

Assessment of Fire Disaster Preparedness of Commercial Buildings in Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author OOS initiated the idea, designed, carried out literature search and compiled the draft of the manuscript. Author MI is responsible for supervising every stage of the research, and proof reading while author OKC carried out the data acquisition and analysis. All authors read and approved the final manuscript.

Abstract: Fire disaster in Commercial buildings is a threatening one nowadays. The incidence of fire in buildings is a major threat to safety of occupants, owners of buildings and properties therein, particularly, where inflammable materials are commonly used. Hence, its occurrence has been a major source of concern to stakeholders in the built environment. The study aimed at assessing the level of Fire disaster preparedness and fire safety measures adopted by Commercial Buildings owners in Imo State. A set of structured questionnaires was used for data collection which was the primary source. Related literature was reviewed. Data were analysed with basic descriptive statistical tools such as frequency distribution table, percentage, mean, standard deviation with the aid of SPSS version 23.0 and T-Test. A total number of Four hundred and seventy-five (475) questionnaire were administered to selected commercial building operators and a total of four hundred and sixty-two (462) were completed and returned. This corresponds to a response rate of 97.3%. The result showed that 65.8% of the respondents were not satisfied in terms of availability of firefighting equipment and lacked experience on the operation of the available equipment. Again, 70.6% and 72.5% were not satisfied on the area of fire safety strategies and policy adopted by the commercial building owners. This study concluded that the level of fire preparedness of commercial building operators was grossly inadequate. The study recommended that there should be adequate provision of fire safety equipment in all the commercial buildings, occupants or users should undergo requisite training and fire drills, there should be regular inspection of commercial buildings for compliance with fire safety acts and codes by relevant authority and maintenance of fire safety equipment. Conclusively, the recommendations of this study will go a long way to bolster enforcement of fire disaster preparedness and ensure quick response to fire outbreaks if occurred.

Key words: Fire Disaster, Fire Safety, Commercial Buildings, Built Environment.

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I. Introduction

Fire or combustion is the process of burning. It is a chemical reaction initiated by the presence of heat in which a substance combines with oxygen in the air and the process is accompanied by emission of energy in the form of heat. Fire needs continuous supply of heat, fuel and oxygen in any given building. Therefore, concentration must be on these three factors, the *supply of oxygen*, which is common and continuous from the atmosphere, *heat energy* and *combustible material*; Fire incident is an unplanned or unexpected event in the built environment. There are several factors that causes fire or sources of ignition in buildings ranging from human error to use of faulty electrical appliances (Cote, 2011).

Furthermore, the incidence of fire outbreak in commercial buildings has become a major threat to safety of occupants, owners of buildings and properties therein, particularly, where inflammable materials are commonly used. Hence, its occurrence has been a major source of concern to stakeholders in the built environment (Godschalk, Beatley, Berke, Brower, and Kaiser, 1999). Commercial buildings as infrastructure along with people's lives need protection against fire outbreaks. Knowledge on the use of installed facilities is essential in tackling fire emergencies. Otherwise, their installations become worthless as lack of knowledge could hamper escape from fire hazards and thwart attempts to curtail fire spread at its preliminary stage.

There have been several incidences of fire outbreak in Commercial buildings in Imo State which have resulted in loss of human lives, valuable property and documents destroyed. These fires have continued to render many jobless, damage the built environment. The effective solution to these fire incidents will require enhancing the capacity of the relevant regulatory authorities in evaluating the proneness of any building to fire outbreak with the view to proffering remedial measures to this fire threat (Buchanan, 2001).

II. Literature Review

Fire begins without prior warning. When fire occurs, the occupants are restricted in the limited time either to extinguish the fire or to escape (Salleh and Ahmad, 2009). According to Spadaccini (1998), when fire occurs and is not effectively controlled, people suffer injuries and at times death. The building and all that is within are razed down, temporary or permanent displacement of people, economic activities become stalled among other things. As a result of this, it becomes essential that adequate fire safety measures are put in place to prevent the occurrence of fire or reduce its impact if occurred.

The concept 'fire disaster' is a serious disruption of the functioning of a system, community or a society, causing widespread infrastructural, human, material, economic or environmental losses which exceed the ability of the affected community/society or persons to cope using its own resources, International Strategy for Disaster Reduction (ISDR., 2002). Fire disaster is an unplanned or unexpected event in the building environment, it is believed to be a sting of nature or repercussion of manmade actions, causing losses of both natural and manmade resources in affected areas.

According to Mudalige (2011), fire disaster preparedness encompasses measures aimed at enhancing life safety when a fire disaster occurs, it also includes actions designed to enhance the ability to undertake emergency actions in order to protect property and curtail damage and disruption, as well as the ability to engage in post-disaster restoration and early recovery activities. The activities that are commonly associated with fire disaster preparedness include developing planning processes to ensure readiness; formulating disaster plans; stockpiling resources necessary for effective response; and developing skills and competencies to ensure effective performance of disaster-related tasks. For example, the training and preparation of fire disaster managers will affect the way in which the persons' function during and after fire event. Preparedness efforts also aim at ensuring that the resources and equipment necessary for responding effectively in the event of a fire disaster are in place, and those that will respond know how to use those resources and equipment (Newey, Lepschi and Croft, 2008).

Dynes (1982) defines fire disaster management in four phases: preparedness that focuses on alleviating/preventing the emergence of fire; mitigation which focuses on minimizing the damage; response which focuses on providing assistance when a disaster has happened, and in the rehabilitation phase, the damage will be restored. Thus, this study focusses on the preparedness phase of fire disaster management.

The fire disaster preparedness, fire prevention, protection and insurance measures earlier mentioned are to be undertaken before the occurrence of any fire in a building. Before fire occurs, appropriate actions planned well in advance should be initiated to provide all the help and assistance for occupants to reach places of safety inside or outside the building involved in the fire. These include fire drills and staff training in the use of first-aid fire-fighting methods such as fire extinguishers. Actions to be taken after a fire is extinguished include salvage operations, repairs to parts of the building damaged by the fire or total rehabilitation, and submission of claim for insurance compensation. These actions are to ensure that the activity interrupted by the fire is restarted as soon as possible (Ramachandran, 1999).

According to Langdon (1972), when dealing with dangers of a fire in a building, consideration should be given to two systems which are complimentary. These are fire protection and fire safety systems. Fire protection incorporates active and passive measures. Fire protection aims at protecting human life, goods and activities as well as protecting buildings. Fire protection provides for all means of escape from buildings; safeguarding or eliminating possible sources of accidental fire; detecting outbreaks and limiting rate of fire spread; efficient professional rescue and firefighting service; means of extinction in inception stage of fire either automatic or hand; restraining spread of fire risk from one building to another.

III. Methodology

Though the study was essentially a descriptive survey, it however employed a mixed research design approach (quantitative and qualitative). Data collection were through questionnaire, observation, checklist, journal articles, seminar papers and review of related literature. Data collected were analyzed with the use of frequency distribution tables, percentage, mean scores, standard deviation and T-test.

The benchmark for judgment was placed at 95% confidence interval which in other words is 0.05 level of significance. Statistical Package for Social Sciences (SPSS) version 23.0 was used in all the analysis.

3.1 POPULATION OF THE STUDY

According to the data collected from Owerri Capital Development Authority (OCDA), the population of the registered commercial buildings in Owerri was 1,463; Orlu 471; and Okigwe 334 which gave a total of 2,268. The population of this study constitutes the registered commercial buildings in the study area – Owerri, Orlu and Okigwe, and the commercial building owners and users in the study area. Purposive method of sampling was used for the distribution of the questionnaire.

3.2 SAMPLE, SAMPLE SIZE AND TECHNIQUES

The sample size for the study consists of 2,268. According to Peck, *Chris and Jay (2008)*, a sample is the number of people drawn from a population large and good enough to represent the entire population. A representative size is an essential requirement of any research study. As a result, it is pertinent to apply a mathematical approach to obtain such representative sample.

Based on the above population premise, the sample size for this study was determined using Cochran’s formula. According to Cochran, (1977), this formula is used where the population size for a study is known. Thus, it is stated:

$$n = \frac{z^2 Npq}{Ne^2 + z^2 pq} \dots\dots\dots \text{equation 1}$$

- Where: n = Sample Size
- N = Population Size
- e = Allowable Errors (4%)
- z = Normal Distribution

p = Proportion of population likely to be included in the sample (50% or 0.5 is assumed)

q = Proportion of population not likely to be included in the sample (50% or 0.5 is assumed)

$$\text{There: } n = \frac{(1.96)^2 \times 2268 \times (0.5) \times (0.5)}{2268(0.04)^2 + (1.96)^2 (0.5)(0.5)}$$

$$n = \frac{3.8416 \times 2268 \times (0.5) \times (0.5)}{2268(0.0016) + 3.8416(0.5)(0.5)} = \frac{2178.1872}{3.6288 + 0.9604} = \frac{2178.1872}{4.5892} = 474.633313$$

Approximately, n = 475. Base on the calculation, the sample size for building owner/user or occupants/manager is 475.

Table 3.1: Sample size

Targeted Population/ Focus group	Total
Building Owner/User or Occupant/Manager	475

Source: Field Survey, (2018).

Table 3.2 Distribution of Questionnaire and Percentage Return rates

Focused Groups	No of Questionnaire Distributed	No of Questionnaire Returned	No of Questionnaire Unreturned	Percentage Returned
Building Owner/User or Occupant/Manager	475	462	13	97.3%

Source: Field Survey, 2019.

IV. Results And Discussion

Table 4.1: Availability of fire-fighting equipment in the buildings studied.

Fire equipment	SA	A	NS	D	SD
Dry chemical extinguishers	201	261	0	0	0
Halon extinguishers	0	0	0	272	190
Foam cylinders	201	114	51	60	36

Carbon dioxide extinguishers	60	81	0	108	213
Sprinklers/Hose reels	20	22	0	148	272
Wet chemical	39	159	49	76	139
Fire blankets	22	43	0	165	232
Sand	232	216	0	9	5

Source: Field Survey, 2019.

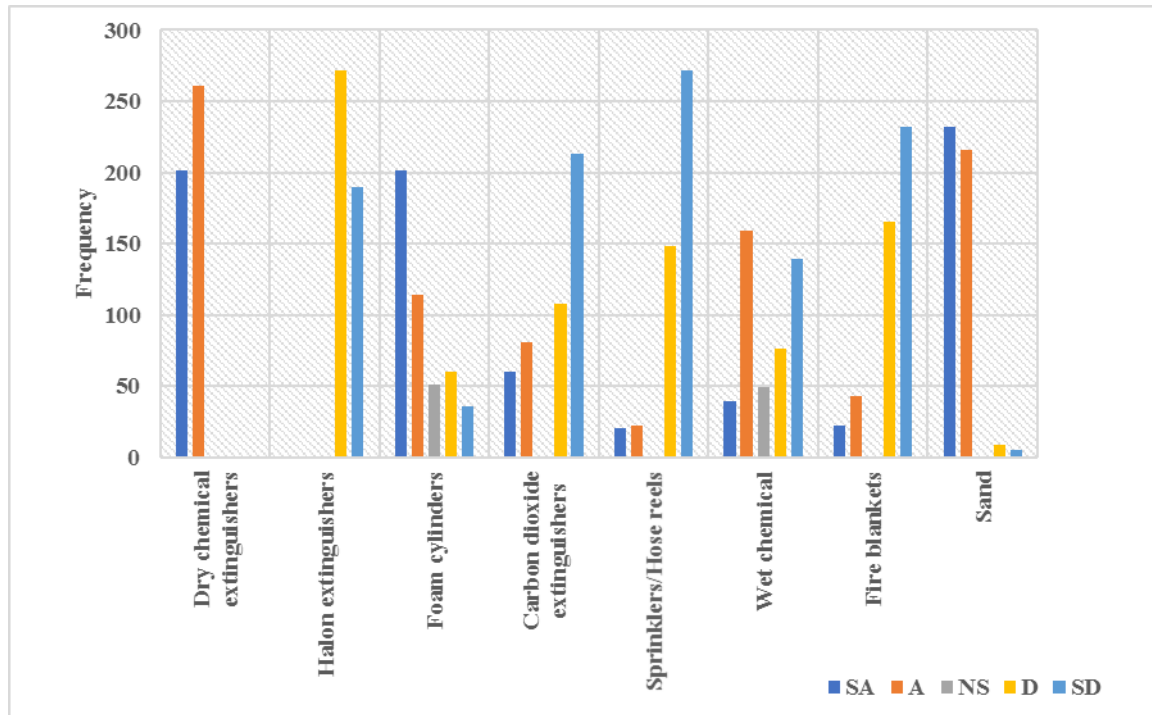


Fig. 1 Availability of firefighting equipment

Source: Field Survey, 2019.

Table 4.1 shows the decision rule of the respondents on the availability of fire safety equipment available in the commercial buildings. It could be summarized that the commonest firefighting equipment available in all the commercial buildings were dry chemical extinguisher, foam cylinders, wet chemical and sand with (462) respondents in each case. Since the major causes of fire outbreak are faulty electrical appliances and use of sub-standard electrical materials, it is obvious that the available extinguishers aforementioned are not the types that could suppress the class ‘C’ fire. This area of availability of firefighting equipment should be taken seriously by commercial building owners because different types of fires have its own suppressive extinguisher. So, all the types of fire extinguishers should be provided in the commercial buildings. This shows that the level of fire safety measures adopted by commercial building owners were comparatively low.

Table 4.2: Perception on availability of firefighting equipment in the building

Level of satisfaction	Frequency	Percent (%)
Satisfied	98	21.2
Not satisfied	304	65.8
Not Sure	60	13.0
Total	462	100

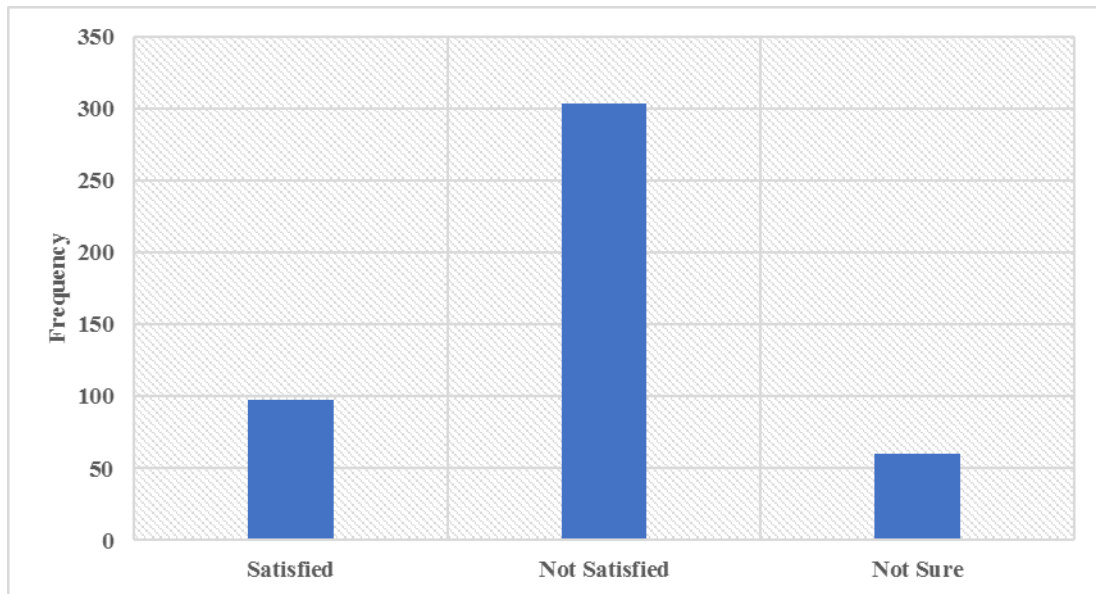


Fig. 2: Level of satisfaction of Firefighting equipment availability

Source: Field Survey, 2019.

From table 4.2, the respondents’ view on the area of availability of firefighting equipment was not satisfied because the commonest among the firefighting equipment available in all the commercial buildings were dry chemical extinguisher, foam cylinders, wet chemical and sand which have not been effective in most cases.

Table 4.3 Firefighting equipment that can be operated by Users

Fire equipment	SA	A	NS	D	SD
Dry chemical extinguishers	216	246	0	0	0
Halon extinguishers	0	0	0	208	254
Foam cylinders	171	134	51	59	47
Carbon dioxide extinguishers	86	55	0	100	221
Sprinklers/Hose reels	15	16	0	206	225
Wet chemical	81	117	49	124	91
Fire blankets	33	32	0	170	227
Sand	238	210	14	0	0

Source: Field Survey, 2019.

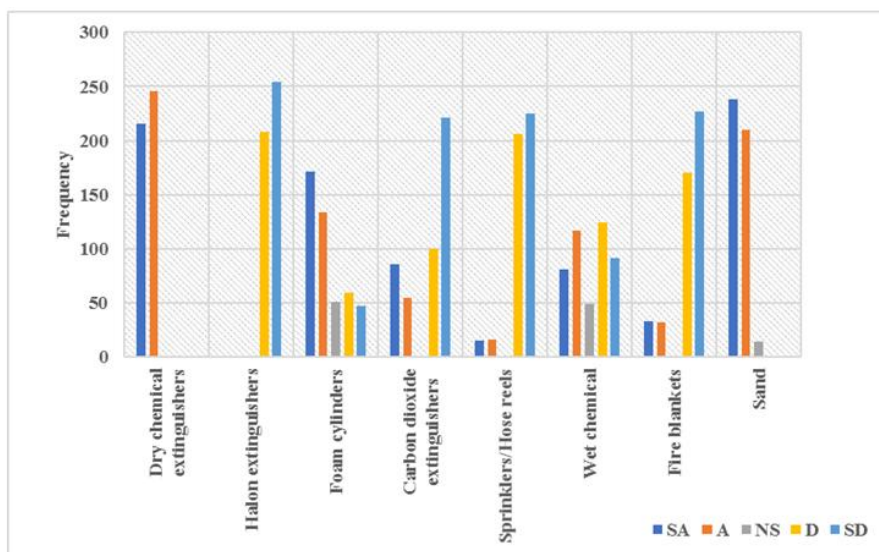


Fig. 3 Ability to operate firefighting equipment

Source: Field Survey, 2019.

From table 4.3, the result shows that there is a low level of fire disaster preparedness and awareness on fire safety measures in the study area. It could then be concluded that most of the owners/ occupants of commercial buildings in the studied area could only operate dry chemical extinguisher, foam cylinder and sand because it is the commonest among all the equipment. This means there is need for education and training of all the occupants of these commercial buildings on the use of different types of firefighting equipment. In determining the level of fire disaster preparedness of commercial building owners, availability of firefighting equipment and the operation were variables measured. Tables 4.1 – 4.3 show that the level of fire preparedness of commercial building owners in the study area were far below standard.

Table 4.4: Ways fire disaster preparedness measures could be enhanced as suggested by the respondents.

Preparedness measures	Frequency	Percent (%)
Emphasis should be on fire drill and maintenance policy	102	20.1
More fire-fighting personnel should be employed	115	24.9
There should be fire insurance policy	140	30.3
Every building should have fire equipment	105	22.7
Total	462	100

Source: Field Survey, 2019.

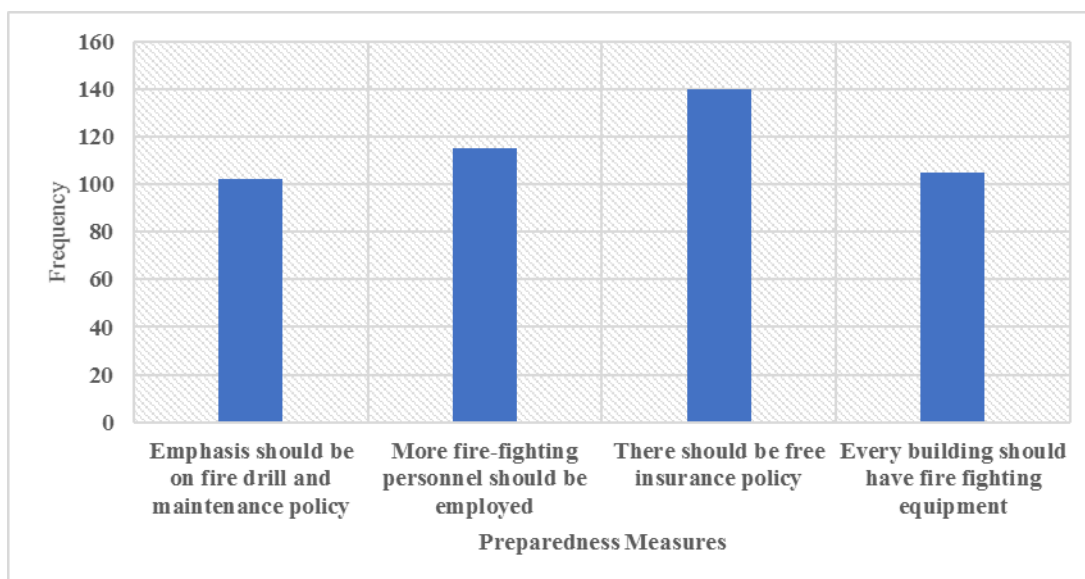


Fig. 4 Ways to enhancing fire disaster preparedness for commercial buildings.

Source: Field Survey, 2019.

From table 4.4, the respondents prescribed four (4) suggestions: 75 (31.9%) respondents suggested that Firefighting Personnel should be employed in all the commercial buildings. 58 (24.7%) suggested that fire drill (training and education) should be put in place at regular interval. 46 (19.6%) respondents perceived that there should be fire insurance policy in all the commercial buildings, this corroborates the fire safety regulation and code of the federal Republic of Nigeria. And 56 (23.85%) respondents viewed that every building should have various firefighting equipment since there are different type of extinguisher for different fire.

Table 4.5: Level of fire disaster preparedness of commercial building owners

Fire disaster preparedness measures	N	Mean	Std. Deviation
BUILDING MATERIALS			
Hard Wood	462	4.7944	0.40460
Sand-Crete block	462	4.5022	0.52500
Concrete	462	4.8312	0.37501
Reinforcement bars	462	4.7511	0.43285
Glass	462	4.8615	0.34583
Aluminum	462	4.8853	0.31903
Polyvinylchloride (PVC)	462	4.0931	0.56083
FIRE DETECTIVE DEVICES			
Fire alarms	462	4.2273	0.41952
Smoke detectors	462	4.1840	0.44518
Smoke vents	462	4.1494	0.59041
FIRE SUPPRESSIVE MEASURES			
Water sprinklers	462	3.2294	0.58484
Fire hydrants (Internal and External)	462	4.1147	0.31903
Fire extinguishers	462	4.0779	0.32667
Hose reels	462	3.2294	0.58484
FIRE SPREAD CONTROL MEASURES			
Fire compartment	462	4.3658	0.48212
Fire grading	462	3.4870	0.50037
Fire stopping	462	3.2359	0.53365
Fire wall	462	3.5519	0.73678
Fire resisting doors and windows	462	3.1299	0.33652
FIRE SAFETY MEASURES			
Exit access or Means of Egress	462	4.4134	0.49298
Appropriate Signage	462	3.1710	1.21406

Source: Field Survey, 2019

The results from table 4.5 shows that the majority of the building materials, fire detective device, fire suppressive measures, fire spread control measures, and fire safety measures used were adequate in terms of facial appearance because they were all above (3.0) the mean score. Table 4.5 shows building design specification of National Building code for fire in public buildings with users greater than 150. The results analyzed in tables 4.5 - 4.7, indicates that the level of fire disaster preparedness of commercial building owners in Imo State were comparatively low. And this corroborates with Osaro (2013), that “the nation has not been properly enlightened (education, training, awareness and practice) on the enormous impact of fire on lives and property”.

Table 4.6: Availability of fire safety strategies in case of fire outbreak

Suggested fire safety strategies	SA	A	NS	D	SD
Emergency comm. System	210	180	0	29	43
Regular inspection & maintenance	26	21	0	218	197

Trained fire-fighting personnel	26	38	0	187	211
Existence of fire assembly point	98	116	0	172	76
Availability of an emergency fire disaster kit	0	0	0	218	244
Accessibility to fire hydrants	0	0	0	246	216
Existence of insurance policy	41	74	0	138	209
Regular training and fire drills	0	0	0	249	213

Source: Field Survey, 2019.

From the frequency in fig. 6, the respondents' view shows that fire safety strategies adopted by commercial building owners in table 4.6 were not adequate. The study concluded that the fire safety strategies were far below expectation, from the view of the respondents indicated that the strategies put in place by the owners of these commercial buildings were not adequate. This corroborates with the assertion of Proulx (2013), that the occupants/ users who are usually the victims of fire disaster are without adequate insurance cover. So, to combat the emergence of fire, fire spread and fire hazard in commercial buildings, it is expedient to put some if not all these strategies in place.

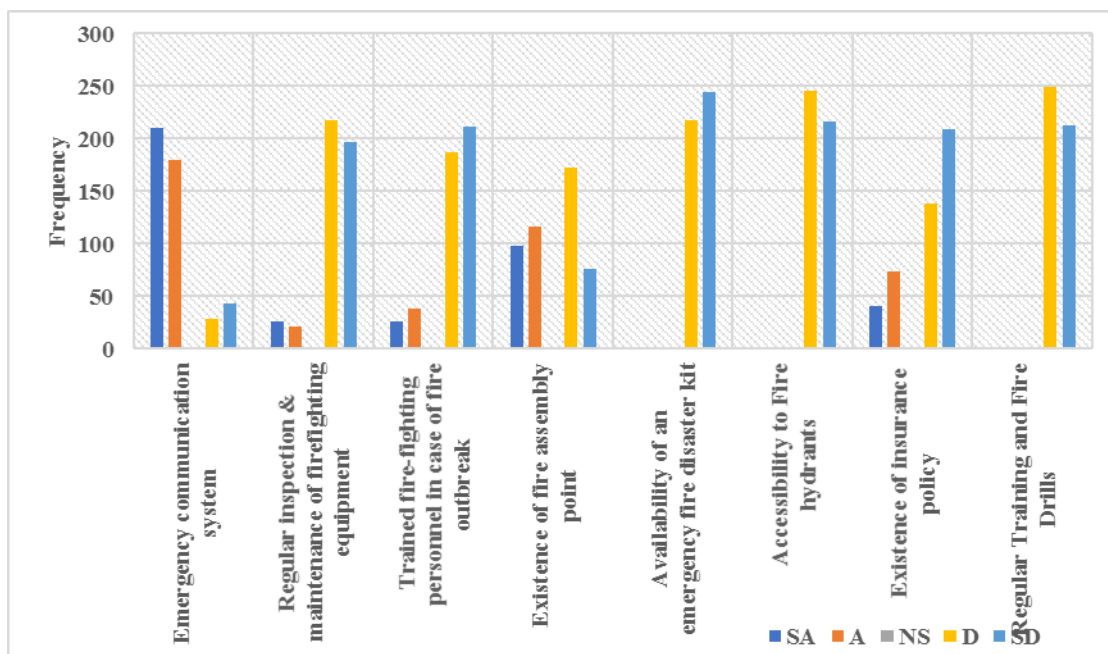


Fig. 6. Fire Safety Strategies

Source: Field Survey, 2019.

Table 4.7.1: Perception on the level of fire safety strategies in the building

Level of satisfaction	Frequency	Percent (%)
Satisfied	82	17.7
Not satisfied	326	70.6
Indifferent	54	11.7
Total	462	100

Source: Field Survey, 2019.

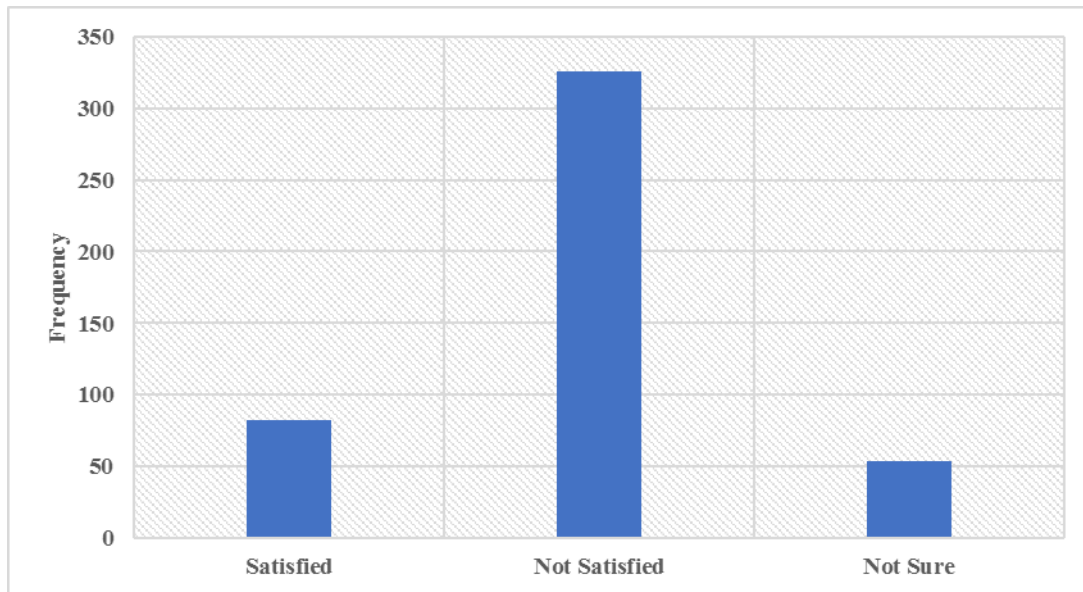


Fig. 7 Level of satisfaction of fire safety strategies

Source: Field Survey, 2019.

From table 4.7.1, the result of the respondents show that 326 (70.6%) were not satisfied with the level of fire safety strategies adopted by commercial building owners. Emergency communication system was the commonest measure available in the majority of the commercial buildings because they could make calls with their respective phones or handsets. Other measures were not readily available, so, there is need for adequate provision for all the strategies if fire hazard must be prevented or its impact be reduced.

Table 4.7.2 Fire Safety Policy in the commercial buildings in case of fire occurrence

Suggested Fire Safety policies	SA	A	NS	D	SD
Fire insurance policy	0	0	0	316	146
Fire safety policy	12	42	12	286	110
Evacuation plans	2	13	32	216	199
Sanctions against those who disobey fire regulation	281	131	0	28	22

Source: Field Survey 2019

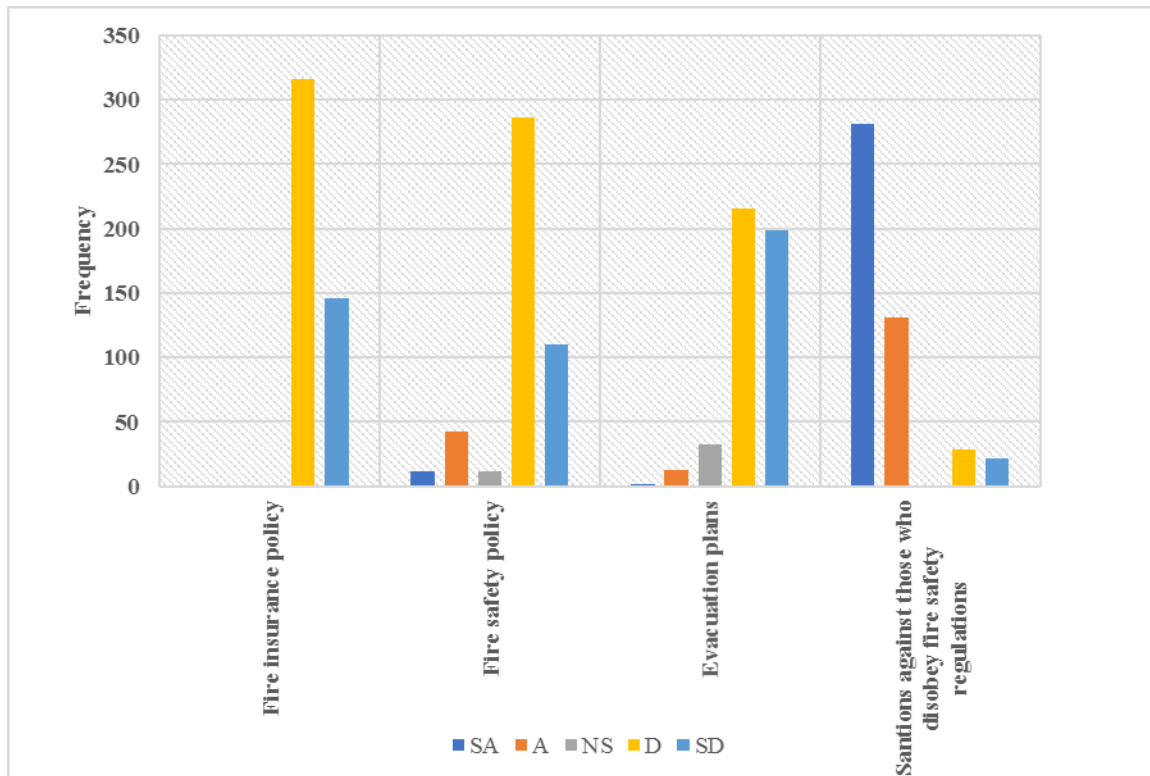


Fig. 8: Level of availability of Fire Safety Policy

Source: Field Survey, 2019.

Table 4.7.2 shows the decision rules of the respondents, the data gathered indicates that all the commercial buildings are in operation without any fire safety policy put in place in case of fire emergence. The only well-pronounced among the suggested measures was sanction for those who may disobey fire regulation, that is, those who may refuse or might have forgotten to switch off their lights or sockets, air-conditions at the close of work. Other measures were far below expectation. Figure 4.8 shows the respondents' perception level. This was contrary to the Federal Government Fire Safety Code of 2013, Sections 48, sub-section (1), (2) and (89), Sub-Section (3), which stipulates that Commercial building Owners, occupants or Operators shall provide general liability Insurance for the building as detailed in the fire safety code.

Table 4.7.3: Perception on the level of Fire Safety Policy in the commercial buildings

Level of satisfaction	Frequency	Percent (%)
Satisfied	72	15.6
Not satisfied	335	72.5
Indifferent	55	11.9
Total	462	100

Source: Field Survey, 2019.

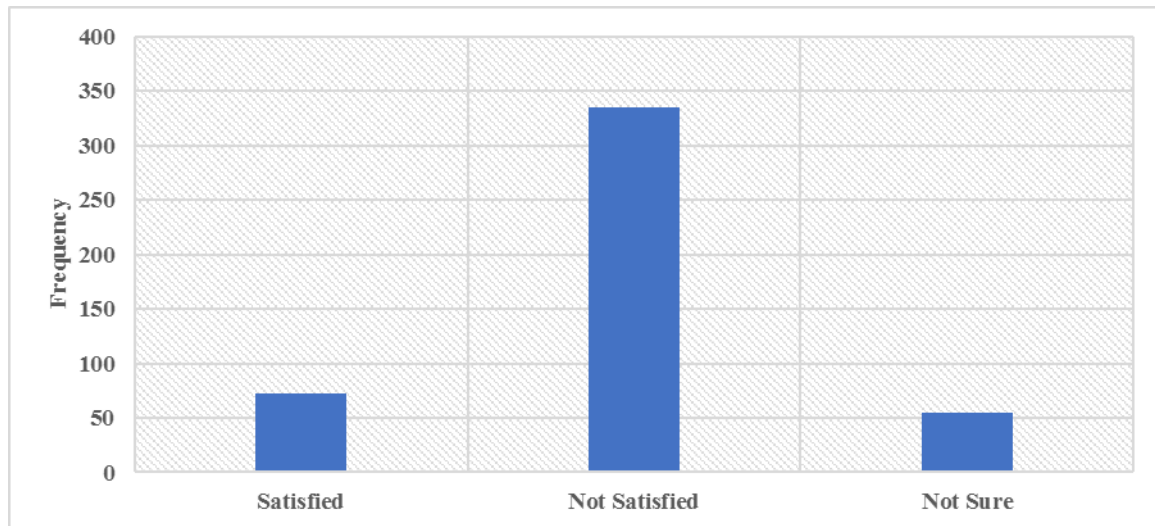


Fig. 9: Perception level of Fire Safety Policy in the commercial buildings.

Source: Field Survey, 2019.

From table 4.7.3, (335) respondents representing 72.5% show that they were not satisfied with non-existence of fire safety policy in majority of the commercial buildings. The respondents' perception corroborates with Proulx (2013), that victims of fire disasters, mostly small-scale traders and artisans, are without adequate insurance cover. It could be concluded from tables 4.6 – 4.6.3 there were no fire safety strategy and policy put in by the commercial building owners in the study area.

V. Conclusion

Despite the technological advancement in fire safety and prevention, fire disaster remains the leading cause of lives and property loss at commercial facilities worldwide and fire could lead to the premature winding up of an organization no matter how big it is. The study revealed that use of Sub-standard materials and faulty electrical appliances were the major causes of fire disaster in commercial buildings.

Again, the study examined the level of fire disaster preparedness by the owners of these commercial buildings in other to ensure life's safety. The result revealed that level of fire disaster preparedness was not adequate, because, there was inadequate provision of the required fire safety and suppressive devices, unavailability of fire safety trained personnel and lack of training and fire drill.

It is therefore expedient for all stake holders to collaborate and advocate the incorporation of all fire firefighting equipment, fire safety policies and strategies in the design and construction of these commercial buildings.

VI. Recommendations

In recent times, efforts have been made by building owners at various levels to prevent the emergence of fire in buildings but failed. The occurrence of fire in most times is unavoidable due to human attitude to handling certain issues especially selection of materials for building components.

- i. Each commercial building should have firefighting department and trained personnel adequately equipped to handle fire emergence at its inception stage.
- ii. There should be public enlightenment, orientation, training and education on fire disaster for all commercial building operators so as to know their level of vulnerability to fire hazards and what to do when fire occurs.
- iii. Parts of a building vulnerable to fires should be properly monitored in the course of construction. Mostly, kitchen area could be built to have dual roof that is, it is decked first and later roofed over with other parts of the building.
- iv. At least three different types of fire suppressive devices should be installed in all commercial buildings to automatically intervene in the event of fire. Among the three, water sprinkler should be made compulsory.
- v. Occupants/ Users should guard against overloading electrical sockets/outlets with a lot of appliances at the same time to prevent sparks that may lead to fire.

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