenberg, Xie, Goel, Mendon, and Liu (2013).

An office is generally a room or other area where administrative work is done, but may also denote a position within an organization with specific duties attached to it, office as place originally referring to the location of one's duty, Long (2004). When used as an adjective, the term "office" may refer to business-related tasks. In legal writing, a company or organization has offices in any place that it has an official presence, even if that presence consists of, for example, a storage-silo rather than an office. An office is an architectural and design phenomenon; whether it is a small office such as a bench in the corner of a small business of extremely small size, through entire floors of buildings and including massive buildings dedicated entirely to one company. In modern terms an office usually refers to the location where white-collar workers are employed. James (2012), a Business Administrator, defines office is that part of business enterprise which is devoted to the direction and coordination of its various activities.

Offices in classical antiquity were often part of a palace complex or a large temple, the High Middle Ages (1000–1300) saw the rise of the medieval chancery, which was usually the place where most government letters were written and where laws were copied in the administration of a kingdom, Hamilton (2011). With the growth of large, complex organizations in the 18th century, the first purpose-built office spaces were constructed. As the Industrial Revolution intensified in the 18th and 19th centuries, the industries of banking, rail, insurance, retail, petroleum, and telegraphy dramatically grew, and a large number of clerks were needed, and as a result more office space was required to house these activities. The time and motion study, pioneered in manufacturing by F. W. Taylor led to the
“Modern Efficiency Desk” with a flat top and drawers below, designed to allow managers an easy view of the workers. However, by the midpoint of the 20th century, it became apparent that an efficient office required discretion in the control of privacy, and gradually the cubicle system evolved, Eugene and Paul (2002).

The main purpose of an office environment is to support its occupants in performing their job. Work spaces in an office are typically used for conventional office activities such as reading, writing and computer work. There are nine generic types of work space, each supporting different activities, Cheshire and Hilber (2008). In addition to individual cubicles, there are also meeting rooms, lounges, and spaces for support activities, such as photocopying and filing. Some offices also have a kitchen area where workers can make their lunches. There are many different ways of arranging the space in an office and whilst these vary according to function, managerial fashions and the culture of specific companies can be even more important. While offices can be built in almost any location and in almost any building, some modern requirements for offices make this more difficult, such as requirements for light, networking, and security. The primary purpose of an office building is to provide a workplace and working environment primarily for administrative and managerial workers, Juriaan and Hermen (2010). These workers usually occupy set areas within the office building, and usually are provided with desks, PCs and other equipment they may need within these areas. Therefore, this project centers on integrating the natural environment as a major element influencing the design of office buildings in the tropics, it will also explore alternate ways of achieving safety, sustainability, adaptability and comfort in office buildings at the lowest possible cost.

RESEARCH PROBLEM

One major and common problem in office buildings is in the use of alternate source of ventilation and lighting which is a common problem in most developing nations like Nigeria. It has been discovered that when there is power outage in these office buildings, office activities is at a standstill due to inadequate consideration at the design stage in the use of natural lighting and ventilation (tropical Architecture) Zhang et al (2015) thus this project seek to discover best practices on how to utilize these natural elements in order to achieve an office building design that blends with our environment and adapt to its natural features.

Safety is a very important aspect in office buildings most especially fire safety which tends to be deficient in most office buildings. Liu (2015). Therefore, this project will explore best practices as regards fire safety, considering escape routes, emergency exits, and other approach to safety in office buildings.

Waste disposal system is another problem facing office buildings due to adequate provision of equipment for waste disposal. Umezurike (1988) outlined that littering of premises has always been a recurring decimal in multi-tenantable properties. Aziyu (2001) also outlined that it is a habit of occupants to disrespect the immediate environment by littering. Despite the positioning of dust bins in different areas within the building and around the premises, visitors still drop pieces of paper and garbage in unwanted places. This problem creates additional work for cleaners. Therefore, it is of essence that alternate and more effective measures are put in place to manage waste.
RESEARCH QUESTIONS

1. What are the challenges facing the adaptability of office buildings in Nigeria?
2. How can safety be ensured in office buildings?
3. How can office buildings become more sustainable in Nigeria?

AIM

The research is centered to promote adaptability and sustainability in office buildings. It will seek to understand the prevailing circumstance as regards the design of office buildings in Nigeria and to increase the sustainability of office buildings as it relates to the use of natural elements. Thus, recommends best solutions to make office buildings adaptable and sustainable in accordance with best practices.

OBJECTIVES

1. To investigate the challenges facing the adaptability of office buildings.
2. To articulate measures towards a safe office environment.
3. To examine the problems facing the sustainability of office buildings in Nigeria.

2.0 LITERATURE REVIEW

In contemporary cities, skyscrapers are an increasingly common sight in areas where rents are high. Urban economists usually assume that high density buildings are merely the result of a high price for land, which provides an incentive to economize on land and to increase expenditure on building capital. (Lucas and Rossi-Hansberg, 2002). However, it is argued that the presence of very tall buildings cannot be fully explained by standard urban economic models (Helsley and Strange, 2008). Helsley and Strange indicate that skyscrapers arise from two additional basic forces. First, workers may be more productive in skyscrapers, which we label as within-building agglomeration economies. Tall buildings imply an extreme density of workers, allowing for internal returns to scale. (Gold, 1981). As almost all tall buildings are offices that host many tenants, within-building external returns to scale may also play a role.

An important source of external returns encompasses face-to-face contacts, leading to knowledge spillovers between workers (Marshall, 1890; Storper and Venables, 2004; Combes et al., 2008). Moreover, Jacobs (2011) argues that a diverse portfolio of firms may lead to product innovations and new combinations. Arzaghi and Henderson (2010) show that most of these externalities take place within a very close distance from the firm location, especially for high-end business services. Within-building interactions are more likely than between-building interactions because restaurants, gym facilities, etc. are shared among workers of the same building. Moreover, the low time cost of vertical (within-building) transportation using elevators (compared to horizontal transportation) stimulates interactions and leads to the construction of tall buildings, even on cheap land (Sullivan, 1991). Second, Helsley and Strange pointed out that there is an inherent value placed on being the tallest, a reputation effect. A developer may receive a prize (social status, reputation etc.) when it constructs tall buildings. This may lead to overbuilding, as a builder has an incentive to construct a building that is taller than the welfare-maximizing one. Given a competitive
building industry, this reputation effect must capitalize in office rents, i.e. firms have a preference to locate in tall buildings that are landmarks, as a favourable reputation allows firms to set higher prices, attract investors and attract a talented workforce (Klein and Leffler, 1981; Milgrom and Roberts, 1986; Eichholtz et al., 2010).

Although the construction of tall buildings requires enormous investments and receives much attention in the media, the economics of building height are underexposed. The literature heavily relies on studies that theoretically investigate the development of skyscrapers and high-rise buildings (Arnott and McKinnon, 1977; Grimaud, 1989; Sullivan, 1991; Bertaud and Brueckner, 2005; Helsley and Strange).

Empirical evidence is limited to studies which confirm that height competition is a determinant of building height, although this only holds for a small portion of the building stock (Barr 2010a; 2010b). To what extent taller buildings receive rent premiums, and more specifically, whether there is a reputation premium, is unknown, where the presence and height of nearby buildings that are constructed before World War II are used as instruments for building height. In this way, we also control for spatial variation in prices that is due to variation in the demand for land as indicated by standard urban economic theory (Fujita, 1989). This effect can be disentangled from within-building agglomeration effects by assuming that the marginal agglomeration effect is diminishing in height, which is in line with Helsley and Strange. It is important to note that, although in the Netherlands, maximum building height restrictions are common, hedonic price analyses are still applicable. The results show that firms are willing to pay about 4 percent more to locate in a building that is 10 meters taller. It appears that the willingness to pay for building height is highly nonlinearly related to rents, and the marginal effect is non-monotonic. We then demonstrate that the reputation effect is at least 17.5 percent of the additional rent for a building that is 6 times the average height. We only find evidence of within-building agglomeration benefits, and not of between-building agglomeration effects, suggesting that interactions between workers are an extremely local phenomenon (Arzaghi and Henderson, 2008). We also derive the welfare costs of height restrictions that are shown to be higher than when a constant rent over building height is assumed (which is the standard assumption in the literature on regulatory constraints, Glaeser et al., 2005; Cheshire and Hilber, 2008).

In developing countries like Nigeria, where the electricity required to run the building is inadequate to run office buildings effectively, it is necessary to adopt tropical Architecture in the design of such office buildings. Tropical, in the sense that the building can run conveniently with or without electricity. Meaning, the building should have enough openings to throw in light and air.
3.0 RESEARCH METHODOLOGY

A careful study of early building design technology around the globe will be compared with contemporary designs using case studies from existing office buildings, then explore the various office buildings as it relates to sustainability and the ability of these buildings to adapt in times of power outage which will also stop the air-conditionals from working and retard visibility. Information gathered from case studies in descriptive analysis and also carry out investigations on safety measures that needs to be incorporated in office buildings most especially as it concerns fire and escape. An overview of existing office buildings was conducted, gathering important information about the technology adopted in the sustainability and adaptability of the building. Useful literature materials such as books, magazines, journals and the internet was also very instrumental and was consulted in the course of the research work.

4.0 DISCUSSION

(A brief history of the office building)

The structure and shape of the office is influenced by both management thought as well as construction materials and may or may not have walls or barriers. The word stems from the Latin officium, and its equivalents in various, mainly romance, languages. An officium was not necessarily a place, but rather an often mobile 'bureau' in the sense of a human staff or even the abstract notion of a formal position, such as a magistrature. Offices in classical antiquity were often part of a palace complex or a large temple. There was usually a room where scrolls were kept and scribes did their work. Ancient texts mentioning the work of scribes allude to the existence of such "offices". These rooms are sometimes called "libraries" by some archaeologists and the general press because one often associates scrolls with literature. In fact they were true offices since the scrolls were meant for record keeping and other management functions such as treaties and edicts, and not for writing or keeping poetry or other works of fiction. Kennedy (2006)

The High Middle Ages (1000–1300) saw the rise of the medieval chancery, which was usually the place where most government letters were written and where laws were copied in the administration of a kingdom. The rooms of the chancery often had walls full of pigeonholes, constructed to hold rolled up pieces of parchment for safekeeping or ready reference, a precursor to the book shelf. The introduction of printing during the Renaissance did not change these early government offices much. Saval (2014).

Medieval illustrations, such as paintings or tapestries, often show people in their private offices handling record-keeping books or writing on scrolls of parchment. All kinds of writings seemed to be mixed in these early forms of offices. Before the invention of the printing press and its distribution there was often a very thin line between a private office and a private library since books were read or written in the same space at the same desk or table, and general accounting and personal or private letters were also done there. Hamilton (2011).

It was during the 13th century that the English form of the word first appeared when referring to a position involving duties (the office of the ...). Geoffrey Chaucer appears to have first used the word in 1395 to mean a place where business is transacted in The Canterbury Tales. As mercantilism became the dominant economic theory of the Renaissance, merchants tended to conduct their business in the same buildings, which
might include retail sales, warehousing and clerical work. During the 15th century, population density in many cities reached the point where stand-alone buildings were used by merchants to conduct their business, and there was a developing a distinction between church, government/military and commerce uses for buildings. Saval (2014).

The Japanese office layout improves work productivity, harmony in the office, and holds every employee accountable for the work they produce. The type of office layout used in Japan is called an open plan, and relies on ergonomics to help make employees as productive as possible. The Japanese open office layout allows them to use an organizational structure known as the horizontal structure. In the typical Japanese office there are no walls dividing desks, no cubicles, and no individual offices. Also they are able to implement policies using the ringi-sho consensus. Durlabhji (1993)

In order to get group members to work effectively in the open office floor plan the use of island style desks are used. The most dominant feature of the Japanese island style office layout is that each group forms an island. Kageyu et al (2003), researches of ergonomics in the work place, stated,” Japanese offices have traditionally adhered to island layouts because these reflect the Japanese style of teamwork and top-down style of management.” The group leader will then sit at the prominent position and ensure productivity.

The group leader will assign a task to the group, and each member of the group then receives their individual task to complete. Island style seating also gives the group the benefit of being able to speak to one another at any time, and ask for help if needed. Being in such close proximity to one another in the office gives another advantage to the supervisor in that he can call an uchi-awase. Uchi-awase is an informal meeting in order to get an important message across, and also allows all members of the team to be creative in the office. “The open office layout allows for this because there are hardly any independent rooms or enclosures. If the supervisor stands at his desk he can glance at his associates and easily call them over.” according to Durlabhji et al (1993), author of Japanese Business Cultural Perspective. Once all individual tasks are complete the group then combines each person's work and the project is the put together as a whole and returned to the supervisor. The work is viewed as a team effort and that each member of the group receives equal credit for being part of a team completing the goal assigned. The group itself holds each member accountable for ensuring that the work is getting done, and that no one individual is doing more work than another. Another motivating factor is that the groups boss is also seated at the same desk, and the effect that this has on the individuals is that they must work hard just like the boss. The role of having an open layout with island type seating allows the office to be structured so the employees are put together as teams. Durlabhji et al (1993).

The type of organizational structure found within the Japanese office is known as a horizontal structure. According to Andrew, Ghillyer (2012), authors of Management Now,” Horizontal structure is an organization structure consisting of two groups: the first composed of senior management responsible for strategic decisions and policies and the second composed of empowered employees working together in different process teams; also known as a team structure. The benefit of using this type of structure is that hierarchy is flattened to reduce supervision, teams are able to self-manage, team performance, not just the individual is rewarded, and training is highly emphasized amongst all employees. With the heightened sense of empowerment and responsibility workers are motivated to complete objectives in a
timely manner. Having the office structured horizontally allows for the easy communication of introducing new policies and ideas amongst the groups.

“Ringisho” refers to the concept of submitting proposals and making decisions off those ideas. By unifying everyone together in the Japanese office it helps to make better informed decisions on policies of the company that all managers and employees have input on. The idea behind this is to get a hold of various thinking individuals to see if there is a good way in writing their policies that come to benefit the company better. Richard (2006), author of “When Cultures Collide”, states “Suggestions, ideas and inventions make their way up the company hierarchy by a process of collecting signatures among workers and middle managers. Many people are involved. Top executives take the final step in ratifying items that have won sufficient approval.” With this system in place changes to policies are only passed if there is an overall consensus to pass it. Allowing each group to have a say on which policies should be implemented improves overall job satisfaction and harmony throughout the office. The way Japanese offices are structured allow them to be more efficient when conducting business. The efficiency at which they operate has been noticed by such companies like General Motors, Ford, Motorola, and Chrysler Company. They continue to look for other ways to be more efficient and productive with the office layout and employee productivity.
OFFICE SPACES
The main purpose of an office environment is to support its occupants in performing their job—preferably at minimum cost and to maximum satisfaction. With different people performing different tasks and activities, however, it is not always easy to select the right office spaces. To aid decision-making in workplace and office design, one can distinguish three different types of office spaces: work spaces, meeting spaces and support spaces. For new, or developing businesses, remote satellite offices and project rooms, Serviced Offices can provide a simple solution and provide all of the former types of space. Kennedy (2006)

WORK SPACES
Work spaces in an office are typically used for conventional office activities such as reading, writing and computer work. There are nine generic types of work space, each supporting different activities.

Open office: An open work space for more than ten people, suitable for activities which demand frequent communication or routine activities which need relatively little concentration.

Team space: A semi-enclosed work space for two to eight people; suitable for teamwork which demands frequent internal communication and a medium level of concentration.

Cubicle: A semi-enclosed work space for one person, suitable for activities which demand medium concentration and medium interaction

Private office: An enclosed work space for one person, suitable for activities which are confidential, demand a lot of concentration or include many small meetings

Shared office: An enclosed work space for two or three people, suitable for semi-concentrated work and collaborative work in small group

Team room: An enclosed work space for four to ten people; suitable for teamwork which may be confidential and demands frequent internal communication.

Study booth: An enclosed work space for one person; suitable for short-term activities which demand concentration or confidentiality

Work lounge: A lounge-like work space for two to six people; suitable for short-term activities which demand collaboration and/or allow impromptu interaction

Touch down: An open work space for one person; suitable for short-term activities which require little concentration and low interaction

MEETING SPACES
Meeting spaces in an office are typically used interactive processes, be it quick conversations or intensive brainstorm. There are six generic types of meeting space, each supporting different activities.

Small meeting room: An enclosed meeting space for two to four persons, suitable for both formal and informal interaction
**Large meeting room:** An enclosed meeting space for five to twelve people, suitable for formal interaction

**Small meeting space:** An open or semi-open meeting space for two to four persons; suitable for short, informal interaction

**Large meeting space:** An open or semi-open meeting space for five to twelve people; suitable for short, informal interaction

**Brainstorm room:** An enclosed meeting space for five to twelve people; suitable for brainstorming sessions and workshops

**Meeting point:** An open meeting point for two to four persons; suitable for ad hoc, informal meetings, Kennedy (2006)

**SUPPORT SPACES**

Support spaces in an office are typically used for secondary activities such as filing documents or taking a break. There are twelve generic types of support space, each supporting different activities.

**Filing space:** An open or enclosed support space for the storage of frequently used files and documents.

**Storage space:** An open or enclosed support space for the storage of commonly used office supplies.

**Print and copy area:** An open or enclosed support space with facilities for printing, scanning and copying.

**Mail area:** An open or semi-open support space where employees can pick up or deliver their personal mail.

**Pantry area:** An open or enclosed support space where people can get coffee and tea as well as soft drinks and snacks.

**Break area:** A semi-open or enclosed support space where employees can take a break from their work.

**Locker area:** An open or semi-open support space where employees can store their personal belongings.

**Smoking room:** An enclosed support space where employees can smoke a cigarette.

**Library:** A semi-open or enclosed support space for reading of books, journals and magazines.

**Games room:** An enclosed support space where employees can play games (e.g. computer games, pool, darts).

**Waiting area:** An open or semi-open support space where visitors can be received and can wait for their appointment.

**Circulation space:** Support space which is required for circulation on office floors, linking all major functions. Kennedy (2006).
Spaces features that may be classified as a separate space type or covered as a special feature include:

- Millwork other than service unit/coffee bar and coat storage.
- Meeting spaces and conference rooms that include special lighting systems, acoustical treatment, moveable partitions, millwork, or A/V systems.
- Secure storage, strong rooms, vaults, and hardened partitions located within the office suite.
- Large filing, library, or storage areas with concentrated floor loads.
- Enclosed spaces requiring acoustical separation higher than 40 STC, partitions to structure with acoustical insulation, and ductwork sound baffling.
- Specialized window treatments (blackout shades, plantation shutters, motorized fabric draperies, etc.), interior windows, glass block partitions, and glazed doors.
- Humidity, pathogenic, or hypoallergenic air treatment systems
- Upgrade or changes to standard items such as plaster or vaulted ceilings, specialty lighting, or upgraded ceiling tiles.
- Private toilets, elevators, or staircases
- Office space plans can be arranged in several scenarios, including: 100% closed office (fully closed), 80%-20% (open), 20%-80% (closed), and 100% open office (fully open) Zhang et al (2015).

**OFFICE STRUCTURE**

There are many different ways of arranging the space in an office and whilst these vary according to function, managerial fashions and the culture of specific companies can be even more important. Choices include, how many people will work within the same room. At one extreme, each individual worker will have their own room; at the other extreme a large open plan office can be made up of one main room with tens or hundreds of people working in the same space. Open plan offices put multiple workers together in the same space, and some studies have shown that they can improve short term productivity, i.e. within a single software project. At the same time, the loss of privacy and security can increase the incidence of theft and loss of company secrets. A type of compromise between open plan and individual rooms is provided by the cubicle desk, possibly made most famous by the Dilbert cartoon series, which solves visual privacy to some extent, but often fails on acoustic separation and security. Most cubicles also require the occupant to sit with their back towards anyone who might be approaching; workers in walled offices almost always try to position their normal work seats and desks so that they can see someone entering, and in some instances, install tiny mirrors on things such as computer monitors. Richard (2006).

**Development of open-plan workspace types**

Prior to the 1950s open-plan offices mostly consisted of large regular rows of desks or benches where clerks, typists, or technicians performed repetitive tasks. Such designs were rooted in the work of industrial engineers or efficiency experts such as Frederick Winslow Taylor and Henry Ford. In the 1950s a German team named *Quickborner* developed the office layout, which used conventional furniture, curved screens, large potted plants, and organic geometry to create work groups on large, open floors. Office layout was quickly supplanted by office-furniture companies which developed cubicles based on panel-hung
or systems furniture. Many terms (mostly derisive) have been used over time for offices using the old-style, large arrays of open cubicles.

An increase in knowledge work and the emergence of mobile technology during the late 20th-century led to an evolution in open-plan offices. Many companies have started experimenting with designs which provide a mix of cubicles, open workstations, private offices, and group workstations. In some cases, these are not assigned to one particular individual, but are available to any employee of the company on either a re-servable or "drop-in" (first come, first served) basis. Terms for this strategy include Hoteling, "alternative officering" and "hot-desking".

Michael Bloomberg used a team-oriented bullpen style – where employees can see and hear each other freely, but desks are grouped into teams – at his media company Bloomberg L.P. and for his staff while Mayor of New York City (in office: 2002–2013). Richard (2006). Neither open- nor closed-plan offices are perfect for all situations or for all individuals. The right balance is required. Any office design is likely to involve trade-offs for the workers, with some positives and negatives.

Architect Frank Duffy developed a taxonomy to classify the form of office space that would suit different types of workers. How much interaction individuals require, the work design (i.e., the amount of job autonomy), together with the information technology available, predict the office design that may best suit the worker. Ghillyer (2012).

OFFICE BUILDINGS

While offices can be built in almost any location and in almost any building, some modern requirements for offices make this more difficult. These requirements can be both legal (e.g. light levels must be sufficient) or technical (e.g. requirements for computer networking). Alongside, other requirements such as security and flexibility of layout, has led to the creation of special buildings which are dedicated only or primarily for use as offices. Ghillyer (2012). An office building, also known as an office block or business center is a form of commercial building which contains spaces mainly designed to be used for offices. The primary purpose of an office building is to provide a workplace and working environment primarily for administrative and managerial workers. These workers usually occupy set areas within the office building, and usually are provided with desks, Personal Computers and other equipment they may need within these areas. An office building will be divided into sections for different companies or may be dedicated to one company. In either case, each company will typically have a reception area, one or several meeting rooms, singular or open-plan offices, as well as toilets. Richard (2006).

Many office buildings also have kitchen facilities and a staff room, where workers can have lunch or take a short break. Many office spaces are now also serviced office spaces, which means that those occupying a space or building can share facilities. Richard (2006). In a gross lease, the rate quoted is an all-inclusive rate. One pays a set amount of rent per time and the landlord is responsible for all other expenses such as costs of utilities, taxes, insurance, maintenance, and repairs. The triple net lease is one in which the tenant is liable for a share of various expenses such as property taxes, insurance, maintenance, utilities, climate control, repairs, janitorial services and landscaping. Office rents in the United States are still recovering from the high vacancy rates that occurred in the wake of the 2008 depression. The Building Owners and Managers Association (BOMA) classifies office space
into three categories: Class A, Class B, and Class C. According to BOMA, Class A office buildings have the “most prestigious buildings competing for premier office users with rents above average for the area”. BOMA states that Class A facilities have “high quality standard finishes, state of the art systems, exceptional accessibility and a definite market presence”. BOMA describes Class B office buildings as those that compete “for a wide range of users with rents in the average range for the area”. BOMA states that Class B buildings have “adequate systems” and finishes that “are fair to good for the area”, but that the buildings do not compete with Class A buildings for the same prices. According to BOMA Class C buildings are aimed towards “tenants requiring functional space at rents below the average for the area”. The lack of specifics allows considerable room for “fudging” the boundaries of the categories. Richard (2006).

ADAPTABILITY AND SUSTAINABILITY OF OFFICE BUILDINGS

ADAPTABILITY
This can simply be described as the ability for something to be able to change to meet requirements or to change to suit different conditions or purpose. Microsoft Encarta (2009). In this context it is the flexibility of an office building to change its configuration to suit different work conditions as it relates to tenants’ needs.

SUSTAINABILITY
Sustainability is the ability to maintain and preserve the ecological balance and usability of something, in this context it is the ability for an office building to be maintained at little or no cost. Microsoft Encarta (2009). It can also be referred as the use of the ecological environment to continue the existence of the office building.

The benefits of an adaptable office building
Building technologies and designs that enable flexibility and adaptability have been identified as bringing a number of benefits. These are primarily associated with the requirements for upgrading and maintaining office buildings throughout their life and enabling internal fit-out changes in high turnover internal environments such as retail facilities or offices. Slaughter (2001) identified that the cost and time of refurbishments is reduced if buildings are designed for flexibility. This is echoed in respect of building services. Webb et al’s (1997) research examining how building services can be designed to accommodate change concluded that ‘by utilizing reusable service components, facilities managers may be able to increase the adaptability of both new and existing office buildings and reduce the financial impact of change’.

Slaughter (2001) further suggests that the need for changes to a building is increasing with rising consumer expectations, the increasing rate of technological progress and intensifying competitiveness. Some of the needs for adaptability and flexibility are well understood and office building design solutions to address these needs are well established. For instance office partition systems designed to accommodate changes required to the internal configuration of offices are ubiquitous. Services and in particular IT systems have relatively short lives and are installed in buildings in accessible floors and ceiling systems facilitating their replacements.
In relation to climate change we are seeing changes to office building regulations that aim to reduce the building’s operational energy requirements. Refurbishments will be required to include an upgrade of the building to improve office building performance. Such improvements may require significant changes to the building fabric that could be facilitated by designing office buildings to be adaptable. The financial benefits identified could be replicated in respect of the changes needed to improve energy performance and cope with other performance requirements resulting from climate change. In a post-peak oil future these financial savings would be more pronounced as both energy and material costs are expected to rise. Slaughter (2001).

Definitions of adaptability and flexibility

Flexibility is generally perceived as an adaptive response to environmental uncertainty (Gerwin 1993). More specifically, it is a reflection of the ability of a system to change or react with little penalty in time, effort, cost or performance (Upton 1994). Hence, flexibility may be seen as a proactive attribute designed into a system, rather than a reactive behavior that may in fact result in a detriment to time, effort, cost and performance (Naim et al. 2006). Adaptability has also been classified as a capability and flexibility a competence, where capabilities are derived from lower level competencies (Swafford, 2006).

There is little agreement in the construction literature between the concepts of ‘adaptability’ and ‘flexibility’. Edmonds and Gorgolewski (2000) for example, view adaptable buildings as incorporating, at the design and construction stage, the ability to make future changes easily and within minimum expense to meet the evolving needs of the occupants. Rappaport et al. (1991) consider that adaptability seeks to establish basic systems configurations that allow expansion and contraction of functional areas, but always within established fixed constraints.

According to Edmonds and Gorgolewski (2000) adaptable buildings incorporate, at the design and construction stage, the ability to make future changes easily and with minimum expense to meet the evolving needs of occupants. It means designing a building to allow its hierarchical layers to change, each in its own timescale. Incorporating adaptability into a building during initial construction saves time, money, and inconvenience when changes are needed to designed later in the life of the building.

Addis and Schouten (2004) consider that a flexible building is a building that has been designed to allow easy rearrangement of its internal fit out and arrangement to suit the changing needs of the occupants. Groak (1992) defines adaptability as capable of different social uses and flexibility as capable of different physical arrangements (Groak, 1992). We use the following definitions in this paper:

- adaptable building – a building that has been designed, constructed and maintained with thought of how it might be easily altered to prolong its life, for instance by addition or contraction, to suit new uses or patterns of use (Adapted from Addis and Shouten, 2004)
- flexible building- a building that has been designed to allow easy rearrangement of its internal fit out and arrangement to suit the changing needs of occupants (Addis and Shouten, 2004)
Achieving adaptable buildings

*Design for flexibility*

Slaughter (2001) argues that three general types of changes can be expected to occur, changes in the function of the space, changes in the load carried by the systems of the building and changes in the flux of people and forces from the environment. General design approaches to increasing flexibility and more specific design strategies are also distinguished. The approaches proposed include physically separating the major building systems, prefabrication and overcapacity. The design strategies include reduce inter-system interactions, reduce intra-system interactions, use interchangeable system components, increase layout predictability, improve physical access, dedicated system zones, enhance system access proximity, improve flow, phase system installation and simplify partial/phased demolition. Schneider and Till (2007) categorize designs as either ‘hard’ or ‘soft’. Hard designs refer to elements that more specifically determine the way that the design should be used over time. Soft refers to tactics that offer indeterminacy, allowing the user to adapt the plan according to their needs. They also refer to ‘circulation’, the way that rooms are accessed, and movable elements as key to flexible designs. The Open Building movement has also promoted flexible designs for buildings. Open Buildings seeks to respond to user’s preferences by offering flexibility needed for adaptation of individual units over time. Buildings should be designed to enable sub-systems to be installed or changed with a minimum of interface problems. This is usually achieved by the separation of a ‘base-building’ and its interior ‘fit-out’ (Kendell and Teicher 2000).

*Process flexibility*

A process can be defined as any activity which takes a set of input resources which are then used to transform something, or are transformed themselves into outputs (Slack *et al.* 2004). Process flexibility refers to the ability of a process or system to adjust to and accommodate changes and disruptions (D’Souza and Williams 2000). In the context of construction process flexibility has mostly been described at the project level (Gil *et al.* 2005; Olsson 2006), referring to the ability to structure the project process so that it can accommodate late changes. For example, differentiation of works, where building subsystems are designed to be less susceptible to design changes, or offsite fabrication, where more concurrency between fabrication, assembly and onsite construction is offered (Gil *et al.* 2005).
5.0 CONCLUSION AND RECOMMENDATIONS

Office buildings are built to meet certain demands, therefore, there are specific requirements that must be met in order to achieve a sustainable and adaptable office building. These requirements are vital most especially in areas where electric power is inadequate, expensive and unstable. However, it is important that these office buildings are sustainable in the use of materials and in its design. Therefore, office activities should be able to run conveniently with or without electric power, this becomes possible when the building is designed to suit the natural environment which makes it necessary that the building is naturally ventilated and lighted up. The use of photovoltaic panels should be encouraged to obtain the minimum energy requirement for office buildings with the incorporation of low energy appliance to reduce electricity consumption rate. Also it is necessary for office buildings to be adaptable in its design layout in order to adapt to a number of variations in the use of office space. The office space type refers to a variety of spaces including: meeting spaces integrated into the office environment, reception, office support spaces such as work rooms, storage rooms, file rooms, mail rooms, copier areas, service units/coffee bar, coat storage and waste disposal channels like the chute system, ducts, etc. integrated into the office environment.

SPACE ATTRIBUTES

According to the National Institute of Building Sciences, An Authoritative Source of Innovative Solutions for the Built Environment, Washington, DC published in 2016 that over 50 percent of workers in the U.S. spend the workday in office buildings and spaces, and employers today are increasingly bearing the responsibility of providing a quality workspace. Thus the Office space type is typically a flexible environment that integrates technology, comfort and safety, and energy efficiency to provide a productive, cost-effective, and aesthetically pleasing working environment. Typical features of office space types include the list of applicable office design recommendations, elements as outlined below.

Functions / Operations

- **Integrated Technology:** The design process is a thorough understanding of the technological requirements of the space, including anticipated future needs.
- **Occupancy:** Office space types fall into the occupancy classification, which is a major consideration in office design since occupants needs varies.

Productive

- **Flexibility:** The office space type is durable and adaptable, and will typically include features such as a raised floor system for the distribution of critical services (power, voice, data, and HVAC) and mobile workstations to accommodate changes in employee, equipment, and storage needs over time.

Secure / Safe

- **Comfort and Safety:** The health, safety, and comfort of employees is of paramount concern to employers. For this reason, the office space type should be designed with increased fresh air ventilation, the specification of non-toxic and low-polluting materials and indoor air quality monitoring. Non-quantifiable benefits such as access to windows and view, and opportunities for interaction should also be taken into account.
Sustainable

- **Energy Efficiency**: As energy costs increase with higher reliance on technology, strategies such as the specification of high-efficiency lighting and lighting controls; the application of daylighting; the installation of high-efficiency HVAC equipment; ecological balance and integration of the natural elements (such as lighting, ventilation, sun, vegetation, earth, water, etc.) into the office environment as a major phenomenal for the continuous existence of the building should be considered.

The office building as a multi-purpose work station should be designed to cater for any change in tenants needs (Adaptability). Adaptability in an office building is the flexibility required to conveniently adjust to tenants needs. This is a very vital feature in office buildings that integrates all possible office activities in the business environment. An adaptable office building usually has a blend with sustainability which puts the office in a state of continues existence at little or no cost.
REFERENCES
Cannon Place, London - Steelconstruction.info.html (2011)


Tower Wharf, Birkenhead - Steelconstruction.info.html (2015)