Users' perspectives of fire safety in high rise buildings in Lagos. Nigeria

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USER'S PERSPECTIVE OF FIRE SAFETY IN HIGH RISE BUILDINGS IN LAGOS, NIGERIA

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Abstract

High rise buildings all over the world are becoming popular due to their capacity in ensuring optimum use of land, increasing urban density and housing more number of households. Despite the numerous advantages, occupants of high-rise buildings are confronted with fire safety challenges. In view of the aforementioned, this study examines the perception of high-rise building occupants in Lagos State with a view to ensuring fire safety consciousness. Random sampling method was used in gathering data from occupants of 1004 estates through a self-administered questionnaire. A total of 172 questionnaires were obtained from the occupants and used for the analysis. The data were analysed with statistical package for social science (SPSS version 17), using frequency and mean score (descriptive statistics), while correlation analysis (inferential statistics) was used for the test of hypotheses. The study revealed that fire policy regarding the development of high rise building focuses more on active policies, involving the provision of equipment to combat fire outbreaks rather than policies that facilitate easy means of escape. Also, there is a positive relationship between fire safety measures provided by the facility managers and prescribed fire safety standards. This implies that if facility managers ensure that occupants are aware of fire safety measures. Their level of compliance with the prescribed fire safety standards in the building increases and in return will enhance occupants' safety. This study recommends that investors should incorporate more ways and means of escape in the high rise buildings development plan. Also, facility managers should educate the occupants on fire safety measures and ensure their participation in a fire drill or other training related to life safety. Furthermore, the government should set up a regulatory body to monitor and assess fire safety facilities and measures put in place for in high rise buildings.

Keywords: *Fire Safety, High-Rise Building, Land Value, Urban Density, User Perception.*

1.   Introduction

High rise building throughout the world is becoming popular by virtue of improvement in construction activities and technology, with the aim of reducing the scarcity of land, increase urban density and house more families in lesser space (Kavilkar and Patil, 2014). This has made the construction of high-rise buildings in Lagos metropolis important due to the high cost of land for development. The adoption of high rise building in enhancing more land for development has been utilized in other developed countries. According to Housing London (2014), land shortage within the metropolis was reduced by intensification of land use, through the construction of high and middle rise buildings on major roads within the city. Similarly, Wong (2010) was of the opinion that in countries like Japan, Singapore and Hong Kong, shortage of developable land in urban areas has resulted in vertical living as the most common style for most of the people.

However, some opinions have been raised by different authors criticising high rise living in various contexts. Charlterjee (2009) reported that the occupants of high-rise buildings are exposed to psychological problems like fear of isolation in personalised space causing loneliness which leads to depression, stress, anxiety, and lowering interest in community affairs. Regarding the risk involved in a fire outbreak with high rise buildings, Zahari, Alimin, Sudirman and Mydin (2014) emphasised that the risk is quite enormous relative to low rise buildings. This is due to the multiple floors in high-rise buildings which create a cumulative effect, requiring a great number of persons to travel through vertical distances on stairs. Abduallah (2011) further corroborated that the occurrence of stack effect (temperature difference between two areas) is much in high rise buildings thus creating a difference in pressure between the floors that results in natural air movement within the building capable of moving a huge volume of heat and smoke during fire outbreak. Similarly, Lantz and Skroder (2013) submitted that the effects of fire in high rise buildings are related to the construction features which may lead to extensive fire and smoke spread, or reductions in occupant's ease of exist. Likewise, Olagunju, Aremu and Ogundele (2013) buttressed that fire outbreak is terrible in high-rise buildings, as means of escape are tedious by virtue of a large number of people occupied by the building.

Gifford and Lacombe (2007) further revealed that a large number of occupants in high-rise buildings contribute to making fire outbreak disastrous as most of them panic during fire outbreak thereby leading to stampede or taking the wrong exit during a fire outbreak. Nevertheless, Yang (2013) averred that majority of the occupants are often not aware of the fire safety measures and facilities within their building. Similarly, Evans, Wells and Moch (2003) asserted that occupants of high-rise buildings are unsure about the effectiveness of firefighting measures. Therefore this study intends to investigate user's perception of fire safety in high rise buildings in Lagos state, Nigeria.

2.   Literature review

According to Chudley and Greeno (2006), high rise buildings are buildings with a height of 35metres and 100 metres and a minimum of 12 floors. Tharmarajan (2007) opines that high rise building came into existence as a result of advancement in technology and building components such as; the development of safety elevator by Elisha Graves Otis which enhanced vertical movement, the invention of steel frames in 1870 that lead to the replacement of weaker combination of cast iron and wood with the invention of air conditioning by carrier in 1902 which addressed the provision of ventilation.

Ismail, Termizi and Hassan (2015) report that high-rise buildings have developed through three generations; the first was within 1870 to 1920. During this period, the exterior walls of the building consisted of stones or bricks and cast iron and the floors were made of wood. The elevator shafts were closed and the only means of escape was through a single stairway. The second generation was from 1920 to 1940 which came as an improvement to the first generation that involves replacing the combustible construction materials. The third generation of high rise building (1940 to present) started after World War II. It was constructed with lightweight steel or reinforced concrete frame with exterior curtain walls.

Due to the design of high-rise buildings, it has been described by various authors as a tool that ensures maximum use of land, such authors include Housing London (2014) that perceive high rise building as a tool which makes land available within the metropolis. Similarly, Wong (2010) was of the opinion that in countries like Japan, Singapore and Hong Kong shortage of developable land in urban areas has been reduced through vertical living as the most common style for the majority of the people. Ama (2012) looked at the advantage of high rise from another angle and proposed that high rise building serves as a major economic boost for countries like United Arab Emirates (UAE), Hong Kong and Malaysia and also their source of prestige. Despite the advantages of high-rise buildings in some African countries like Nigeria, it still has most of their buildings characterised by low buildings.

Gifford and Lacombe (2007) opined that most developers do not like erecting high-rise buildings, as it is required complex designing and provision of different amenities like appropriate exits, alarms, emergency lighting, communication systems, and sprinkler systems. Similarly Olagunju, et al (2013) proclaims that the adequate attention put in designing and maintaining high rise building discourage developers, because it is essential to ensure that routes leading to the exits, as well as the areas beyond the exits, are accessible and free from materials or items that would impede individuals from easy evacuation.

2.1   Theoretical Framework Supporting High-rise Buildings

The theory underpinning this study is the compact city model. Williams (2003) suggests that the model aims at ensuring more land for development in urban centres through the encouragement of inward and upward development, rather than just focusing on outward development. This implies that the compact city model encourages the development of high-rise buildings. On the other hand, Iderlina (2010) was of the opinion that the compact city model enhances high density and mixed use activities within the city thereby enabling people to live near their place of work and leisure facilities which reduce the use of automobiles. Salingarous

(2006) affirms that this characteristic enables compact city models to reduce urban sprawl because sprawl exists due to the outgrowth of car activities.

According to Williams (2003), the compact city models involve the re-organization of low density to high-rise density function as shown in figure 1. Aurbury (2006) reports that the advantage of a compact city model is that it ensures sustainability because it provides infrastructure, such as roads and street lighting, that are cost-effectively per capita and population densities sufficient to support local services and businesses. Agus and Yudi (2005) gave the advantage and disadvantage of the compact city model as showed by table 1.

Table 1 Advantages and disadvantage of the compact city

Advantage	Disadvantage
Energy saving	Over saturated
Reduced emissions	Pollution
Improved standard of living due to high-density areas and mix use	Lack hospitality
	Less disaster prevention

(Source: Agus and Yudi, 2005)
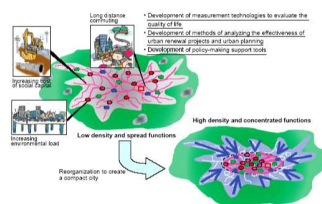
Figure 1: Development of compact city

Source; Williams (2003)

Salingarous (2006) asserts that the idea of the compact city was originated by the compact model development of most historic cities in Europe, which raises the question whether the concept is suitable in accord with the urban development character in developing countries. In view of this Afolahan and Omirin (2010) asserts that the theory serves various function depending on its particular need for instance in England the theory focuses on controlling urban population while in developing nations where the cities are characterised by rapid urbanisation and uncontrolled growth the theory is centred on reducing urban sprawl. Agus and Yudi (2005) opines that the difference in function of compact city models in developed countries and developing country because the cities in developing countries seem to be compact enough, which means it is already rigid and found its own shape.

Williams (2003) opines that it is difficult to apply the full concept of compact city to a town planning in developing countries due to lack of social infrastructure (caused by the population growth exceeding the economic growth), Increased slum area or squatter, land speculation, difficulty in slums area redevelopment (to demolish or to relocate), weakness in public transportation system and lack capacity in planning. Regardless of its application in developed and developing countries Iderlina (2010) posited that the common phenomenon of compact city development is ensuring intensification of land use, increase the density and encourage vertical expansion.
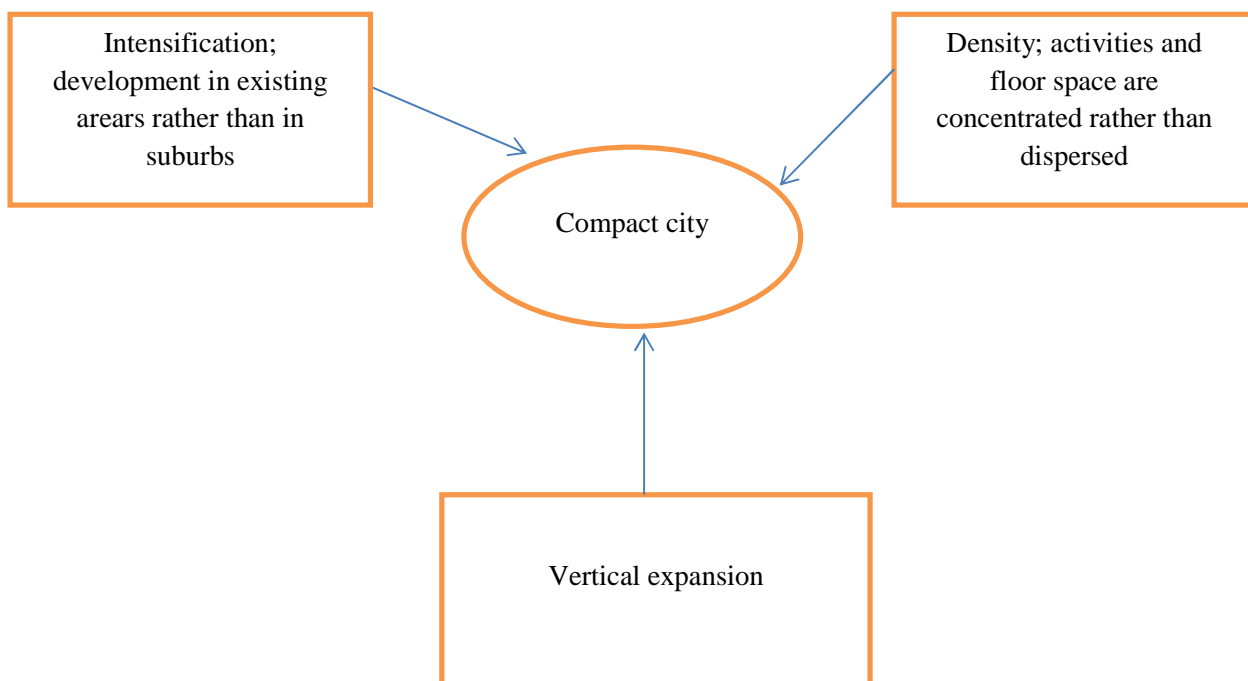
Figure 2: Objectives of compact city development

Source; Adapted from Iderlina 2010

3.   Research methodology

The cross-sectional research design was used and the population of the study comprises of occupants of 1004 estates in Lagos Island, Nigeria. The estate was chosen because it has a large number of high-rise developments under a single management which makes it easy to get a large number of people and information. A sample of 283 respondents was selected from the population of occupants of the high-rise buildings using the simple random selection method. The sample size was determined using Cochran's sample size formula for continuous data (Cochran, 1977) taking an acceptable margin of error (d) of 0.05, an alpha level of 0.05, population proportion (P) taken to be 0.5, and a total number of population (N) is 1070. Data for the study were obtained through field survey using a structured questionnaire. A total of 283 structured questionnaires were administered out of which 172 were returned and used in the analysis. Statistical Package for Social Sciences (SPSS) was used to analyse the data gathered. Descriptive statistics - frequency and mean score were used for data presentation.

4.   Findings and discussion

4.1   Awareness with fire safety measures provided by the facility managers

The respondents were asked to rate their level of awareness with fire safety measures incorporated into their building using five Likert and their response is presented in Table 2. The table shows that storage of flammable materials in a safe area (Mean = 4.07) was ranked as the fire safety measures they are most cognisant with. It was followed by clear signage indicating exit routes (mean = 3.93), installation of high tech fire safety equipment (mean = 3.85), implementation of good housekeeping (mean = 3.82), ensuring that areas under renovation are regularly inspected (mean =3.51), training programs on fire outbreak (mean = 3.46), presence of law enforcement that ensures compliance with statutory requirements (mean = 3.42), and conducting regular inspection (mean = 3.30). It can be deduced from Table 2 that the occupants are aware of fire safety measures but have little awareness of measures that require the direct effort of facility managers such as; the selection of a specific personnel as building emergency response staff, implementation of floor warden system and distribution of pamphlets containing emergency procedure and evacuation plans.

Table 2 Awareness of fire safety measures provided by facility managers

	Mean	Rank
Flammable material is stored in safe area	4.07	1
Clear or glow in the dark signage indicating exit routes and location of fire safety equipment	3.93	2
Installing high-tech fire safety equipment	3.85	3
Implementation of good and regular housekeeping	3.82	4
Areas under renovation are regularly inspected	3.51	5
Training programs on fire outbreak for users	3.46	6
Presence of law enforcement that ensures compliance with statutory requirements	3.42	7
Conducting regular inspection of all electrical installations	3.30	8
fire and evacuation drills on a regular basis	3.22	9
Specific personnel as building emergency response staff	3.08	10
Implementation of floor warden system	2.97	11
Distribution of pamphlets or leaflets containing emergency procedures and evacuation plans	2.91	12

(Source: Author's Field Survey, 2016)

4.2   *Fire policy regarding high-rise building developments*

Table 3 reports the fire safety policy in a high rise building. The development policy is broken down into means of escape, active and passive policies. A critical look at the table reveals that the respondents indicate active policies as the most important policy by virtue of high mean score attributed to each of the factors within the policies. However, provision of fire extinguishers(mean = 4.60) was ranked as the utmost active policy followed by availability of sprinklers(mean = 4.54), availability of fire alarms (mean = 4.48), availability of smoke detection (mean = 4.44), availability of smoke control system (mean = 4.40), hose reel (mean = 4.28), alternative power supply (mean = 4.24) , fire control centre within the estate (mean =4.16) , the

use of voice over communication system (mean = 4.14) and the use of fire hydrant system (mean = 3.96).

From the table 3, it also shows that easy access to stairways (mean = 3.62) is the most significant policy regarding means of escape, followed by adequate signs (mean = 3.34), fire isolation components (mean =3.23), emergency lighting (mean = 3.17) and less travel distance from apartment to the nearest means of escape (mean = 3.09). While the use of fire resistant materials was regarded as the construction (mean = 2.24) most essential passive policy followed by easy access to facilities for the fire services (mean = 2.08).

Table 3 Fire policies regarding high-rise building developments

Means of escape	Mean	Rank
Easy access Stairways/corridors	3.62	1
Adequate Signs	3.34	2
Fire isolation compartments	3.23	3
Emergency lightning	3.17	4
Less Travel distance from apartment to the nearest means of escape	3.09	5

Active	Mean	Rank
Provision of fire Extinguishers	4.60	1
Availability of Sprinklers	4.54	2
Availability of fire Alarm	4.48	3
Availability of Smoke detection	4.44	4
Availability of Smoke control system	4.40	5
Hose reel	4.28	6
Alternative power supply	4.24	7
Fire control Centre within the estate	4.16	8
The use of Voice communication system	4.06	9
The use of Hydrant/riser system	3.96	10

Passive	Mean	Rank
The use of Fire resistant construction materials	2.24	1
Easy access to facilities for the Fire services	2.08	2

(Source: Author's Field Survey, 2016)

4.3   *Prescribed fire safety standards*

Table 4 presents the implementation level with prescribed fire safety standards in the study area. The table shows that provision of clear signage indicating exit routes (mean = 4.38) are the most implemented fire safety standard followed by ensuring all corridors remain clear (mean = 4.08) and taking renovation work precautions (mean = 4.08). While conducting inspection for fire safety equipment (mean = 3.94), inspection of electrical installations (mean = 3.89), implementation of good housekeeping program (mean = 3.79), provision of fire safety plan or guidelines (mean = 3.61), operation of building fire safety equipment (mean = 3.54), appointment of designated supervisory staff to carry out fire duties (mean= 3.44) and maintaining up to date list of occupants in the building are slightly implemented (mean = 3.37).

Table 4 Level of compliance with fire safety standards

	Mean	Rank
Provision of clear signage indicating exit routes and location of fire safety equipment	4.38	1
Ensuring that all corridors, exist and pathways remain clear and unlocked inside the building	4.08	2
Taking renovation work precautions and inspections	4.08	3
Conduct inspection, operation and maintenance of fire safety equipment	3.94	4
Inspection of electrical installations	3.89	5
Implement good housekeeping practices	3.79	6
Implement pest control program	3.61	7
Provision of fire safety plan or guidelines which contain type, location and operation of building fire safety equipment	3.54	8

Appointment and organisation of designated supervisory staff to carry out fire safety duties	3.44	9
Maintaining up to date list of occupants in the building	3.37	10
Provision fire compartment section within the building	3.25	11
Conducting practice for evacuation	3.18	12
Education and training on fire safety measures/precautions	2.97	13
Implementation of fire and evacuation drill procedures	2.88	14

(Source: Author's Field Survey, 2016)

However, conducting practice for training occupants on fire safety measures and implementation of fire evacuation drill procedures are rarely implemented.

4.4 *Relationship between Fire Safety Measures and Prescribed Fire Safety Standards*

In investigating the relationship between fire safety measures provided by the facility managers and the prescribed fire standards, Pearson correlation analysis was employed and the outcome is presented in table 5. For an easy interpretation of the result, the factors that account for fire safety measures was computed into a dummy variable called fire measures the same was done for fire safety standards. Table 5 shows that there is a significant relationship with fire safety measures provided by the facility managers and prescribed fire safety standards at 0.05 and 0.01 significant level,

This implies that if facility managers ensure that occupants are aware of fire safety measures, their level of compliance with the prescribed fire safety standards in the building increases and in return will enhance occupants' safety. In view of this, we reject the null hypothesis and accept the alternative hypothesis.

Table 5 Pearson correlation analysis for fire safety measures and fire standards

Correlation coefficient	0.398**
Level of significant	0.000
N	172

(Source: Author's Field Survey, 2016)

5. Conclusion and recommendation

High rise buildings are built to optimise the use of land all over the world and it is becoming part of Nigeria modern housing system. In order to fully harness the many advantages that high-rise buildings offer in providing more land for development particularly in Lagos metropolis, where there is limited land for development, it is expedient to assess occupants' perception of fire safety in high rise buildings. Their perception was acquired by examining their level of awareness with fire safety measures, the fire development policy in high rise buildings, compliance with fire safety standards and available firefighting facilities within the building. It was discovered that, from the perspective of occupants in high-rise buildings, the buildings are not safe in terms of fire outbreak because the current fire development policy in the high rise building is concentrated more on active policies which involve providing fire-fighting equipment's to combat fire outbreak while passive policies such as the use of fire construction materials, fire isolation compartments that facilitate easy means of escape are not adequately provided.

The study recommends that since the means of escape is what makes fire outbreak in high rise building disastrous, investors should incorporate more ways and means of escape in the highrise buildings development plan and also incorporate fire-fighting equipment's that enhance combating fire outbreak externally. While the government should ensure regulatory body be set up to monitor and control fire safety facilities and measures put in place for upcoming high rise buildings. Facility managers should educate the occupants on fire safety measures and ensure their participation in a fire drill or other training related to life safety.

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