CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Thefrequent occurrenceoffiredisastersin buildings in Nigeria hasbecomea seriousthreatto thenation's fragileeconomy. Manybuildings,be it residential, commercial, industrial or purpose made structures havebeen guttedbyfire,livesand propertyworthseveralbillionsofnairadestroyed,(National Environment Management Authority, (NEMA), 2012). Proulx(2013) posits that the socio-economicimpacts of these fire eventsareaggravatedbythefactthatvictims offiredisasters,mostlysmall-scaletraders and artisans, arewithoutadequateinsurance cover. These fireshave continuedto rendermany jobless,damagetheenvironment, disrupt economic activities andworsening the problemof poverty.Theeffectivepreventionof these fire incidents will require enhancing the capacity oftherelevantregulatoryinstitutionsin evaluatingthepronenessofanybuildingto firedisaster (Buchanan, 2001).

Theincidenceoffireinbuildingsis amajorthreattosafetyofoccupants, owners of buildings and propertiestherein,particularly,whereinflammable materialsarecommonly used.Hence,its occurrencehasbeenamajorsourceofconcernto stakeholders inthebuiltenvironment (Godschalk, Beatley, Berke, Brower, and Kaiser,1999). Buildingsasinfrastructure alongwithpeople'slives needprotectionagainstfireoutbreaks.Knowledge on theuseofinstalledfacilitiesisessentialintacklingfire emergenciesotherwisetheirinstallationsbecome worthlessaslackofknowledge couldhamperescape fromfirehazardsandthwartattempts tocurtailfire spreadatitspreliminarystage.

Osaro(2013), definedfire disastersas thoseevents that displace the structural,economic, organizational, cultural andspiritual well-being of communitiesby destroyingtheirmeansofexistence. Fire disastercouldeitherbehuman-inducedor naturaloccurrences.Fire disasters arenaturalifthey justhappenwithoutbeinginducedby humans likebush burning, electric sparks, fuel and gas explosion. According to United Nations International Strategy for Disaster Reduction (UNISDR, 2008),when fire disaster occurs,human beings are among themost vulnerablepopulationgroup,especially thosepresentintimesofthe fire event.Furthermore, duringfire disasters,buildingsaredestroyed,takingaway thepreciouslivesofpeopleandstallingaccesstoactivitiesintheaftermathoffire disaster(Dowd,2012).Fire disaster could be naturalor man-made, however, its occurrence cannotbeeliminated outrightly in the built environment,butcould be prevented, reduced or mitigated throughpreparednessmeasuresas indicatedby(Chen, Chuang, Huang, Lin, and Chien, 2012).

Karen (2009)pointed out that fire disasters can often be mitigated or avoided altogether by a comprehensive, systematic, emergency-preparedness program; which provides a means for recognizing and preventing risks and for responding effectively to emergencies. Mudalige (2011), noted that industry resources are very valuable either for the information they contain or for their physical aesthetics. Mathew(2005) carried out studies on fire disaster and the study revealed that fire disasters in industries are almost inevitable. In line with this, Mudalige (2011), stated that fire disaster prevention and security are vital to the preservation and protection of the industry.

Theconcept 'fire disaster'isaseriousdisruptionofthe functioningofa system, communityora society,causingwidespread infrastructural, human,material,economicorenvironmental losseswhichexceed theabilityoftheaffectedcommunity/society or persons tocopeusingitsownresources,(International Strategy for Disaster Reduction (ISDR),2002). Firedisasterisanunplannedorunexpected eventinthe 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 toMudalige (2011), fire disasterpreparedness encompassesmeasures aimedatenhancing lifesafetywhenadisasteroccurs,italsoincludes actions designedtoenhance theabilitytoundertakeemergencyactions inordertoprotectpropertyandcurtail damageanddisruption,as wellas theabilitytoengageinpost-disaster restorationandearlyrecoveryactivities.Theactivities thatarecommonlyassociatedwith fire disasterpreparednessincludedevelopingplanningprocesses toensure readiness;formulatingdisasterplans;stockpiling resources necessary foreffective response;anddevelopingskills andcompetencies toensureeffectiveperformanceofdisaster-relatedtasks.Preparedness efforts alsoaimatensuringthattheresources and equipmentnecessary forrespondingeffectivelyintheeventofafire disasterareinplace, andthose that will respondknowhowtouse those resources and equipment(Newey, Lepschi and Croft, 2008).

In another view, fire disasterpreparednessrefers toactivitiesand measurestakeninadvance toensureeffective response to theimpactoffire disasters, includingtheissuanceoftimely and effective early warningsandthetemporaryremovalofpeopleandpropertyfromathreatenedlocation(ISDR., 2002). According to Newey, Lepschi and Croft (2008),preparedness involves: identification of a disaster response team; training of an emergency action team; identification of recovery work areas; and ensuring supply of equipment and materials. When appropriate, industries security staff should take steps to limit potential damage while waiting for fire safety personnel (fire service personnel) to arrive. Such steps include making sure that owners/ occupants, andthe propertiesare not in danger(Newey, Lepschi and Croft,2008).

Dynes(1982)definesfire disastermanagementinfourphases: preparedness thatfocuson alleviating/ preventingtheemergence of fire;mitigation whichfocusonminimizingthe damage;response which focuson providingassistancewhenadisasterhashappened,andin therehabilitation phase,the damagewillberestored.Thus, thisresearch workfocussedonthepreparednessphaseof fire disaster management.

Therefore, the developed framework for fire disaster preparedness for commercial buildings will enhance *fire disaster policy, procedures and processes* to manage the risks to life due to fire in the selected type of building which are owned and operated by individuals or corporate organisations. Again, the framework provided will ensure*safe and working environments,* secure buildings, owners, occupants/ users, staff and personnel of fire brigade/ firefighting operators, and professionals in the building industry.

From the investigation carried out in the study area, severalcasesof fireincidences in commercial buildingshavepreviously occurredin the three major towns (Orlu, Owerri and Okigwe) ofImo Statebetween 2010 and 2019most of the affected buildings were commercial (hotels, bars, shopping malls) buildings withmostofthe incidences having beenfatal.

These casesamong others include:

(i) **Newton Hotel**along General hospital, Umuguma in New Owerri gutted by fire; (https://www.lindaikejisblog.com/index.php/2017/12/photos-newton-hotel-in-imo-gutted-by-fire.html)

(ii) **Pretoria Hotel and Suites**, Owerri, situated near Winner's Chapel, off Port Harcourt road, New Owerri, and the two storey buildings that torched the hotel were enveloped by balls of fire, the three floors were wrapped in flames which consumed properties worth over N350million; http://nigeriapilot.com/byline/owerri/January 23, 2016)

(iii) **Stone Castle Hotel**at Okigwe area of Imo State mysteriously razed by fire (http://dailypost.ng/2017/11/29/fire-razes-popular-hotel-imo/)

Thisshowsthatmajority of the commercial buildings in Imo Statelack fire disaster preparedness withinadequacy inresponding tofiredisastersoccurrence.Also, there were no plans towards reducing or mitigating the outbreak of fire in the area under study.Rescueteams (firefighting personnel) have failedinmanyoftheoccasionseitherarriving lateat tragedy struckscenesor makingitontimebuthalfequippedhencefailingtocounter thefire outbreakg(see plate A2a and A2b). It is against this background that this studyfocussedonthepreparednessphaseof fire disastermanagementfor commercial buildings in Imo State.

1.2 Statement of the Problem

Fireis known to be crucial in peoples' lives and have beenused mainlyfor cooking,lighting andheating.Firehasalsobeenknowntobea dangerous phenomenoninman's life (Makanjuola, Aiyetan and Oke, 2009).Fire is apotentialthreat to life inany buildingandcancreateanevenworsesituationif thereisnopriorpreparation to curtail itsoccurrence(Abdullah,2011).

Fire disastersoccurmorefrequentlyandtouchincreasingamountsof humanlives and the risk of fire occurrence in buildings cannot be eliminated in the built environment during the operational life of a building but could be prevented, reduced or mitigated through preparedness measures (Emergency Events Database (EM-DAT; UNISDR.,1994).

Fireoutbreaks occurasaresultofhumanfactors suchascarelessness,negligenceorsimplydueto lackoffiresafetyawareness, use of sub-standard electrical materials and faulty electrical appliances.AsmentionedbyTan and Hiew (2004), design teams, buildingowners, users/occupants, cleaners,security, maintenance andfire safety personnel areall responsible forfiresafetyinanybuilding.Thus, there is need to establish a comprehensive fire disaster policy and implementation framework so as to reduce the impact of any unforeseen fire event in buildings.

A good number of properties have beendestroyedandliveslostduetooutbreakoffires in Imo state particularly, in the three major towns namely: Owerri, Orlu and Okigwe where these fire disaster occurrences are more prevalent(Appendix A, plates A1 – A14). This is due to thefast-growing economic activities and developments in these towns and the potential for substantially greater future losses loom if adequate fire safety and preventive measures are not put in place. Sinceitisdifficultto predictfireoutbreaks,preparedness action or planning or measuresareessentialto preventing fire occurrence,reducingits' impact on livesand lossofbuildings in the study area.

Therefore, this research work concluded with a developedframeworkfor fire disaster preparedness for commercial buildingsinordertopreventing fire disaster emergence or reduce fire events in buildings to the barest minimum. This will aidthe design and construction of structures (buildings) that would be more resistant to fire disasters, ensuring strict adherence to fire safety rules,design codesand construction standards,by conforming tothecodesandrequirements fromthe town planning and fire serviceauthorities, preventive actionsand training ofbuildingoccupants, fire safety personnel andfacilitymanagersinproperresponsetofire emergencies, theoverallthreatoffireandfirerelated damagescanbegreatly reduced.

Limitedresearchhasbeendone on fire safety and preventioninNigeria, but in the study area (Imo State), no research has been conductedinthe area of fire disaster preparedness. From records (Table 4.3),there have been several cases of fire disasters in Imo State particularly in the three major towns namely Owerri, Orlu and Okigwe,predominantlyincommercial buildingssuch as hotels and shopping malls.It is againstthisbackgroundthatthis study soughtto access the causes of fire disaster in commercial buildings in Imo State anddevelop a frameworkfor fire disaster preparedness with a view to preventing the likely occurrence of fire disasters or reduce the impact of fires on lives, property and buildings if occur.

1.3 Aim and Objectives

The aim of this research is to develop a framework for fire disaster preparedness forcommercial buildingswith a view tominimizingtheoccurrence and effectsof firedisaster in buidings in Imo State. In view of this, the specific objectives of this research work are to:

i. Establish the incidences of fire outbreak in Imo State.
ii. Determine thecausesoffiredisastersin Imo State.
iii. Examine fire disaster preparedness level ofcommercial building ownersin Imo State.
iv. Determine fire safetymeasures or strategies adopted byownersofcommercial buildings in Imo State.

v. Evaluate the level of compliance of commercial buildings withprovision offire safety acts, design standards and fire safety codesin Imo State.

1.4 Significance of the Study

This study on completion, will be beneficial to all design and construction teams in the built environment as this research work will foster the planning, design and construction of a building that will be more resistant to fire hazard in Imo State particularly in Owerri, Orlu and Okigwe where fire disaster is more prevalent.

This study, on completion, will establish policies and implementation processes for fire disaster preparedness and empowering commercial building owners, occupants/ users to develop solutions to fire disaster emergence or curtail the spread of fire (Chapter 5.3).

This study will also provide commercial building owners/ users with a higher degree of security fromfire attack through training and educationon fire disaster preparedness concepts and techniques through the applications of building codes, construction standards and fire safety rules and regulations.

This research on conclusion will be of great importance to the general public as it will enlighten the public, building owners and users on their level of vulnerability to fire disaster and thus help to establish measures to preventing or reducing the shocking effect of fire disaster when it occurs.

Finally, this study will be beneficial to researchers, students and other professionals in construction industry and will also provide areas for further studies.

1.5 Scope and Delimitation of the Study

Due to wide range of fire disaster occurrences in commercialbuildings in the study area, the study examined and established fire disaster incidences in Imo State between 2010-2019. The major factors leading to fire disaster in the study area were critically studied. The study also determined the level of preparedness of the owners/occupants and compliance of these buildings to design and construction standards, fire cafety codes in tackling the emergence of fire.

This studywas delimited tocommercial buildings such as hotels andshopping mallsin the threemajor towns of Imo State namely: Owerri, Orlu and Okigwe where these fire events are more predominant.Other types of buildings, such as market buildings, industrial and residential buildings were not examined is this study. The data for this study wereobtained from the commercial building owners/occupants/users, the design and contruction teams, Town Planning and Fire Service Station Officers and victims of these fire events from the three major towns of Imo State.

The limitation of this study was the delay in recovering the questionnaires from the respondents due to their geographical location. Also, many of the respondents denied access to their facilities, they did not allow picture to be taken in the course of the study most especially during the observation and walk-through exercise.Again, some relevant authorities refused access to the required information for this study.

Conclusively, a framework for fire disaster preparedness for commercial buildings of these categories in the area of study was developed that could foster fire safety and prevention of life of building owners, occupants/ users and buildings. The developed framework will also enhance the planning, design and construction of buildings that could resist fire outbreak.

Asoftware was developedfor the implementation oftheframework – chosentobeaMobileApp in order to makeithandy,universalanduser-friendly. In the event of fire, the software will enable the owners/users to immediately contact the firefighting Agencies or Authorities for quick intervention or response.

1.6 Research Questions

i. Has there been cases of fire outbreak in Imo State?
ii. What are the causes of fire disaster in commercial buildings in Imo State?
iii. What is the level fire disaster preparedness of building ownersin Imo State?

iv. What are the fire safetymeasures or strategies put in place by theownersofcommercial buildings in Imo State?

v. Whatisthelevel of compliance of commercial buildings withprovision offire safety acts, design standards and codesin Imo State?

1.7 Research Hypotheses

H_{O1}. The level of fire disaster preparednessofcommercial building owners in Imo State is not adequate.

H_{O2}. The level of compliance of commercial buildings in Imo State with the provision of fire safety acts, design standards and codes is not adequate.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE, CONCEPTUAL AND THEORETICALFRAMEWORK

2.1 Review of Related Literature

2.1.1 Meaning, Nature and Character of Fire

Firesstartwhenaflammable ora combustiblematerial, incombinationwitha sufficient quantity of an oxidizer such as oxygen gas or another oxygen-rich compound,isexposedto asourceofheatorambienttemperatureabovetheblazepointforthefuel/oxidizer mix,andisabletosustainarateofrapidoxidationthatproducesachainreaction(Murali and Vijayalakshmi, 2014). Thisiscommonly calledthefiretetrahedron (fig. 2.2).Fire cannotexistwithoutallofthese elementsinplaceandintherightproportions.Somefuel-oxygenmixesmay requirea catalyst,asubstancethatisnotdirectly involvedinany chemicalreactionduring combustion,butwhichenablesthe reactantstocombustmore readily.Once ignited,a chainreaction takesplacewhereby firescansustainitsownheat by thefurther releaseofheatenergyintheprocessofcombustionandmaypropagate,provided thereisacontinuoussupplyofanoxidizerandfuel.Iftheoxidizerisoxygenfromthe surroundingair,the presence ofa force ofgravity,caused by acceleration,isnecessary toproduceconvection,whichremovescombustionproducts andbringsasupply ofoxygentothefire.Withoutgravity,afirerapidlysurrounds itselfwithits owncombustionproductsandnon-oxidizing gasesfromtheair,which exclude oxygenandextinguishit (Nnabuko,2015).

Whenafirebegins,itgrowsbiggerandthenrunsoutofcontrolandgetsafirmgrip onitssurroundings.There isdramainfullmeasure:peopledie;corporateassetsgoup insmoke;livelihoodsmeltaway intheheatandeventually somebody issaddledwith theblame National Environment Management Authority,(NEMA., 2012).Althoughitisagreedthatfirerisksandfirewastageareastatistical functionof developmentinany country,thereisneedtoensurethatsuchiskepttoa minimum(Derek, 1986).

According to Chow (2012),fireoccurswhenthereisa chemicalunionofoxygenwithfuelaccompaniedbyevolutionofthermalenergy informofincandescenceorflame.Themannerinwhichandthefactorsthatinfluencethe releaseofheatenergy,involvesthestudyoffirebehaviorwhichisdefinedasthe releaseof heat energyduring combustionas describedbyfire intensity,rate of spreadofthe fire front, flamecharacteristicsand otherrelated phenomena. Variousfireparametershavebeendevelopedtoquantitativelydescribethe behavioroffires.Basically,theeffectoffire dependsupontheamount,rate andtheverticallevelatwhichtheheatenergy isreleasedandthefirebehaviorparametershavebeendevelopedthatquantitatively describethedifferentaspectsofthe releaseofheatenergyduringa fire.

Firesareamongthemostdestructivehazardscausing extensivedamagetothebuiltandnaturalenvironment, and devastation tohumansettlements acrosstheglobe (FireDisasterPrevention&Safety Awareness Association of Nigeria (FDPSAAN.,2008).

According to Makanjuola,Aiyetan, andOke(2009), firehasbeenusedinthedailylifeofhuman-kindfromtimeimmemorial.Traditionally, firehasbeenusedforcooking, steamengines, wood andcoal,smeltingofironand othermetal,dryinghidesandmeatfor preservation,charcoalburning, andcommunication signaling.Firehasbeenasignificanttoolforhumansbyplayingakeyroleforconversionofra w materialtousablefood,energyandlight.Withinthehospitality industry,fireisusedincooking throughuseofgas, charcoal,electricalappliances andequipment. However,fireriskwouldbehighduetothevulnerability factorssuchas lack oftrainingandexposuretoflammablematerials.Thus,itwould beimportanttoincorporatefire preparednessamong suchbusinessesto safeguardthemfromlossordisruptionofbusiness (Ball,2001).

2.1.2 Causes of fire

Akomolede(2015), opined threemain causes of fire, theyinclude:

a. Art of God

This is fire causeddueto providenceforinstancethunder and lighting.

b. Accidental origin

This type offiremaybe caused by use of substandard electrical materials, faulty electrical appliances, electrical cables,and careless disposal ofitems that have fire properties, forinstance, cigarettes amongothers.

c. IncendiaryOrigin

This maybedueto bush fires, dueto cause of irksome bush burning. Adamu (2013) added;

d. Arson

This is the burningof abuildingor other propertyforacriminal or malicious reason (Arson,2006).

2.1.3 Products of fire

Thecombustionoffuelinthepresenceofoxygenproducessmokeandheat Akomolede(2015). The levels of heat production are substantial and, when fire events arenot constrainedby automaticorhumanintervention,combustionoccurringinanenclosurewill producetoflashover.Bothsmoldering andflamecombustionoftenwillyieldcopious amountsofsmoke,thuscausingdifficulty foroccupantsasthey evacuatethefireridden building.Forthoseoccupantswhoareunableto escapethefire,thelikelyresultswouldbe injuryorevendeath.

Smokeisacombinationofhotgases,particulatematter,aerosols,allofwhichare produced by thecombustionoffuel.Thehotgasesresultfromthedecompositionofthefuelasit oxidizes.Ascombustionisrarely complete,unburnedorpartially burnedparticlesfuel wouldbecomesuspendedinthesegases.Similarly, finedropletsofliquids,aerosols-will enterintothesmoke.Theheatenergy entrainedinthesmokecausesittoroilandexpand outwardly.Ifthesmokeisnotenclosed,itwould riseupwardsintothesky.ifthesmokeis enclosedwithabuildingthenitwouldexpandtofillthespace.Foroccupantsstillpresent inthesmoke-filledspace,thesmoke wouldirritatetheeyesandobscure visionbecause of thesuspendedparticlesof matterandaerosols,bothof whichrestrictlighttransmission throughthesmoke.Thesmokewouldmakebreathing difficult, asitaffectsthelining ofthe respiratorytrackandlungs.And,mostseriously,thesmokewouldinducenarcosis,in which,first,musclecoordinationandordinary mentalfunctionwillbegintofailand,soon after,unconsciousnesswilloccur.Ifanoccupantcontinuestostayinthesmoke- f i l l e d space,theoccupantisrenderedunabletoleave-lossof consciousness-thendeathwouldbe eminent (GoK,2012a).

2.1.4 Fire Hazards of Materials and Products

The presence of combustible material in combustible systems represents an obvious condition of burning. Burning phenomena and the phases of the burning process fundamentally depend on the physical and chemical properties of the material involved (Simmons, 1990).

(i) Wood and wood-based products

Wood is one of the most common materials in the human environment. Houses, building structures, furniture and consumer goods are made of wood, and it is also widely used for products such as paper as well as in the chemical industry.

Wood and wood products are combustible, and when in contact with high-temperature surfaces and exposed to heat radiation, open flames or any other ignition source, will carbonize, glow, ignite or burn, depending upon the condition of combustion. To widen the field of their application, the improvement of their combustion properties is required. In order to make structural units produced from wood less combustible, they are typically treated with fire-retardant agents e.g., saturated, impregnated, provided with surface coating (Janssens, 1991).

(ii) Fibres and textiles

The majority of the textiles produced from fibrous materials that are found in the close surrounding of people is combustible. Clothing, furniture and the built environment partly or totally consists of textiles. The hazard which they present exists during their production, processing and storing as well as during their wearing (Gordon, 1981).

The basic materials of textiles are both natural and artificial; synthetic fibres are used either alone or mixed with natural fibres. The chemical composition of the natural fibres of plant origin (cotton, hemp, jute, flax) is cellulose, which is combustible, and these fibres have a relatively high ignition temperature (approx. 400 °C). It is an advantageous feature of their burning that when brought to high temperature they carbonize but do not melt (Griffith and Mullins,1984).

The most important fire hazard characteristics of textiles are the properties connected with ignitability, flame spread, heat generation and the toxic combustion products. The fields of application for these products (tents and flats, furniture, vehicle upholstery, clothes, carpets, curtains, special protective clothing against heat and weather), as well as the stipulations to restrict the risks in their use (Mizuno and Kawagoe, 1986).

(iii) Combustible and flammable liquids

In the presence of ignition sources, combustible and flammable liquids are potential sources of risk. First, the closed or open vapour space above such liquids provides a fire and explosion hazard. Combustion, and more frequently explosion, might occur if the material is present in the vapour-air mixture in suitable concentration (Hilado and Cumming, 1977). From this, it follows that burning and explosion in the zone of combustible and flammable liquids may be prevented if:

(i) the ignition sources, air, and oxygen are excluded; or

(ii) instead of oxygen, inert gas is present in the surrounding; or

(iii) the liquid is stored in a closed vessel or system; or

(iv) by proper ventilation, the development of the dangerous vapour concentration is prevented.

2.1.5 Fire Disasters in Buildings

According to Linville (1990), fire and combustion have been defined in various ways. For the purposes of the study, the most important statements in connection with combustion, as a phenomenon, are as follows:

(i). Combustion represents a self-sustaining run of reactions consisting of physical and chemical transformations

(ii). The materials involved enter into reaction with the oxidizing agent in their surroundings, which in most cases is with the oxygen in the air.

(iii). Ignition requires favourable starting conditions, which are generally a sufficient heating up of the system that covers the initial energy demand of the chain reaction of burning.

(iv). The resultant of the reactions is often exothermic, which means that during burning, heat is released and this phenomenon is often accompanied by visibly observable flaming.

2.1.6SourcesofFireinBuildings

Sourcesoffirecouldbemanyandeveninnumerable.Accordingto (IssahandAliyu, 2012), "firecouldoriginatefrombothexternalandorinternalsources.Externalsourcesincludethe risk ofbushburnings,andlightning strikes.Internal risksoffireareeverpresentwithourwide spreadrelianceontheuseofelectricalappliancessuchasdesklamps,heaters,computers, powerboardsand otherequipmentwithin the collection building”.

(Akomolede,2015),opined that,many firesoccurredinbuildingsduetothecarelessdisposalofsmoking materialintowastepaper baskets.Intoday'sworldof electronicofficeequipment,there is increasein fireincidents dueto faulty electricalequipmentandpowerdistributionsystems.Manycommoncausesoffire canberelatedtoopenflames,electricalfires,cookingandspontaneousignitionand theIgnitionof wastematerials.Openflamesarisefromsuch unsafe conditionsas negligenceinconductinghotwork,suchas welding,cutting orgrinding;improperuse ofcandles;improperhandlingofflammableorcombustibleliquidsorflammable gasesinnear-to-potentialignitionsources;matchesand cigarettesthat are improperlydisposed.Electricalfiresarise fromconditionsincluding damagedelectricalconductors,plugwiresorextension cords;useoffaulty,modifiedorunapprovedelectricalequipment;insufficientspace orclearancebetweenelectricalheating equipmentandcombustibles;shortor overloadedcircuits;loose electricalconnections;andlighting.Spontaneousignitionandtheignitionof waste materialsoccurwhenthere isimproperdisposalof materialssusceptible to spontaneouscombustion,suchasoily ragsfromwoodfinishing orpolishing; accumulationoforganic materials,suchasgreenhay,grainorwoodchips;and accumulationofwastecombustiblematerialsnearpotentialsourcesofignition (Nnabuko,2015).

2.1.7 Ignition Sources

The phenomena supplying heat energy may be grouped into four fundamental categories as to their origin (Ohtani, 1990).

1. heat energy generated during chemical reactions (heat of oxidation, heat of combustion, heat of solution, spontaneous heating, heat of decomposition.
2. electrical heat energy (resistance heating, induction heating, heat from arcing, electric sparks, electrostatical discharges, heat generated by lightning stroke).

3. mechanical heat energy (frictional heat, friction sparks)
4. heat generated by nuclear decomposition.

The following discussion addresses the most frequently encountered sources of ignition (Berta and Fodor, 1990).

a. Open flames

Open flames may be the simplest and most frequently used ignition source. A large number of tools in general use and various types of technological equipment operate with open flames, or enable the formation of open flames. Burners, matches, furnaces, heating equipment, flames of welding torches, broken gas and oil pipes, etc. may practically be considered potential ignition sources. Because with an open flame the primary ignition source itself represents an existing self-sustaining combustion, the ignition mechanism means in essence the spreading of burning to another system.

b. Spontaneous ignition

The chemical reactions generating heat spontaneously imply the risk of ignition and burning as “internal ignition sources”. The materials inclined to spontaneous heating and spontaneous ignition may, however, become secondary ignition sources and give rise to ignition of the combustible materials in the surroundings. Although some gases (e.g., hydrogen phosphide, boron hydride, silicon hydride) and liquids (e.g., metal carbonyls, organometallic compositions) are inclined to spontaneous ignition, most spontaneous ignitions occur as surface reactions of solid materials. Spontaneous ignition, like all ignitions, depends on the chemical structure of the material, but its occurrence is determined by the grade of dispersity.

Spontaneous ignition of liquids is also promoted if they come into contact with air on solid materials of large specific surface area. Spontaneous ignition of glass-wool and mineral-wool products produced from non-combustible fibres or inorganic materials covering large specific surfaces and contaminated by oil have caused very severe fire accidents.

c. Electric ignition sources

Overloading exists when the wiring and electrical appliances are exposed to higher current than that for which they are designed. The overcurrent passing through the wiring, devices and equipment might lead to such an overheating that the overheated components of the electrical system become damaged or broken, grow old or carbonize, resulting in cord and cable coatings melting down, metal parts glowing and the combustible structural units coming to ignition and, depending on the conditions, also spreading fire to the environment. The most frequent cause of overloading is that the number of consumers connected is higher than permitted or their capacity exceeds the value stipulated. The heat energy released during over currents with large short circuits might result in a fire in the device affected by the short circuit, with the materials and equipment in the surrounding area coming to ignition and with the fire spreading to the building (Boddington, Griffiths, and Hasegawa. 1984).

d. Lightning

This is an atmospherical electric phenomenon in nature and may be considered an ignition source. The static charging produced in the clouds is equalized towards the earth (lightning stroke) and is accompanied by a high-energy discharge. The combustible materials at the place of lightning stroke and its surroundings might ignite and burn off. At some strokes of lightning, very strong impulses are generated, and the energy is equalized in several steps. In other cases, long-lasting currents start to flow, sometimes reaching the order of magnitude of 10A (NFPA, 1983).

e. Mechanical heat energy

Technical practice is steadily coupled with friction. During mechanical operation, frictional heat is developed, and if heat loss is restricted to such an extent that heat accumulates in the system, its temperature may increase to a value that is dangerous for the environment, and fire may occur.

Friction sparks normally occur at metal technological operations because of heavy friction (grinding, chipping, cutting, hitting) or because of metal objects or tools dropping or falling on to a hard floor or during grinding operations because of metal contaminations within the material under grinding impact. The temperature of the spark generated is normally higher than the ignition temperature of the conventional combustible materials (such as for sparks from steel, 1,400-1,500 °C; sparks from copper-nickel alloys, 300-400 °C); however, the ignition ability depends on the whole heat content and the lowest ignition energy of the material and substance to be ignited, respectively. It has been proven in practice that friction sparks mean real fire risk in air spaces where combustible gases, vapours and dusts are present in dangerous concentrations. Thus, under these circumstances the use of materials that easily produce sparks, as well as processes with mechanical sparking, should be avoided. In these cases, safety is provided by tools that do not spark, i.e., made from wood, leather or plastic materials, or by using tools of copper and bronze alloys that produce sparks of low energy (Babrauskas and Grayson, 1992).

f. Hot surfaces

In practice, the surfaces of equipment and devices may warm up to a dangerous extent either normally or due to malfunction. Ovens, furnaces, drying devices, waste-gas outlets, vapour pipes, etc. often cause fires in explosive air spaces. Furthermore, their hot surfaces may ignite combustible materials coming close to them or by coming in contact. For prevention, safe distances should be observed, and regular supervision and maintenance will reduce the probability of the occurrence of dangerous overheating (Ohtani, 1990).

2.1.8 An Overview of Fire DisasterPreparedness

Fire disaster Preparedness is typicallyunderstoodas consistingofmeasures thatenabledifferentunits ofanalysis—individuals,households,organizations,communities,societies and government—to respondeffectivelyandrecovermorequicklywhen fire disasters strike.Preparedness efforts alsoaimedatensuringthattheresources necessary forrespondingeffectivelyintheevent of fire disasterareinplace, andthatthose facedwithhavingto respondknowhowtouse those resources. Theactivities thatarecommonlyassociatedwith fire disasterpreparedness includedesigning and construction ofbuildings that can resist fire attack so as to prevent losses of lives and buildings fromfires (Ball,2001).

The NationalFireProtectionAssociation (NFPA, 1983)defines preparedness as: activities,programs, andsystems developedandimplementedpriortoa fire emergencethatareusedtosupportandenhancemitigationof, response to,andrecoveryfrom fire disaster/emergencies.

NationalEmergencyManagementAgency(NEMA., 2012), defined preparedness as: theleadership,training, readiness andexercisesupport,andtechnicaland financialassistancetostrengthencitizens,communities,state,local, andtribal governments,andprofessionalemergencyworkers as theypreparefor fire disasters, mitigatetheeffects of fire disasters,respondtopeople'sneeds aftera fire event,and launcheffective recoveryefforts.

Fire safety forcommercial buildings oftenfocuses onactivities designedtomitigatephysicaldamage to property and occupants/users, inventoryloss,protectcriticalbusiness records, vital information, andavoiddowntime. But fire disasterpreparedness measures should centeronadequate planning to prevent fire outbreak in any building or minimize its impact if occur (Chen et. al., 2012).

2.1.9 FireDisasterPreparednessGlobally

TheUSMarineMunicipalAssociationreportsthatabout 15% offiresresult fromequipmentfailurewhile85%are causedbyfactorsrelatedtohumanbehavior

Resource Management Strategy (RMS,2004). In1974atFlixboroughUK.,afactoryfireclaimed18lives andinjured38people. Investigationrevealedthat plant modification,design, construction andlayoutoftheplant failedto considerthepotentialforamajordisaster happening instantaneously International Competitive Building(ICB.,2010).

InJanuary2003,devastating fires andexplosions destroyeda NorthCarolina PharmaceuticalPlant,6lives were lostand38workersinjured. The investigation revealed thatthere were inadequacies inhazardassessment,communicationand EngineeringManagement; Columbia Broadcasting System (CSB,2004). In2005,afireincidentinTexas CityRefinery claimed15livesand injured170workers. Factors responsiblewereoperatorerror,equipmentrisk andstaff managementfailuresand workingcultureatthesite(Body, 2010).

Asurveyonhigh-risebuildingfiresafety,emergencies andevacuation proceduresconductedinChicago,USAin2006 indicatedthatalmostalloccupants knewwherefireexitswerelocated.Thefindings supported theneedforcontinued publiceducationaboutemergency evacuation proceduresinhigh-risebuildings Zmud,(2008). Furtherstudiesonthe importanceoffirepreparedness and safety throughtrainingforoccupantsofbuildingsweredemonstratedbyMakanjuolaet.al., (2009)inNigeria.Theresearchfocusedontheassessmentofthelevelof firepreparedness provisionsinbuildingsand associatedsafetyawareness ofusersandoccupants.Thestudyconsideredanumberofscenariosthatwouldaffectthe success orotherwise ofanevacuation,includingtheknowledgeofoccupants regardingthelocationofsafeexits,dealing withpeoplewithdisabilities,andoccupantsattemptingtore-enterthebuilding.Heconcludedthatinadequatestaff traininginconductingevacuationscouldbeamajorcontributortosubsequentfatalitiesandinjuries.Alowlevelof trainingonfiresafetyforoccupantswasmanifestedbylackofknowledgeonbothavailability anduseoffirefighting equipment.Thiscouldbecounteredbyimprovingtrainingandenhancing effectiveadministration offireregulationsto reducefireincidentsinbuildings.

Therisk of fire isoneofthegreatestthreats tohealth andsafety,property and thedelivery of essentialservices in anycommunity. The lossof livesorpropertyasa resultoffire isa tragedy.

Industryandgovernmentandindeedeveryoneshareintheresponsibilityofprotectinglives andproperty from theconsequencesoffire"(Anextractfrom NorthernAboriginalAffairsand Development,Canada.), Wikipedia(2015), From theforegoing,*all stake holdersshouldbeproactiveasfire disastercould renderawhole family homelessinablink ofamoment,agovernmentbuilding totallyinhabitableandvitaldocumentscompletelyburnt andevensustainableprivateand publichousingeffortsmightbethreatenedbyunexpected firedisasters*. For instance, Grenfell Tower fire - The fire which destroyed Grenfell Tower in June 2017 was one of the UK's worst modern fire disasters. Just before 01:00am on 14 June, 2007, fire broke out in the kitchen of a fourth floor flat at the 23 storey tower block in North Kensington, West London. The fire raced up the exterior of the building and then spread to all four sides. By 03:00, most of the upper floors were well alight. Seventy-two people died in this fire event.

In another development, on *Sunday/ Monday, September 2 and 3, 2018, the National Museum of Brazil, founded in 1818 and representing the heart of the nation's historic, anthropologic, and scientific endeavours was effectively razed down by fire. The fire destroyed over 20 million artifacts including Luzia, an 11,500-year-old human fossil and the oldest in the America.*

2.2.0 FireDisastersinNigeria

InNigeria,memorable commercial buildings,highwayandworkplaceaccidentsthathave occurredinthepastarethosethatassociated withfires.Firecandevastatewide rangeofcriticalutilitiesandbusinessessuchas gas and petrol filling stations, hotels,restaurants,malls,hospitals andschools.Whiletheoccurrenceoffiresdisasterscaneitherbenaturalormanmade,itremainsunpredictable inits outcomes, largelybecauseeffectivefiredisasterpreparednessandresponsestrategiesarenotwelldeveloped ordeployed intheseevents.Itisclearthatriskassessmentisvery low.Themaincausesoffiredisasters arefaulty electricalsystems;carelessness inhandlingoffiresourcesindomestic andcommercialbuildings (G OK,2011a).

Fireis adominanthazardinthe workplace.Humanfactors suchascarelessness,negligence andlackoffiresafety awareness are someofthe leading causesoffireoutbreaks. Despitethetechnologicaladvancementinfiresafety, fire remainstheleadingcauseoflives andpropertylossat commercial facilitiesworldwide (Blank, 2004) andfirecouldleadtotheprematurewindingupofan organisation nomatterhowbigitis.

ArecentstudybytheFireDisasterPrevention&Safety Awareness Association of Nigeria (FDPSAAN., 2008) revealedthatthere issignificantlowlevelofawarenesson fire preparedness and safetyinNigeria. About20%of199million (NPC 2018) peopleinthe Nigeriahavebasicfiresafetyknowledge, while80%lack such knowledge.

AsodikeandAbraham(2011)inthesurvey conducted on fire safetypracticeinsome schoolsinPortHarcourtopinedthat perhapstherare incidenceoffireoutbreakinschoolsin Nigeriaaccountsforthelack ofacquisitionoffire extinguishers and organised periodic safetytrainingfor staff.AstudyonfiresafetypracticebyAjaoand Ijadunola (2013),inIle-Ife,Nigeriarevealedthatmajority(62%)of the respondentshad goodandexcellentknowledgeof preventingfireoutbreaksin offices.Only28% ofthe premiseshadfunctioningwallfireextinguishers.Lessthan 10%ofthepremiseshadsmokedetector,firealarm, fire exits andemergencylighting system,respectively.The studyconcludedthattherewaspoorpracticeoffiresafety inofficesinIle-Ife.

Managementcommitmentto fire disaster preparedness and safetyisreinforcedby havingtherightpeople,proceduresandsystemsinplace butmosttimes aninvestigationintoaworkplaceincident revealsagapbetween themainstreambusinessandsafety management(Scott,2010).Forinstance,therewasafire incidentina plasticfactoryinIkorodu,Lagos,Nigeriain 2002where120 workerswereroastedtodeath at night. It was reported that the casualty figure would probably have not been that high if the exit points had not been locked(Victor Ahiuma-Young, Olasunkanmi Akoni & Kenneth Ehigiator, 2002).

About 120 factory workers were feared dead after a massive fire swept through a rubber slippers/aluminium spoon/bottled water factory [Taiwanese-owned], at Odogunyan, in Ikorodu, Lagos State in September 17, 2002. It was gathered that the casualty figure would probably have not been that high if the exit points had not been locked. Also, in December 24, 2018, three workers died in fire incident in Chinese factory in Lagos.

Thishighdisregardforhumanlifestemsfromthereality thatmanagementofsomeorganizationsfocusprimarily on financialgain and tendto view any investment in fire safety management asa distraction. Scott(2010), reported that the FinancialTimesnewspaper conductedaglobalmulti-industrysurveyof650executivesinthe energy, financial, manufacturing,life science,technology and transportation industries. He concludedthatmany companies aregoing through changes buttheir fire safety and riskmanagement systemsare not veryeffective.Morethanonethird oftheexecutives consideredtheirbiggestchallengeasthatof aligningrisk datatostrategiesandoperations.

2.2.1 Some cases of fire incidences in Nigeria

i. **TheNECOMHousefireoutbreak in1983**:Thebuilding wasa37storey structurehousing thethenNITELinLagos.Thefirestartedmysteriouslyandthehavocwastremendous .The loss wasmostly on the property as itwas learnt firestarted inoneof thenightsoftheyear.It cost theFederalgovernmentcolossalamountofmoney to renovate thebuilding,notto talk of thevitaldocumentlostinthe inferno.

ii. **PipelineexplosioninJesse,DeltaState:**ThisoccurredaccordingtoNEMA inoctober18, 1998whichaccounted for thehighestnumberofcasualtieswith 1082person’sdeadand hundredsinjured.Theimpacton propertycould bemuch.

iii. **MultiplebombexplosionsattheNigerianmilitarycantonment,Lagos:** Thisoccurredon January27, 2002, whichleftupto 800personsdeadand thousandshomeless.

iv. **Pipe line explosion, Abule Egba (Lagos):**This occurred in December26, 2006. Up to 700 personslost theirlivesandseveralundefined personsinjured.

v. **Frequent fireaccidentsin theyear2012, inAbuja, theFederalcapital:**Notfewerthan69 persons were killed in the fire incidents and property worth 765million naira wasalso destroyed duringtheperiod**(extract**fromtheFederalfireservicemagazine).

vi. **Variousfireaccidents in RiversState:**theseoccurredin2012, andno fewer than230persons diedwhile73othersreceivedvariousdegreesofinjuriesin222recordedfire incidentsthat occurredin PortHarcourtand otherpartsof thestate.

vii. **Numerousfireaccidentsin Osunand GombeStates:in**OsunStatefireincidentsclaimed31 livesanddestroyedpropertyworth227millionnaira in2012.Also,thesameyearinGombe State, firekilled about60 personsanddamaged propertyworth 790million naira.

viii. **Innumerable bombing activities in Nigeria particularly in the north East:**Bombings in severalpartsoftheNorth Eastand someotherpartsof thecountry since2009,has left uncountablenumberofpersonsdead and propertyworth billionsofnairadestroyed.

2.2.2 FireSafetyRegulationinNigeria

TheNigerian federallawsregulatesafetypracticesof organizationsinthe countrybutmosttimesthe effects of these laws are not feltmainlybecausethe laws are poorly enforced.Alotofchallengeshavebeenattributedtothis lackofeffect.For instance,the manufacturing industriesin Nigeriaoften perceive governmentsafetystandards as an attempttoincreaseproductioncosts.Thisisduetolackof anacceptabletemplateforsettingattainablestandards and safety performanceforthe manufacturing industry (Adebiyiand Owaba,2009).Inmostdevelopingnations (Nigeriainclusive),importantservicessuch aspreventive maintenanceprograms and regularfiresafetyinspections are mostly implementedbysubsidiariesofmultinational corporations.Thesemultinationalsoftenadoptapolicy of havingtheircorporatestandardsin additiontothe requirementsofthehost country(Attlan,2003;Firthand Stickles,2012).

Another common problemisthat thedevelopingnations often adopt standardsmodelledafter technologically advanced western countries.These standards are usually complexanddifficultforthedevelopingnations to implement.Inordertotackletheaboveproblemsandin turn enhance firedisaster preparednessin commercial buildingsin Imo State,there isneedtodetermine the baselinelevel offiresafety practice and awarenessamong the owners and users/workersofcommercial buildings in Imo State,sothatimprovementscanbemade where gaps areidentified.

2.2.3 WorkplaceFire Disaster PreparednessRequirements

There are differentmethods ofdeveloping fire disaster preparednessplans,dependingonthesizeofthefacility, the numberofemployees,andthe type of operations. Small companies(forexample,beautysalonsor medicinestores) mighthaverelativelysimpleplans wherebythe company ownertellsemployeeswheretheexitsarelocated,whatthe alarmsoundslike,andwhichemergencyservicenumbers touse.Incontrast,employersinlarge organizations,with multiple sites,greater variabilityinoperations,or large numbersofemployees(asseen inthe oil andgasindustry) maydevelopcomplexpreparednessplansthat cover all typesoffacilities(Ball,2001).In facilities where the evacuationofoccupantsduringadrillisunrealistic,suchas inhealth carefacilities,firedrillsinvolvingstaffmayserve thepurpose.

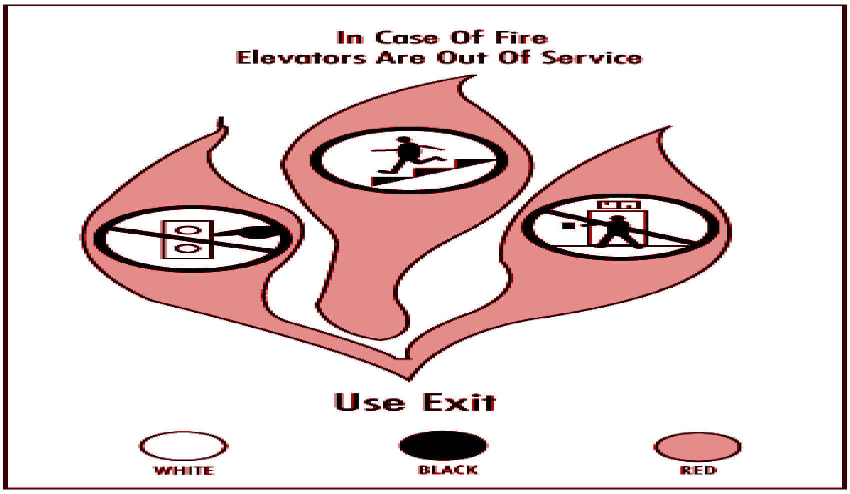

Fig 2.1: Fire Drill
Source: (Ball2001).

2.2.4 The roleofDesignand ConstructioninPreventingFire Disasters

Inrecentyearstherehavebeencasesoffiredisastersleavingbehindirretrievablelosesoflives and property.Mostfiredisastersresult in anunforgettableexperienceinthe lives ofvictims.Fireoccurrencescouldleadtodeathofpeople.Sometimesawhole life timeinvestmenteitherinproperty or humanscould be razeddownina jiffyby fire.Twostudents of Imo State Polytechnic in a room alongwithvaluable propertywereburnttodeathduetofire (See Appendix A1 to A14).

Many researchershavealsosubstantiatedthefactthatthepossibilityoffiredisastersarenotprevent able buttechnicalmeasurescouldbeadducedtoabatethespread.According toIssahandAliyu (2012),“thenaturaldisasteris likely to happenany timeandcannotbeprevented,butmeasures could be takentoreduce thepossibility regardlessofthemany formsthatadisastermay take”. Onthe issue ofpublic enlightenmentandeducation ontheenormousimpactsoffire,Osaro (2013),saidthat“thenationhasnotbeenproperlyenlightenedontheenormousimpactoffire onlivesandproperty”.

Therisk of fire isoneofthegreatestthreats tohealth andsafety,property and thedelivery of essentialservices in anycommunity. The lossof livesorpropertyasa resultoffire isa tragedy.

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Fire protection is linkedup with mitigating the spread.Once the spread is localised,livesand property wouldhavebeen protected againstfirehazards.FosterandHarrington,(1980), define fireprotection as, "theprotection ofoccupants, contentsand structureofbuilding fromthe risks associated withfire". It takescoordinated effort ofusers, developers, designersand constructioncrewstoensurethis.Duetotheeffectsof fireonmanifallowedtospread,Barry (1982),positsthatpracticalmeasuresshouldbeadoptedtolocalisetheeffectoffire.Oneof suchmeasures is the provision of firebreaksorstopsonopenings.Hedefines firebreaksor stopsas"solid orincombustibleup stand orprojections to windows that serveasabarrier tothe spread of firefromonewindowto anadjacentwindow".

Fire occurrence could take placeany timeand usually occupants are unprepared hence building componentsmustbedesignedandconstructedtobe fireresistantsothat inthe eventofany occurrencetheycouldresistfireforsometimebeforeexternalinterventions.Toachievethis, wecouldhavefiredoorsfixedalongmeansofescape.Accordingto(Barry,1982),"firedoors arefixed towalls thatactasfirebarrierstomaintaintheeffectivenessofwallsasbarriersto the spreadof fireandalong meansofescape routes in building,asabarrier to theproductof combustion.Suchdoors mightalso bedesignated sometimesas halfhourorone-hourfire resistant, which means thatthedoorwillgiveprotection againstfirefor theperiodrequired".

Seely(1987), corroboratesabovestanceonmeasurestomitigatefirespread.According to him "thespreadoffireoverasurfacecouldberestrictedbytheprovisionsforsuchmaterialsto have lowratesofsurface spreadofflame, andin somecases restricttherateofheatproduced".

Substantiating above views, Punmiaand Jain (2008), said that "No buildingmaterialis perfectlyfireproof. Every buildingcontains somematerialssuch asfurniture, clothing, eatables whichcaneasily catch firesorwhich arevulnerable tofire.However, the endeavourof the design teamsshouldbeto plan,designand construct thebuilding in suchaway that safetyoftheoccupantmaybeensured to themaximum possibleextentin theeventoffire outbreak in the building dueto any reasonwhatever". Thetechnical interpretation of firesafety ofbuildingistoconveythefireresistantofabuildingintermsofhourswhensubjectedtofire ofknownintensity.Punmiaand Jain(2008) furtheropined that"Thebuilding shouldhave adequatetime intervalsothattheadequateprotection for theoccupantscould be afforded". Inspite of the above,nothing could be sustainably donetostop theoccurrence butsomething couldbedoneto alleviatethe spread, whichisthesubstanceofthisstudy.

2.2.5 StandardsforDesignBuildingsAgainst Fire

Adamu(2013)opinesvariousdesignstandardshave beendevelopedasaguideforthe developmentof buildingsin respecttofire,thesestandards cutacrossfire safety, non-combustiblebuildingandfire preventionandcontrolamongstothers. Standardshere refertodesignstrategiesandspecificationsby thequalitiesrequiredforfirepreventionand controlmaybeachievedatacertaindegree.TheNationalBuildingCode(2006)definesa non-combustibleconstructionasthattypeofconstructioninwhichadegreeoffiresafety is attainedby theuseofnon-combustiblematerialsforstructuralmembersandotherbuilding assemblies.Itfurtherstates that, thefire-resistivetimeperiodsmay bereducedby onehourfor interiorloadbearing walls,exteriorloadbearingandnon-loadbearing walls,roofsandthe beamssupportingroofs,providedthey donotframeintocolumns.Fortheachievementof firepreventionandcontrolthatwouldbespecifictomarketsstandardsandspecifications areoutlined in table: 2.1

Table: 2.1 Design Specification for firein public buildingwith usersgreater than 150

S/No	ITEM	DESCRIPTION
1.	Materials/ construction	Materials whichare non-combustibleasdescribedin the firesafetycode. adjacentinteriorspaces,floortofloor,walltowallandrooftowall connectionsbymeans of12mmgypsumboard orequivalentapply walls, partitions,structuralelements,floors, ceilings,roofs,andthe exits are constructed andprotected with approved non-combustible materials to afford the fire resistanceratingspecified
2	Firedetectiondevices	Whereanautomaticfiredetectionsystem isrequiredby thisCode,the plans andspecifications shall show the location and numberofall sending stations and signals with specifications of the type of constructionand operationof the system including all automatic detection devices. Anautomatic firedetectionsystem shallbeinstalledandmaintainedin fulloperating condition in the locationsdescribedin allbuilding with expectedusers ofgreaterthan 200.
3	Firesuppression devices	In buildings equippedthroughoutwithan approved automatic fire suppressionsystem,other than buildings, orportions thereof,the area of unprotectedopenings shallnotexceed the tabulated limits forprotected openings. Firehydrants installed on privatepropertyshallbelocated and installed asdirected bythefire department. Hydrantsshallconformto the standards ofthe administrative authorityofthejurisdiction and the fire department. Hydrants shallnotbeinstalled ona watermain lessthan 150mm. Anymeans by whichfiretransferis from oneplace to anotheris reduced.
4	Firespreadcontrol strategies	Easyevacuation ofusersinto safety forthe purposeofdeterminingthe numberofpersons forwhomexitsare to be provided, netfloorarea shallbe the actualoccupied area, not includingaccessoryunoccupiedareasor thickness ofwalls

5	Fire Safety	Exits are permitted todischarge into afenced orwalledcourtyard, providedthatnotmore thantwo walls ofthe courtyardarethe building walls fromwhich exitie beingmade. Enclosed yards orcourts shallbe ofsufficientsizeto accommodate alloccupants,a minimumof15.0m fromthe buildingwitha netareaof1.4m2 perperson.

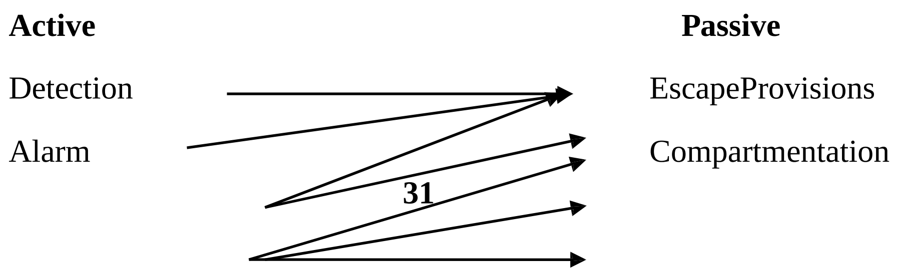
Source: (National buildingcode, 2006).

2.2.6 FireProtection andSafety Systems

Fire protection is the study andpracticeofpreventingtheunwantedeffects of potentiallydestructive fires.It involves the study of the behaviour, compartmentalization,suppressionandinvestigationoffireanditsrelated emergencies,aswellastheresearchanddevelopment,production,testing and application ofmitigating systems(Grant, 2012).

According to Langdon(1972),whendealing withdangers ofafireinabuildingwe havetocontendwithtwo systemswhichare complimentary.Theseare fireprotection andfiresafety systems.Fireprotectionincorporatesactiveandpassivemeasures.Fire protectionaimsatprotecting humanlife,goodsandactivitiesaswellasprotecting buildings. Fireprotectionprovides for;

i. Safemeans ofescapefrom buildings.
ii. Safeguardingor eliminatingpossible sources of accidental fire.
iii. Detectingoutbreaksandlimitingrate of firespread.
iv. An efficient professionalrescueand firefightingservice.
v. Meansofextinctioninearlystagesoffireeither automaticorhand operatedor both.
vi. Limitingspread offire risk from one buildingto another.



Fire fighting Contents

Sprinklers Linings

.

Fig. 2.2 Interaction betweenActivevsPassive fireProtectionmeasures

Source: OverseasBuildingNotes July1980, No. 186

Activemeasuresincludeplanningmatterandmustbeconsideredatanearly stageof buildingdesign.Passivemeasuresarethuspresentandoperating allthetimeina building suchasselectionofnon-combustiblematerials,subdivisionofbuildingsand ensuring correct ventilation. Active measures involvenecessary addition tothe servicesofabuildingsuchasinstallationofalarmsanddetectorstogiveawarning of fireandtheinstallation ofequipmentforfireextinction(Mugure, 1991).*According to Mugure (1991), a firesafetysystemis a system that isaimedat makingstartingof a firedifficult, reducing itsgrowthrate,preventing itsspread,controlling itandaidingescapeof occupantsandpreventingthebuildingfromfailing.*Firesafety isallaboutputtingin placeappropriate fire safetyequipment, management ofexit routes and propermanagement ofspaces.

2.2.7 Fire Safety Equipment

Fire safety equipmentareofvariousmakeandtypeeachservingaspecificpurpose.They canbe manual,automatic or both.Choice ofthetypeofequipmentwilldependonthe risktobecateredfor and sizeofbuilding,available capitalandinsuranceandfireservice requirements.Fire safety equipment as outlined by Blye and Bacon (1991)includes;

(a) Fixed systems

Fixed systems makeitpossible to get moreextinguishingmedium to apointand when there are nopeople around.Fixedsystemscanbe automatic,manualorbothand require a significantamountof capitaloutlay.Principaltypesof fixedsystemsare water hose reels,internal hydrants,sprinklers,foaminstallations,carbondioxide systems and Halon systems.

(b) FireExtinguishers

Thetypeofextinguisherprovidedshouldbesuitablefortheriskinvolved, adequately maintainedandappropriaterecordsofallinspectionandtestskept.Fire extinguishers canbegenerally dividedintocategoriesaccordingtotheextinguishingmediumthey contain.Thisinclude Pressurized Water Extinguishers(hose reels,fire sprinklers), Carbon Dioxide Extinguishers, Dry Chemical Extinguishers, Halon 1211/1301 Extinguishers(Vaporizingliquids),WetChemical**,**FoamandFireblanketsDuke (2012).

(c) Waterhose reels

Waterhosereelsarecoilsofhosecarriedonastoutreelandframe.Itmay besticking outfroma wallonhingedbracketsorstuck outof site behindstylishpanelsmatching thedécor.They may haveavalveforturningonthewatersupply orbefittedwithan automaticsystemoperatedviathereelsaxlesothatwatersupplycomesonwhena fewyardsof hosehave beenranout.Somehosesarefittedwitha plainjetnozzleor a combination jet/spraynozzle dependingon the taste or requirement.

(d) Internal Hydrants

Internalhydrantsare mainsthatriseinsideabuilding toprovidewatertoupperfloors andcanbewetordry risers.Theyshouldbefittedwithstandardhydrantoutletvalves ateachlevelsothatfirehosescanbeconnected.Bothwetanddryriserssharethe sameconstructionspecificationandthechoicewilldependonwhichismore suitable forthebuildinganditscontents.Fordry riserstheinletconnectionshouldbefittedto anexternal walloronaspecialwallorcolumnoutside thebuilding.Therunofthe pipeworkfromthe risertoitsinletconnectionmustslopedownward, toward the inlet to facilitate easydrainage.

(e) External Hydrant System

In external hydrant system, the water storage tank will be separate for fire systems and the water level of the tank is maintained by using of water level controller. The water source to the pipe is from water storage tank only.

Piping system is the important part of the fire system where it conveys or circulates the water internally or externally to the building. It also play a vital role in the emergency of the fire, where there will be valves connected to the pipes for firefighting externally through the hose system.

Hose is a system which is used in case of fire. The occupants / authorized personnel or fire department personnel can use this system by opening the valves & hoses.

Pump is a machine or device for raising, compressing, or transferring fluids. In fire system several types and models of pumps are used as per the design requirements and the amount of pressure required. Pumps play a vital role in supplying the water from storage tank to all parts of the fire systems. A type of pump which is used to maintain the pressure of the water in the pipes is known as Jokey pump.

(f) Sprinklerinstallations

Sprinkler installationsare suppliedwithwaterfromthemainsand/orheadertank whichisreleasedoverthefireareainformofaspray whenthesprinklerheadsare activated.

(g) Detectors

Thereare threemaintypes ofdetectorsincludeHeat detectors,Smokeandthe Radiationdetectors.They canbecombinedtogetherwithfirealarmsorkeptseparate. The alarmmustbeabletogiveoffanaudiblewarning,unmistakabletotheperson hearing it.Itshouldgiveoutanambiguoussignal.Heatdetectorsfallintotwo categories; fixed temperature and therateofriseorcompensating detector.The choice betweenthetwoismade after a careful assessmentof realneed for one and additionalcostincluded.Fixedtemperature detectorsrespondtoa presettemperature withintheareasofthedetectorheadwhilecompensating detectorsareableto distinguish between a slow and a sudden rate of temperature increase. Smoke detectorsontheotherhandrespondtosmokearoundthedetectorhead.Theyoperate inone of three-waysnamely:ionization,lightscatter or lightobscuration.The ionizationtypeoperatesontheprinciple thatsmokeparticlesabsorbions,inthe detector heading reducing thecurrentflow.Thiscausesanimbalance betweencurrent in thetest chamber and thescaled companionchamber which triggers an alarm (Derek, 1986).

The lightscatter operatesonthe principle thatsmoke particlesscatter a beamof light, causing ittofallona photoelectriccellthatactivatesanalarm.Smokedetectorsare preferable in that most fires give off an appreciable amount of smoke that is detectable before sufficientheatisproducedtoactivatea heatdetector.Radiation detectorsrespondtoinfra-redorultra-violetradiationemanatingfromflamesand heat.They arehoweverpronetofalsealarmsbecausethey canreacttoinfraredor ultraviolet radiation from sources other than heat(Rubaratuka, (2013).

(h) FoamInstallations

Foam installations comprises a foam-carryingsupplypipe,awatersupply with a foam induction systemandafoam-making branchpipewhichmanufacturesfoamfor delivery toatank.Itcanbemanualorautomaticandisusedonspecialriskssuchas petroleum installations.

(i) CO_2/ Halon Systems

Carbon dioxide systemscanbe fedfrombanksof carbon dioxide cylindersor froma refrigeratedtank.They are usedinspecialareassuchaselectricalswitchroomor power-intakesituations.Theyareusually designedastotalfloodsystems.Thismeans thatthey deliversufficientcarbondioxidetofilltheroomatadesignedconcentration inavery shorttime.Dischargecanbeautomatic,manualorboth.Halonsystems operatealong similarlinesascarbondioxidesystemsbutaremore oftenusedfor computerinstallationswheredischargeheadsareplacedoverheadincableducts, underfloorcabletrenchesetc.They canbeoperatedby fireorsmokesensors.Inthe caseof larger units byautomaticor manual means.

(j) Exit Routes

Escaperoutesshouldbeprotectedfromsmokeandheatedgases.Ina situationwhere thereisanescapestaircase,itisessentialtohaveaprotectedlobbyandaprotected staircase,preferablyopentotheoutside.Thefinishesontheescaperoutesshould havezerosurfacespreadofflameandbenon-slippery (Shyamala,1979).Despiteall theprecautionsandprevention,anoutbreakofafireinany premisescannotberuled out. Accordingly, steps should be taken to deal with this firewhen itoccurs.

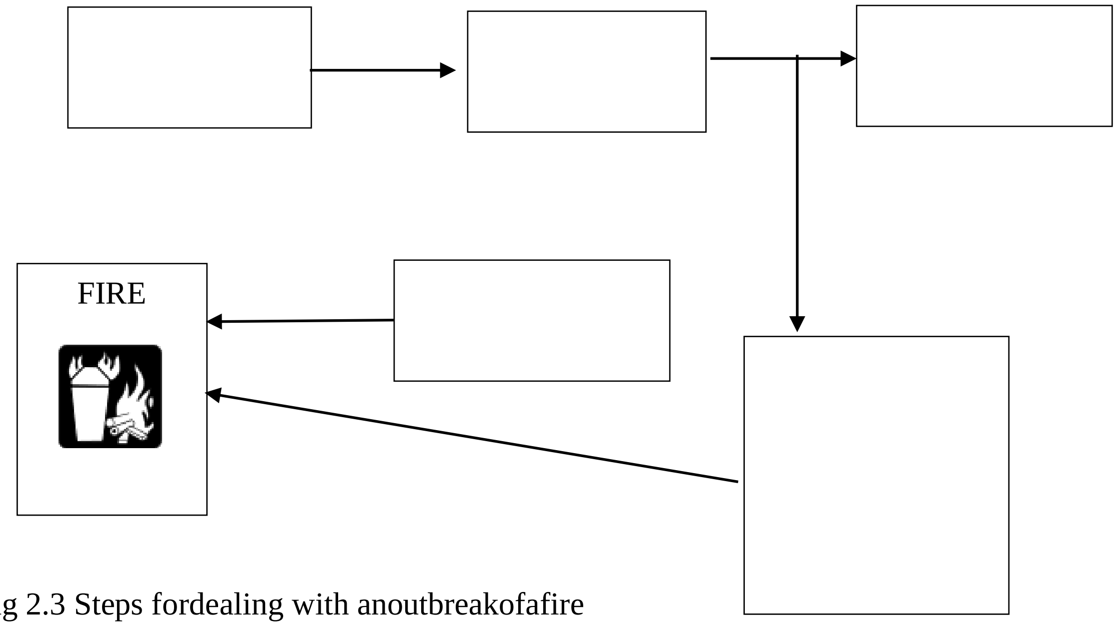


Fig 2.3 Steps fordealing with anoutbreakofafire

Source:(Shyamala,1979)

Considerationsoftheproblemoffire(preparedness, protectionandprevention)areanintegralpart oftheplanningprocessinallbuildingsandshouldbeevidentfromconceptualstages ofthe design.

2.2.8 Fire Management

Practice ofgoodmanagementisintegralinfirepreventionandsafety.Itinvolves regular inspection,goodhousekeeping,posting ofnoticesandexitdirectionalsignsas wellasregular conductof fire drills,evacuationschemesandpresence of fire wardens (Rubaratuka, 2013).

Wahab (2015) Stated that fire preventionisintendedtoreduce sourcesofignition.Fire prevention alsoincludes educationtoteachpeoplehowtoavoidcausingfires inBuildings, especially schoolsandtallbuildings,oftenconductfiredrillstoinformandprepare citizensonhowtoreacttoabuildingfire.Purposely startingdestructivefires constitutesburningandis acrimeinmost jurisdictions.Firefightingservicesare provided inmostdevelopedareastoextinguishor containuncontrolledfires.Trained firefightersusefireapparatus,watersupply resourcessuchaswatermainsandfire hydrantsorthey mightuseAandBclassfoamdependingonwhatisfeedingthefire. Model building codes require passive fireprotection and activefireprotectionsystemstominimize damage resultingfroma fire.The mostcommonformofactive fire protectionisfiresprinklers.Tomaximize passive fire protectionofbuildings, building materialsandfurnishingsinmostdevelopedcountriesaretestedforfire-resistance,combustibility andflammability.Upholstery,carpetingandplasticsusedin vehiclesandvesselsarealsotested.Where firepreventionandfireprotectionhave failedtopreventdamage,fire insurance canmitigate the financialimpact.

In casesof electricalfires,occupantsareadvised nottouseelectricalequipmentthatisinpoor repairorthathasadamagedcordaswellasnottooverloadcircuitsorextension cords.Only approvedpowerbarsshould beusedinsteadofcircuitsplitters.Electrical heatingappliancesshouldbe keptata safedistance fromcombustibles.InGeneral OfficeKitchenFire,Safety shouldbeensuredbyavoidingcookinghazards,suchas putting inplacemini-kitchenswhere staffmay preparetheir ownfood.Toastersand microwaveovensshould not belocatedingeneral officeareas.Itis preferablethat these appliancesbe placedinkitchen areasonly.Occupantsinbuildingsshouldalso avoiddeepfatfryingandotherwisetypically deep-fryyourfoodusingathermostat-controlled appliance, andnever leaveitunattended.All combustible materials, such as paper towelsand cloths,should bekeptat a safedistance (Yohannes,Jacob, and Huba,2010).

2.2.9 Ways ofFireSuppression/Extinction

Threefactorsfromthetriangleoffireare essentialforcombustion,namely; the presenceofafuel,orcombustiblesubstances;thepresenceofoxygen(usually asair) or other supportersof Combustion;andthe attainmentandmaintenanceof a certain minimumtemperature.Firecanbeextinguishedby removinganyone oftheelements ofthefire triangle.Therearefourmethodsused,eachonevalidforoneormorefire classesandinclude cooling,smothering/extinguishing,Dilutionor eliminationof combustibleelement andcontrol of flames or interruption ofthe chain reaction. Cooling isthemostcommonmethod.Itconsistsoflowering thetemperatureofthe combustibleelementsandtheenvironmentbelowits ignitionpoint. Smothering/extinguishing consistsofisolating thecombustibleelementsandoxygen, orreducing theirconcentrationwithintheenvironment.Dilutionoreliminationof combustibleelementconsistsofseparating thecombustibleelementsfromtheheat source or the environmentof the fire.Controlof flamesor interruptionof the chain reactionisamethodthatmodifiesthechemicalreaction,altering thereleaseoffree radical products in the combustion and therefore delaying development (Stocks, 1991). (See Fig. 2.1: Fire Triangle or Combustion Triangle or Fire Diamond).

Fireextinction,inprinciple,consiststhelimitationoreliminationofone ormoreof these factors, and according to him themethods ofextinguishingfiremay be classifiedconvenientlyas; Starvation(orthelimitationof fuel); Smothering / Blanketing (orthelimitationofoxygen);andCooling (orthelimitationof temperature).Inpractice,specificmethodsoffireextinctionoftenembodymore than oneoftheseprinciples,butitwillbeconvenienttoconsiderthemaccordingtothe mainprincipleinvolved.Theextinctionoffire by starvationisappliedinthreeways; by removingcombustiblematerialfromtheneighbourhoodofthefire.Examplesof theseare,thedrainageoffuelfromburningoiltanks;theworkingoutofcargoata shipfire,thecutting oftrenchesinpeat,heath,andforestfires;thedemolitionof buildingstocreateafirestop;counter-burning inforestfires.Starvationcanalsobe doneby removingthefirefromtheneighbourhoodofcombustiblematerialas,for instance,pullingapartaburninghaystackorathatchedroofaswellasbysub- dividing theburning material,whenthesmallerfiresproducedmaybelefttoburnout ortobeextinguishedmoreeasily byothermeans.A typicalexampleisthe emulsificationofthesurfaceofburning oil,whilstthebeating outofaheathfireowes much of its effectivenessto this(Cumming, 2012).

Themethodofextinctionbysmotheringisby preventingorimpedingtheaccessof freshairtotheseatofthe fire,andallowing the combustiontoreducetheoxygen content in theconfined atmosphereuntil itextinguishes itself.Iftheoxygencontent of the atmosphere in the immediate neighbourhood of burning material can be sufficiently reducedcombustionwillcease.Animportantpracticalapplicationofthe smothering methodistheuseoffoam.Thisformsaviscouscoating overtheburning materialandlimits,insofarasitiscomplete,thesupplyofair.Italsotendsto prevent theformation offlammable vapour. Smothering can also bebytheapplication ofacloudoffinelydividedparticlesofdry powder,usuallysodiumbicarbonate,from apressurizedextinguisher.Afurtherdevelopmentinthesmothering methodhasbeen thediscovery ofapowderedcompoundforuseonmetalfires,suchasuraniumand plutonium,thoriumand magnesium.Thispowder(ternary eutecticchloride) isapplied bymeans of agas cartridgepressurized extinguisher(Cumming, 2012). Wherefirehasoccurred,itcanbeextinguishedbyremovingany oneoftheelements ofthefiretetrahedron.Thefirecanbeextinguishedby turningoffthegassupply, whichremovesthefuelsource;covering theflamecompletely,whichsmothersthe flame asthecombustionbothuses theavailableoxidizer (the oxygeninthe air) and displacesitfromtheareaaroundtheflamewithCO_2;aswellasby applicationof water,which removes heatfromthe fire fasterthan the fire canproduce it;or by applicationofa retardantchemicalsuchasHalontotheflame,whichretardsthe chemical reactionitselfuntilthe rate ofcombustionistooslowtomaintainthe chain reaction.Similarly,blowing hardonaflamewilldisplacetheheatofthecurrently burning gas from its fuelsource, to thesame end (Cumming, 2012).

Fire Suppression systemsintheUSA are governedbythecodesundertheNFPA.Fire Suppression Systemsarecommonly usedonheavy powerequipment.Suppression systemsuseacombinationofdry chemicalsand/orwetagentstosuppressequipment fires.Suppression systemshavebecomeanecessity toseveralindustriesasthey help controldamage andlosstoequipment.Commonmeansofdetectionare throughheat sensors, wiring, or manual detection (dependingon system selection)(Grant, 2012).

2.3.0 Conceptual Framework

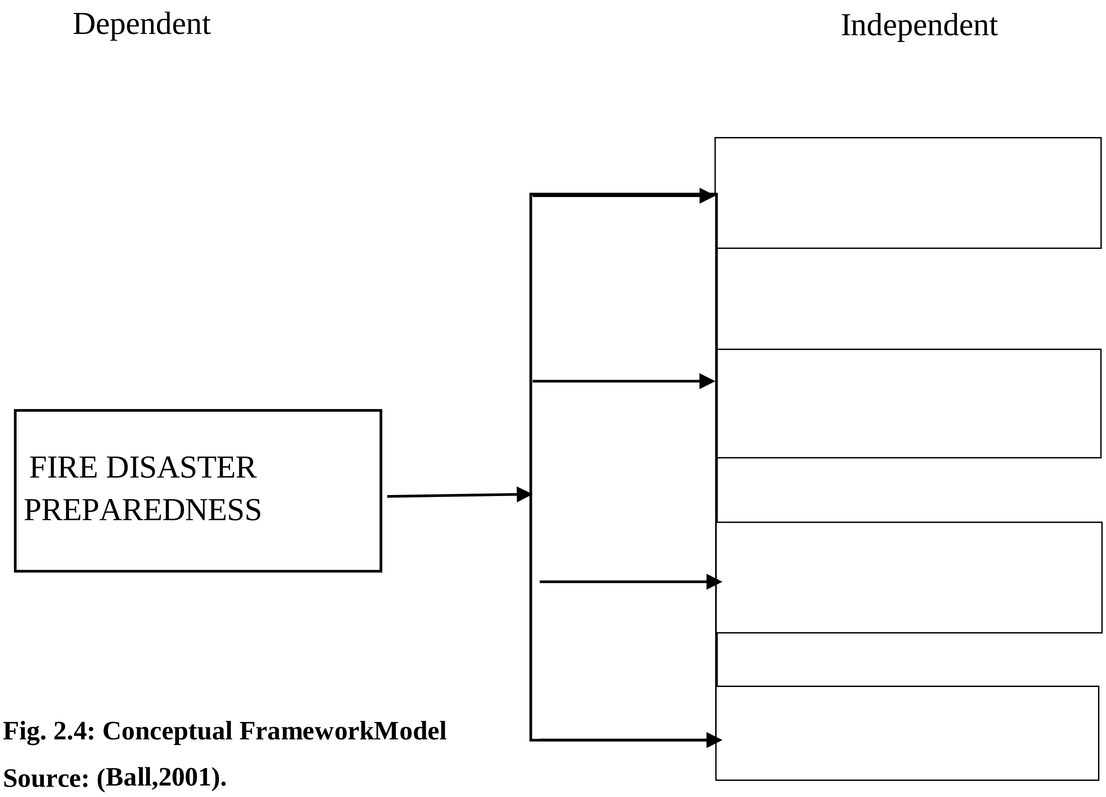


Fig. 2.4: Conceptual FrameworkModel

Source: (Ball,2001).

Theobjectoffire disasterpreparedness fromtheconceptual framework model (f i g 2 . 4) canthusbesummarizedas follows and this will help in realizing the set objectives of this research work.

i. To reduce or eliminatethe possibilityofoutbreaks offire.

ii.Toprovideadequatefacilitiesforfighting fireandescapeofoccupantsfromthe building.

iii.To reducethe spread of firewithin the building to adjoiningbuildings.

iv.To protect theoccupantsfrom the adverseeffects of firelosses.

According to GoK,(2012b), fire disaster preparedness isinthiscaseidentifiedasthedependentvariablebeinginfluenced by availability offirefightingequipment,awareness,fireprotectionandpreventive measuresaswellaspreparedness measuresadoptedby variousplayers.Changesinthe fourindependent variables arelikelyto affect levels offirepreparedness f o r any building.

Firefighting servicesareprovidedtoextinguishorcurtailuncontrolledfires.Trained firefighters on how to usefireapparatus,watersupply resourcessuchaswatermainsandfire hydrantsorthey mightuseAandBclassfoamdependingonwhatisfeedingthefire. Firepreventionisintendedtoreducesources ofignition.Firepreventionalsoincludes educationtoteachpeoplehowtoavoidcausingfires.Buildings,especiallyschools, hospitals, hotels, shopping malls, market andtallbuildings,oftenconductfire drillstoinformandprepareoccupants / usersonhowto reacttoabuildingfire. Buildings generally will requirepassivefireprotection andactivefireprotectionsystems (see fig. 2.5 and National Building Code table 2.1)tominimizedamage resulting fromafire.The most commonformofactivefireprotectioniswatersprinklers.Tomaximize passivefire protectionofbuildings,buildingmaterialsandfurnishingsmay betestedforfire-resistance,combustibility andflammability(Ball,2001).

From the framework in fig. 2.4, fire disaster preparednessisastateofreadinesstorespondtoafire outbreak. General or long-term preparednessencompassesthemarshalling of resourcesintheareasofprediction,forecastingandwarning againstfiredisaster events.Italsoinvolveseducationand training initiatives,and planning toevacuate vulnerable populations fromthreatenedareas.

Fire disaster preparednessisrelatedtotwoother conceptsoflong-term planning:reconstructionand mitigation. Reconstruction means repair orrebuilding, and mitigationinvolvesthinkingofwaystoavertthelikely effects of fire disaster or damage to certainstructuresandplanningsothatany impactfromafuture fire disasterwillbe ameliorated, oreliminated,ifpossible (Issahand Aliyu,2012).

2.3.1 THEORETICALFRAMEWORK

2.3.1.1 History of Fire

Fire was first controlled by humans about 230,000 years ago to 1.5 million years ago, Evidence for the use of fire by Homo erectus beginning some 400,000 years ago has wide scholarly support. Evidence for the controlled use of **fire** by Homo erectus, beginning some 1,000,000 years ago, has wide scholarly support. Flint blades burned in **fire** roughly 300,000 years ago were found near fossils of early but not entirely modern Homo sapiens in Morocco. Humans have been huddling around fires for thousands of years. The element of fire is a significant tool for humans in that it can be useful in a number of ways. From the very basic and primitive essentials to modern living amenities, fire plays one of the most important roles in our daily lives (Harper,2003).

Fire can be used to generate heat, light in the homes, cook foods and produce energy for industrial purposes. Fires are also used in trades such as manufacturing, construction, blacksmithing and other more modern metal forging operations rely on fire to produce extreme heat to help shape raw materials into new objects. Anothercommon use of fire is to aid in landscaping. Burning brush or burning raked leaves is a common task accomplished by many homeowners and landowners, and

these tasks require fire (Lower,2011).Fire has been used by humans in rituals, in agriculture for
clearing land, for cooking, generating heat and light, for signaling, propulsion purposes, smelting, forging, incineration of waste, cremation, and as a weapon or mode of destruction.

Quintiere 2006, stated thatfire in its most common form can result in conflagration, which has the potential to cause physical damage through burning. Fire is an important process that affects ecological systems around the globe. The positive effects of fire include stimulating growth and maintaining various ecological systems. The negative effects of fire include hazard to life and property, atmospheric pollution, and water contamination. If fire removes protective vegetation, heavy rainfall may lead to an increase in soil erosion by water. Also, when vegetation is burned, the nitrogen it contains is released into the atmosphere, unlike elements such as potassium and phosphorus which remain in the ash and are quickly recycled into the soil. This loss of nitrogen caused by a fire produces a long-term reduction in the fertility of the soil, which only slowly recovers as nitrogen is "fixed" from the atmosphere by lightning and by leguminous plants such as clover.

2.3.1.2 Theory of fire

Fire is the rapid oxidation of a material in the exothermic chemical process of combustion, releasing heat, light, and various reaction products. Fire becomes hot because the conversion of the weak double bond in molecular oxygen, O^2, to the stronger bonds in the combustion products carbon dioxide and water releases energy (418 kJ per 32 g of O^2); At a certain point in the combustion reaction, called the ignition point, flames are produced. The flame is the visible portion of the fire. Flames consist primarily of carbon dioxide, water vapor, oxygen and nitrogen. If hot enough, the gases become ionized to produce plasma(Evans, 1995).

Fire is a manifestation of uncontrolled combustion. It involves combustible materials which are found around us in the buildings in which we live, work and play, as well as a wide range of gases, liquids and solids which are encountered in industry and commerce. They are commonly carbon-based, and may be referred to collectively as fuels in the context of this research work. Despite the wide variety of these fuels in both their chemical and physical states, in fire, they share features that are common to them all. Differences are encountered in the ease with which fire can be initiated (ignition), the rate with which fire can develop (flame spread), and the power that can be generated (rate of heat release) (Cote,2011).

2.3.1.3 Fire Processes

Fireistherapidoxidationofamaterialintheexothermicchemical processof combustionreleasingheat,lightandvariousreactiveproducts(Proulx, 2013). Fires start inthreemainwaysi.e.*accidents*(misuseofappliances),*deliberateignition* and *equipment failure*(electricalmalfunction)andproducesmoke andtoxicgaseswhich couldbeextremelyfataltothoseexposedtoit, hence,theneed forprevention and protectionfromspreadingfiresbyforinstancedelayingignitionperiodtoallow peoplemoretimeto escapeand forthe firebrigade personnelto arriveattheincident.Firecan makehomesunsafe.Itcanleadtothecollapseofhouses,lossofpropertyoreven death(Supermedia,2011).

There are two major fire processes, an understanding of which is essential for effective fire disaster preparedness:

(i) the *conditions*under which a combustible material may become involved in flaming combustion; and

(ii) the *rate* at which such a material, once involved, will provide an output of heat, smoke, toxic gases, which can endanger people and property.

The first process (*conditions*) may be regarded as covering both ignition and spread of fire on materials; its complement is the way by which fire may become extinguished. It is necessary for such processes to bring in a characteristic of the basic combustion reaction which, directly or indirectly, expresses the reactivity of the combustion process (Cote,2011). The most important factor governing the production of dangerous product is the *rate* at which volatiles first (fuel-controlled fires) and later air (air-controlled fires) are fed into the flames. The reactivity is of less importance, although it may be one of the factors which control combustion efficiency. In general, the more efficient is the combustion, the more heat is produced, the less smoke and toxic gases are produced. Fire is a chemical reaction involving rapid oxidation (burning) of fuel.

2.3.1.4 Elements of Fire

The following three elements must be present at the same time in order for a fire to start:

(i). Fuel - Combustible material

(ii). Oxygen - the fuel source, and

(iii). Heat - Ignition Source. (see fig. 2.6)

(i) **FUEL** – Any **combustible material** (flammable gases, liquids, solids).
Most solids and liquids must vaporize before they will burn. Combustible material is one which acts as a fuel source for fire, i.e., paper, wood, clothes, any solid combustible material like gasoline, kerosene, grease, tar, fingernail polish, magnesium, sodium, potassium, titanium or aluminum, cooking oil, vegetable oil.

(ii) **OXYGEN** – Oxygen which is the most common factor and is available everywhere. Sufficient oxygen (present in the air, oxidizing substances) must be present in the atmosphere surrounding the fuel for fire to burn.The oxidizer is the other reactant of the chemical reaction. In most cases, it is the ambient air, and in particular one of its components, oxygen (O_2). By depriving a fire of air, it can be extinguished; for example, when covering the flame of a small candle with an empty glass, fire stops; to the contrary, if air is blown over a wood fire with bellows, the fire is activated by the introduction of more air. In certain torches, gaseous oxygen is introduced to improve combustion.

(iii) **HEAT** – **(Hot surfaces)**Ignition source or heat source means flame, spark which ignites sufficient heat or flame for a combustion or fire. Here is an easy way to understand what fire is, is by fire triangle (nuclear fire) (fig. 2.6)(Bryan, 1994). Sufficient heat energy (hot surfaces, electrical equipment, smoking, naked lights) must be applied to raise the fuel to its ignition temperature.

There are also many other ways to bring sufficient activation energy including electricity, radiation, and pressure, all of which will lead to a temperature rise. In most cases, heat production enables self-sustainability of the reaction, and enables a chain reaction to grow. The temperature at which a liquid produces sufficient vapor to get a flammable mix with self-sustainable combustion is called its flash-point International Fire Safety Training Association (IFSTA., 2008).

The combination of these three elements is frequently referred to as the 'fire triangle' (fig. 2.6). The removal of any one of these elements will result in the fire being extinguished or no fire at all. Fire extinguishers will extinguish a fire by removing one or more elements of the fire triangle (Griffith and Mullins, 1984).

2.3.1.5 Classes ofFires

Accordingto(Duke,2012),classificationoffiredependsmainly uponthefuel involved.Based on this, there are five (5) major classesof fire. They are asfollows;

i. **Class"A"**-Thesearefiresfuelledbyordinary combustiblematerials,suchaswood, cloth,paper,andmany plastics.This typeoffireburnswithanember,leavesanash, andisbestextinguishedby removingtheheatsideofthetriangle.Extinguishers suitableforClass"A" firesshouldbeidentifiedby atrianglecontaining theletter"A"; ifcolor-coded,the**trianglewillbegreen**.Thesefiresshouldbeextinguishedbyusing a*drychemicalextinguisher*.*Water*is effectiveinextinguishingthesetypefires; however,waterextinguishers are rarelyfoundespeciallyin Medical Centres.

ii. **Class"B"**-Thesearefiresfuelledby flammableliquids,combustibleliquids, petroleumgreases,tars,oils,oil-based paints,solvents,varnishes, alcoholsand flammablegases.Thistype of fire burnsonthesurface of thefuels,andisbest extinguished by*ablanketing orsmothering action*.Afireofthistypeisfastspreading andcapableofengulfingalargeareainaveryshorttime.Extinguisherssuitablefor Class"B"firesshouldbeidentifiedby asquarecontainingtheletter"B".Ifcolour-coded,the**squareisred.**Eitherdrychemicalorcarbondioxideextinguishersshould be used to extinguish these types of fires. Flammable liquids may re-ignite after being extinguished. Water should not be used for these kinds of fire.

iii. **Class"C"-**Thesefiresoccurinenergizedelectricalequipment,where the electrical non-conductivity oftheextinguishingmediaisofimportance.Blanketingor smothering this type offirewithanon-conductingextinguishingagentisofprime importance.Water, orsolutionscontaining water,isnevertobeusedonaclass"C" fire.Extinguisherssuitableforclass"C"firesshouldbe identifiedbyacircle containingtheletter"C";ifcolor-coded,the**circleisblue**.*Eitherdry chemicalor carbon dioxideextinguishers*shouldbe used toextinguishthesetypesoffires.Water shouldnotbeused.Extinguisherssuitableformorethanoneofthethreeclassesof fireA,Band Cdefined abovemaybeidentified bymultiple symbols (ABC).

iv. **Class“D”**–Thesefiresinvolvecombustible metals,suchasmagnesium,titanium, zirconium,sodium,lithiumandpotassium.Generally, theextinguishingagentis referred toas *dry powder*. These extinguishersshould be identified by a starcontainingthe letter “D”,if color-coded, **the starisyellow**.

v. **Class“K”**–These are firesincookingappliancesthatinvolve combustiblecooking mediasuchasvegetableoranimaloilsandfats.Theextinguishing agentisreferredto as *Wet Chemical*. Theseextinguishers should beidentified bytheletter“**K**.”

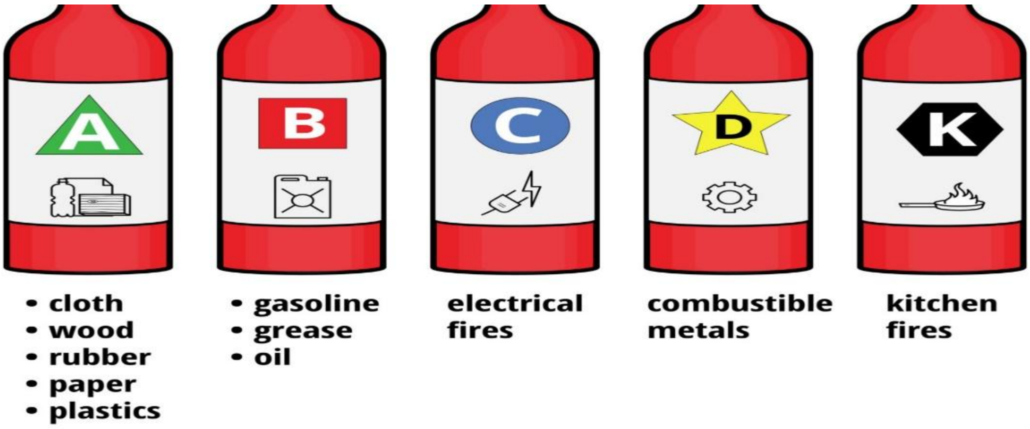


Fig. 2.5 Types of Fire Extinguishers and their coded colours.

2.3.1.6 Condition of Fire

Drysdale,(1985) opined that the condition of fire depends on three things as previously stated, i.e.

(i). presence of material that acts as fuel/combustible substance

(ii). a source of heat/ignition

(iii). the pressure of oxygen in the form of fire

Fire extinction in principle consists the limitation of one or more of these factors (Cumming,2012).

The methods of extinguishing fire may be classified under the following headings:

(a). Starving

(b). Smothering

(c). Cooling

(d). Inhibition or retarding of the combustion reaction

(a). **Starvation:** Starvation is achieved by removal of the fuel burning in the fire. Sometimes combustible material can be removed by shutting off gas valves or fuel flows.

(b). **Smothering:** By excluding the oxygen in the surrounding atmosphere, the fire will be extinguished.

(c). **Cooling:** The most commonly used firefighting medium is water. Water absorbs heat from the fire and cools the fuel to a temperature where it can no longer produces flammable vapors.

(d). **Stop chain reaction:** Stopping or interrupting the chain reaction between the fuel, heat, and oxygen will extinguish the fire. Specific methods of extinguishing fires often involve a combination of more than one of the four principles.

2.3.1.7 StagesofFireDevelopment

Therearefourmainstagesoffiredevelopment. Thesestagesareincipient,growth, fullydeveloped, anddecay(Hartin,2005).Thisfirststage,theIncipientorignition stagebeginswhenheat,oxygenandafuelsourcecombineandachemicalreaction occursresultinginfire(Proulx,2013).Itisusuallyrepresentedbyaverysmallfire whichoften(andhopefully)goesoutonits own,withoutmovingtotheconsequent stages.

Recognizinga fireinthisstageprovidesus withbest chanceat suppressionor escape (Kelvin,2009).Thesecondstageisthegrowthstagewherethebuildingstructures' fireloadandoxygenareusedasfuelforthefireandaslongasairisavailable(inwell ventilatedbuildings),thefiregrowsveryquickly.Factorssuchaslocationofthe room,typesof combustibles,ceilingheightandthepotentialfor thermallayeringaffect thegrowthstage(DiGuiseppi,Roberts,Wade,Sculpher,Edwards,Godward, andSlater, 2012).Itisduringthisshortestofthefourstages whenthesurfaces ofeverythingwithin acompartment orroomseemtoburstinto flame simultaneously; a condition called flashover occurs (Kennedy andKennedy, 2013). Flashovers arewellknown fortheirpotential oftrapping, injuringorkilling personswithinthebuilding.

Thethirdstageis whenthegrowthstagehasreacheditsmaximumand all combustible materialshavebeenignited,afireisconsideredfullydevelopedandisthereforecalled thefullydevelopedstage.Thisis thehottestphaseofafireandthemostdangerousfor anybodytrappedwithin(Mowrer,2012).Thelaststageis thedecayedstage,usuallythe longeststageofafireandischaracterizedby a significantdecreaseinoxygenorfuel, puttinganendtothefire.Twocommondangersduringthisstagearetheexistenceof non-flaming combustibles, whichcan start a new fireif not fully extinguished. Secondly,thereis thedangerofabackdraftwhenoxygenis reintroducedto avolatile, confinedspace.

2.3.1.8 Fire Triangle

Fire triangle is an easy way to understand what fire is. It also gives a clear idea what the primary action is required against fire.

The three elements mentioned earlier (fuel, oxygen and heat) can be represented by a triangle known as “Fire Triangle” or “Combustion Triangle” or ″Fire Diamond ″ (fig. 2.6) are simple models for understanding the necessary ingredients for most fires.

The triangle illustrates the three elements a fire needs to ignite: heat, fuel, and an oxidizing agent (usually oxygen). A fire naturally occurs when the elements are present and combined in the right mixture, meaning that fire is actually an event rather than a thing. A fire can be prevented or extinguished by removing any one of the elements in the fire triangle. For example, covering a fire with a fire blanket removes the oxygen part of the triangle and can extinguish a fire. In large fires where firefighters are called in, decreasing the amount of oxygen is not usually an option because there is no effective way to make that happen in an extended area (Nadzimand Taib, 2014).

Fig. 2.6: Fire Triangle or Combustion Triangle or Fire Diamond
Source:(Thomas, 1974)

2.3.1.9 Fire Tetrahedron

The fire tetrahedron represents the addition of a component in the chemical chain reaction (fig. 2.7), to the three already present in the fire triangle. Once a fire has started, the resulting exothermic chain reaction sustains the fire and allows it to continue until or unless at least one of the elements of the fire is blocked. Foam can be used to deny the fire that the oxygen needs. Water can be used to lower the temperature of the fuel below the ignition point or to remove or disperse the fuel. Halon can be used to remove free radicals and create a barrier of inert gas in a direct attack on the chemical reaction responsible for the fire. Combustion is the chemical reaction that feeds a fire with more heat and allows it to continue. When the fire involves burning metals like lithium, magnesium, titanium, etc. (known as a class-D fire), it becomes even more important to consider the energy release.

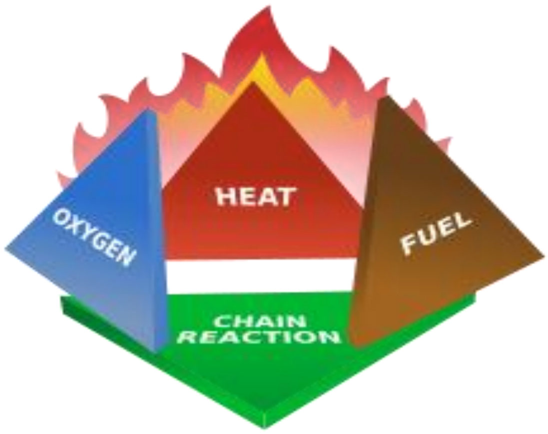


Fig. 2.7: Fire Tetrahedron
Source:https://en.wikipedia.org/wiki/File:tetrahedron.svg

The metals react faster with water than with oxygen and thereby more energy is released. Putting water on such a fire results in the fire getting hotter or even exploding. Carbon dioxide extinguishers are ineffective against certain metals such as titanium. Therefore, inert agents (e.g. dry sand) must be used to break the chain reaction of metallic combustion. In the same way, as soon as one of the four elements of the tetrahedron is removed, combustion stops. (IFSTA., 2008).

2.3.2.0 Theory of Fire Extinguishment

(Grant, 2012) stated that fire extinction and suppression can be examined in terms of the outline of the theory of fire. The gas phase combustion processes (i.e., the flame reactions) are very sensitive to chemical inhibitors. Some of the flame retardants used to improve the "fire properties" of materials rely on the fact that small amounts of inhibitor released with the fuel vapours will suppress the establishment of flame. The presence of a flame retardant cannot render a combustible material non-combustible, but it can make ignition more difficult—perhaps preventing ignition altogether provided that the ignition source is small. However, if a flame-retarded material becomes involved in an existing fire, it will burn as the high heat fluxes overwhelm the effect of the retardant National Fire Protection Association, (NFPA., 1983).

Extinction of a fire may be achieved in a number of ways:

a. Controlling the flow of fuel vapours
b. Extinguishing the flame by chemical extinguishers (inhibiting)
c. Removing the supply of air (oxygen) to the fire (smothering)
d. "Blow-out".

(a). Controlling the flow of fuel vapours

The first method, stopping the supply of fuel vapours, is clearly applicable to a gas-jet fire in which the supply of the fuel can simply be turned off (Cote,2011). However, it is also the most common and safest method of extinguishing a fire involving condensed fuels. In the case of a fire involving a solid, this requires the fuel surface to be cooled below the fire point, when the flow of vapours becomes too small to support a flame. This is achieved most effectively by the application of water, either manually or by means of an automatic system (sprinklers and water spray). In general, liquid fires cannot be dealt with in this manner: liquid fuels with low fire points simply cannot be cooled sufficiently, while in the case of a high-fire point fuel, vigorous vaporization of water when it comes into contact with the hot liquid at the surface can lead to burning fuel being ejected from the container. This can have very serious consequences on those fighting the fire. (There are some special cases in which an automatic high-pressure water-spray system may be designed to deal with the latter type of fire, but this is not common). Liquid fires are commonly extinguished by the use of fire-fighting foams (Cote,2011). This is produced by aspirating a foam concentrate into a stream of water which is then directed at the fire through a special nozzle which permits air to be entrained into the flow. This produces a foam which floats on top of the liquid, reducing the rate of supply of fuel vapours by a blockage effect and by shielding the surface from heat transfer from the flames. The foam has to be applied carefully to form a "raft" which gradually increases in size to cover the liquid surface. The flames will decrease in size as the raft grows, and at the same time the foam will gradually break down, releasing water which will aid the cooling of the surface.

There are a number of foams concentrates available, and it is important to choose the one that is compatible with the liquids that are to be protected. The original "protein foams" were developed for hydrocarbon liquid fires, but break down rapidly if brought into contact with liquid fuels that are water soluble. A range of "synthetic foams" have been developed to tackle the entire range of liquid fires that may be encountered. One of these, Aqueous Film-Forming Foam (AFFF), is an all-purpose foam which also produces a film of water on the surface of the liquid fuel, thus increasing its effectiveness.

(b). **Extinguishing the flame**

This method makes use of chemical suppressants to extinguish the flame. Chemical suppressants applied in sufficient quantity will cause a dramatic fall in the concentration of these radicals, effectively quenching the flame. The most common agents that operate in this way are the halons and dry powders. Halons react in the flame to generate other intermediate species with which the flame radicals react preferentially. Relatively small amounts of the halons are required to extinguish a fire, and for this reason they were traditionally considered highly desirable; extinguishing concentrations are "breathable" (although the products generated while passing through the flame are noxious). Dry powders act in a similar fashion, but under certain circumstances are much more effective. Fine particles are dispersed into the flame and cause termination of the radical chains (Wahab, 2015).

John, (2012) posited that, for a person whose clothing has caught fire, a dry powder extinguisher is recognized as the best method to control flames and to protect that individual. Rapid intervention gives rapid "knockdown", thus minimizing injury. However, the flame must be completely extinguished because the particles quickly fall to the ground and any residual flaming will quickly regain hold. Similarly, halons will only remain effective if the local concentrations are maintained. If it is applied out of doors, the halon vapour rapidly disperses, and once again the fire will rapidly re-establish itself if there is any residual flame. More significantly, the loss of the suppressant will be followed by re-ignition of the fuel if the surface temperatures are high enough. Neither halons nor dry powders have any significant cooling effect on the fuel surface.

(c). Removing the supply of air

Removing the supply of air will certainly cause the fire to extinguish, to do this, it is only necessary to reduce the oxygen concentration below a critical level. A fire in a room may be held in check and may even self-extinguish if the supply of oxygen is limited by keeping doors and windows closed. Flaming may cease, but smouldering will continue at very much lower oxygen concentrations. Admission of air by opening a door or breaking a window before the room has cooled sufficiently can lead to a vigorous eruption of the fire, known as back draught, or backdraft (GoK,2012b).

"Removal of air" can be achieved in the immediate vicinity of a small fire by local application of a suppressant from an extinguisher. Carbon dioxide is the only gas that is used in this way. However, as this gas quickly disperses, it is essential to extinguish all flaming during the attack on the fire; otherwise, flaming will re-establish itself. Re-ignition is also possible because carbon dioxide has little if any cooling effect. It is worth noting that a fine water spray entrained into a flame can cause extinction as the combined result of evaporation of the droplets (which cools the burning zone) and reduction of the oxygen concentration by dilution by water vapour (which acts in the same way as carbon dioxide). Fine water sprays and mists are being considered as possible replacements for halons (Ostrowski, 1991).

(d). **Blow-out**

This method is included here for completeness. A match flame can easily be blown out by increasing the air velocity above a critical value in the vicinity of the flame. The mechanism operates by destabilizing the flame in the vicinity of the fuel. In principle, larger fires can be controlled in the same way, but explosive charges are normally required to generate sufficient velocities. Oil well fires can be extinguished in this manner(Ogunmosunle, 2013).

Finally, a common feature that needs to be emphasized is that the ease with which a fire can be extinguished decreases rapidly as the fire increases in size. Early detection permits extinction with minimal quantities of suppressant, with reduced losses. In choosing a suppressant system, one should take into account the potential rate of fire development and what type of detection system is available Mostue,(2011).

2.3.2.1 The Basic Conceptsof Fire

This section understudies some of the underlying concepts and principles and provide guidance to an understanding of fire processes. Combustible materials are all around us. Given the appropriate circumstances, these materials can be made to burn by subjecting them to an ignition source which is capable of initiating a self-sustaining reaction. In this process, the “fuel” reacts with oxygen from the air to release energy (heat), while being converted to products of combustion, some of which may be harmful. The mechanisms of ignition and burning need to be clearly understood. Most everyday fires involve solid materials (e.g., wood, wood products and synthetic polymers), although gaseous and liquid fuels are not uncommon Fire DisasterPrevention and SafetyAwarenessAssociation ofNigeria(FDPSAAN.,2008).

The model shown in fig. 2.4isasetofconcepts, definitions, andpropositions thatexplainorpredictthese fireevents or situations by illustrating therelationships between variables.Conceptualization isallabout developing orcoming upwith a framework and visualizingitmentally. Itistheprocess ofcreatingnewideasthataimattackling situations.Itisasimplifiedviewoftheworldthataresearcher wishestorepresent (Kisilu andTromp, 2006).

Thisstudyadopted theconceptual framework that helpedinunderstandingtheobjectivesofthestudy.

Asshowninfig. 2.4,variousindependentvariablesneedto bewell coordinatedin orderto haveadequatefirepreparedness measures.Firesafetypoliciesand proceduresneedtobewelldocumented,updatedandmadeavailableto all employees. Seniormanagement mustbecommittedtothepoliciesandshouldprovideadequate trainingandskillstoallthestaff.Resourcesshouldbemadeavailableandfacilitiesand equipmentinplacemaintainedall thetime.

2.3.3.2 Literature Gap

Despitethetechnologicaladvancementinfiresafety and prevention, fire disaster remainstheleadingcauseoflives andpropertylossat commercial facilitiesworldwide andfirecouldleadtothepematurewindingupofan organisation nomatterhowbigitis (Kong, 2011).

From the literature reviewed, few researches have been conducted, but there is no template or framework for fire safety measures, strategy and control that could foster the prevention of emergence of fire, curtail fire spread or reduce the high level of lost of lives and property due to fire disaster. Many researchers had carried out studies on fire safety and control from the angle of mitigation, response and restoration to fire hazards. These three phases of fire disaster management focus on what to do when fire occurs in a building. The previous researchers had also failed to recognize that prevention of fire in any given building begins with adequate and proper planning from the design and conceptual, construction and post construction stages.

Furthermore, this study focused on bridging the gap through the development of a framework that will incorporatefire disaster preparedness measures into a building from the design/conceptual to construction stage and occupationwith the view to preventing the emergence of fire and fire spread in a building if occurred.This is according to Mugure (1991), **a firesafetysystemis a system that isaimedat makingstartingof a firedifficult, reducing itsgrowthrate,preventing itsspread,controlling itandaidingescapeof occupantsandpreventingthebuildingfromfailing,** and this is all about fire disaster preparedness.

Therefore, the developed framework will foster the planning, design and construction of buildings that could resist fire outbreak. Again, asoftware (Computerized Fire Alarm Sysem) was developedfor the implementation oftheframework – chosentobeaMobileApp in order to makeithandy,universalanduser-friendly. In the event of fire, the software will enable the owners/users to immediately contact the firefighting Agencies or Authorities for quick intervention or response.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter presents the methodology or procedures that were applied in collection of data as well as techniques used for the analysis and presentation of the outlined objectives of the study. The data were collected with the use of structured questionnaires and analyzed with statistical tools. The research hypotheses were tested accordingly.

3.1 Research Design

This study is a descriptive survey design, and non-experimental. Considering the nature of the research questions and hypotheses of this study. The set of data required for this study is both qualitative and quantitative in nature and the most apposite design for this study is a mixed research design approach. The term "mixed research design" refers to an emergent methodology of research that advances the systematic integration, or "mixing," of quantitative and qualitative data within a single investigation or sustained program of inquiry.On a more philosophical level, mixed methods research combines paradigms, allowing investigation from both the inductive and deductive perspectives, and consequently enabling researchers to combine theory generation and hypothesis testing within a single study (Jogulu and Pansiri, 2011).The study employed the use of descriptive statistics, organized data into patterns in the analysis. The researcher made use of convenient proportionate cluster sampling in the selection of the research element. The study employed a mixed research design (quantitative and qualitative) approach so as to achieve the research objectives and address the research questions of this study (Mugenda and Mugenda, 1999).

3.2 Study Area

The study area is Imo State. Principally, the study focused on Owerri, Orlu and Okigwe in Imo State (Fig. 3.2). These are the three major towns in Imo State where fire disasters are more predominant due to the high level of industrial activities. Imo State is located within the map of Nigeria (fig. 3.1). Imo State was createdin1976bythelate militaryheadof state,GeneralMurtalaMuhammed,the 43-year-oldStatewaslocatedinSouthEastgeopoliticalzoneofNigeria. ImoStateislocatedbetweenlatitude4°45′Nand7°15′Nandlongitude6°50′Eand7°25′E, withan areaofabout5100 km^2.Itlieswithinthehumidtropicsandisgenerally characterizedby a highsurfaceairtemperatureregimeyear-round.Meanminimum temperatureis23.5°Candmean maximumtemperatureis32.1°C., and covers approximately 5,529.17 km area with a Population of 2,938,708 (2006 Census). The

State derives its name from Imo River, which takes its course from the Okigwe/Awka upland. Imo State is located between the lower River Niger and the upper and middle Imo River in the Southeastern part of the country. ItsspatialextentaccordingtoFederalofficeofstatisticsisabout5,530sqkm. The climate of Imo State is humid, semi-hot equatorial type. The State experiences heavy rainfall, with an average annual rainfall of 2000 - 2400mm/year and an average number of 152 rain/ days particularly during the rainy seasons (April – October) the superficial rainfall distribution is bimodal, with peaks in July and September and two weeks break in August. The rainy season begins in March and lasts till October or early November (Nnaji2009). Rainfall is often at its maximum at night and during the early morning hours. The higher annual rainfall depths and rainfall days encourages large volumes of runoff. However, variations occur in rainfall amount from year to year, usually between 1,990 mm and 2,200 mm. Relative humidity oscillates between 75% and 90% between the Dry and Rainy seasons (Okorie,2011). Temperatures are similar all over the State; the hottest months are January to March, with the mean annual temperature above 20°C. The State ismade up of sixlocalgovernment areasselectedtwoeachfromthreesenatorialzones thatmakeupthestate, theyareIsialaMbanoandOnuimo (OkigweZone),IkeduruandAhiazuMbaise(OwerriZone)andOrluandOguta(OrluZone).


4°0'0"E
8°0'0"E
12°0'0"E
14°0'0"N
10°0'0"N
6°0'0"N
Sokoto
Katsina
Zamfara
Kebbi
Jigawa
Kano
Yobe
Borno
Kaduna
Bauchi
Gombe
Niger
Plateau
Adamawa
Kwara
Federal Capital Territory
Nassarawa
Oyo
Taraba
Osun
Ekiti
Kogi
Benue
Ogun
Ondo
Lagos
Edo
Enugu
Ebonyi
Cross River
Delta
Rivers
Bayelsa
1:1,500,000
Km
0
2,250
4,500
9,000
13,500
18,000
22,500
Imo State in red print

Okigwe

Orlu

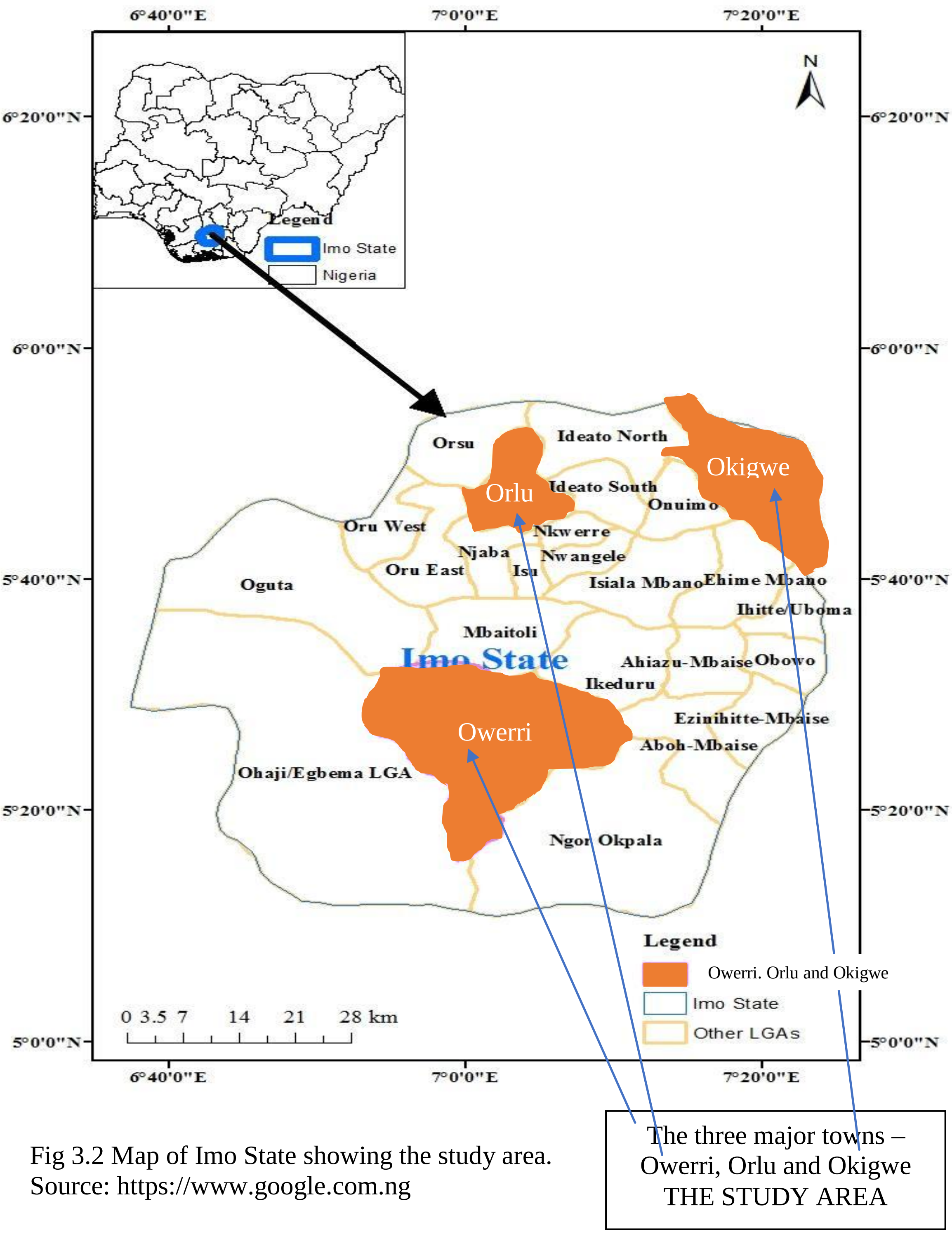


Fig 3.2 Map of Imo State showing the study area.
Source: https://www.google.com.ng

3.3 Population, Sample and Sampling Technique

3.3.1 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.Thepopulation of this study constitutes the following unit of analysis: registered commercialbuildings in the study area – Owerri, Orlu and Okigwe, officers of fire service stations and officers of the Town Planning Authorities in the three towns where the data for the registered commercial buildings and fire victims in the study area were derived, the design and construction teams (Architect, Builders, Electrical and Mechanical Engineers), who were solely involved at the design and construction stages of these commercial buildings, and the commercial building owners and users in the study area.

Table 3.1: Population of the study

S/N	Population of the study	Total
1	Building Owner/User or Occupant/Manager	2268
2	Architect	72
3	Builder	26
4	Electrical Engineer	46
5	Mechanical Engineer	38
6	Fire Brigade Personnel	34
7	Town Planning Authority	22
8	Fire Victims	13
	Total	**2519**

3.3.2 Sample, Sample size and Techniques

The population for the study consists of 2,519. 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:

$$n = \frac{z^2 Npq}{Ne^2 + z^2 pq} \qquad \text{………..... Equation 1}$$

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)

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.Other sample sizes were collected from their various professional bodies; Fire Service Station Office; Town Planning Authority. Due to the insufficient figures in the other focus groups, the figures were used that way. Hence, the summary of figures used in this study are:

Table 3.2: Sample size

S/N	Sample Size	Total
1	Building Owner/User or Occupant/Manager	475
2	Architects	72
3	Builder	26
4	Electrical Engineer	46
5	Mechanical	38
6	Fire Brigade Personnel	34
7	Town Planning Authority	22
8	Fire Victims	13
	Total	**726**

Source: Field Survey, (2018).

3.4 Method of Data Collection

To address the Research Objectives and Questions of this study, primary method of data collection was used. The data for this study were analysed using descriptive statistics (quantitative and qualitative design approach). The data were collected directly from respondents with the use of questionnaires to analyze the research objectives and questions of this study; the questionnaires and observation also assisted in assessing the type of fire safety measures adopted by commercial building owners, examined the level of fire disaster preparedness of the commercial building owners and the effect of fire disaster on the owners and occupants of these categories of buildings.The study made use of checklist for availability and suitability to assess the type of firefighting equipment installed in the buildings for compliance with the provision of fire safety acts, design standards and codes. Data collected through the questionnaire were used to address the aim and objectives of the study, and a policy and implementation framework for fire disaster preparedness for commercial buildings in Imo State was developed (Chapter 4.13).

3.5 Instrument for Data Collection

The data for this study were collected using primary method of data collection based on the aim and objectives of this study. Observations and questionnaires for collection of data for the study. Through the questionnaires, the study revealed relevant information from the respondents, this includes the types of firefighting equipment available in each of the commercial buildings. The occupant's level of training in the use of firefighting equipment. The design teams' consideration at the design stage? i. e. the nature of doors and windows element installed in these buildings – are they fire resistant? Are there fire-fighting personnel on ground in case of fire outbreak?

The questionnaire was structured into two parts: Part A contained personal data of the respondents; Part B addressed the fire disaster in Commercial buildings. Part B was also structured into four sections according to the research objectives.

The questionnaires were structured in a way that the respondents were objective in their responses. The researcher gave a space of two weeks for the respondents to answer the question before collection. The questions were structured in five Likert–Scale format, the ratings were represented in 5 points. The questions were close ended format and were simple and straightforward so that they could be easily be understood by the respondents. The set of responses used in the questionnaire were presented in table 3.3

Table 3.3: Likert-Scale: Responses and Meanings

Scale	Meaning		
1	Very Good	Very Suitable	Strongly Agreed
2	Good	Suitable	Agreed
3	Not Sure	Not Sure	Not Sure
4	Poor	Unsuitable	Disagreed
5	Very poor	Very Unsuitable	Strongly Disagreed

Source: Field Survey, (2018)

3.6 Reliability and Validity of the Instrument for Data Collection

In order to determine the reliability of the instrument, the instrument was administered to 30 members of different design and construction professionals (Architect, Builder, Electrical Engineer, Mechanical Engineer) outside the study area. The data collected through trial testing were analyzed to determine the extent of internal consistency with which the items of the instrument would measure the various traits of interest. The Cronbach's Alpha statistic was used to establish the reliability of instrument which yielded a coefficient of 0.818. The researcher therefore considered the instrument suitable and adequate for the study (See attached reliability result in the Appendix E.

3.7 Method of Data Analysis

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.

The analysis of data obtained through questionnaires were categorized into descriptive statistics. The statistical techniques employed in this study are T-test andAnalysis of Variance (ANOVA). The benchmark for judgment was being placed at 95% confidence which in other words is 5% level of significance. The decision rule is to reject the null hypothesis if p-value is less than the level of significance or if the calculated value is greater than the tabulated value, otherwise null hypothesis is not rejected.

CHAPTER FOUR

4.0 PRESENTATION OF DATA, ANALYSIS AND DISCUSSION OF FINDINGS

Theresultsofthisstudy werediscussedunderthematicsub-sectionsinlinewith researchobjectives.Out of 726 Questionnaire distributed, 705 were returned. Which gave 97.1% of the questionnaire collected. 21 questionnaires which represent 2.9% were not submitted by the respondents.

4.1 Personal data of Respondents

Table 4.1: Percentage Distribution of Respondents' Profile

Variables	Frequency	Percent (%)
Status of Respondents		
Building Owner/User/Manager	462	65.5
Architect	65	9.2
Builder	26	3.7
Electrical Engineer	45	6.4
Mechanical Engineer	38	5.4
Fire Brigade Personnel	34	4.8
Town Planning Authority	22	3.1
Fire Victims	13	1.8
Total	**705**	**100**
Age bracket (year)		
Below 30	134	9.1
31-39	170	9.9
40-49	401	56.9
Total	**705**	**100**
Gender		
Male	483	68.5

Female	222	31.5
Total	**705**	**100**

Table 4.1 Continued**:** Percentage distribution of respondents' profile

Education level		
Primary	63	8.9
Secondary	141	20
Tertiary	501	71.1
Total	**705**	**100**
Years of Occupying a Building		
Less than 3	70	9.9
4-6	141	20
7-9	281	39.9
Above 10	213	30.2
Total	**705**	**100**
Education level		
Primary	63	8.9
Secondary	141	20
Tertiary	501	71.1
Total	**705**	**100**

Source: Field Survey 2019

4.2 Demographic profile of Respondents

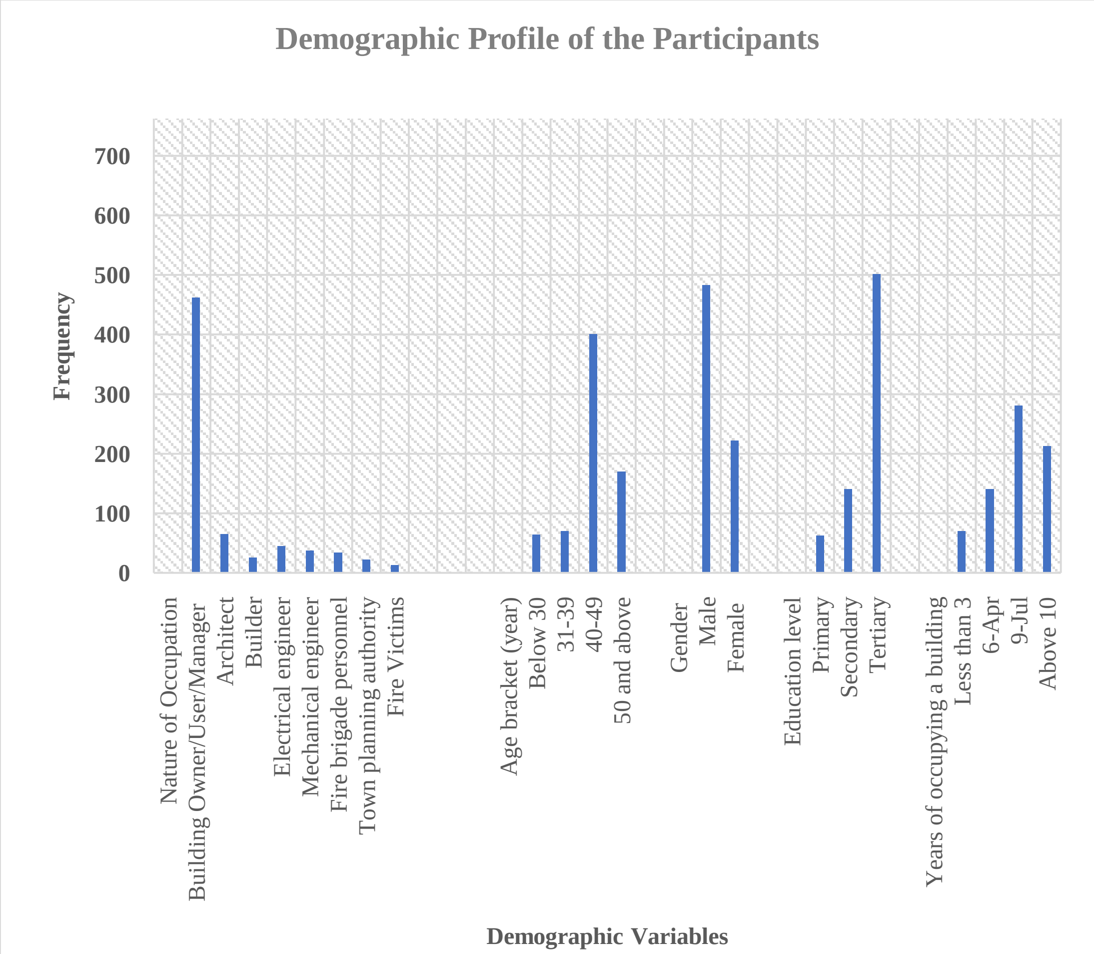


Fig. 4.1: Demographic profile of Respondents

Source: Field Survey, 2019.

Table4.1showsthe frequency and percentage distribution of respondents. The study revealedthatmajorityoftherespondentswere Male 483 (68.5%), while Female were 222 (31.5%) and 501 (71.1%) respondents were graduatesof one tertiary institution or the other and 281 (39.9%) have been occupying the buildings under study within the period of 7-9 years. This findingsignifies that majority oftherespondentswereexpectedtohaveknowledgeoffiredisaster preparedness and requisite skillsbecausethey werealready engaged either as owners, managers orusers. Fromthestudy,itcould beconcludedthatmajorityoftherespondentswereadultshence could haveareliable knowledgebeingsought.

4.3 Targetted Groups and Return rates of Questionnaire

Table 4.2 Return rates of Questionnaire

TARGETTED 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%
Architects	72	65	7	90.3%
Builder	26	26	Nil	100%
Electrical Engineer	46	45	1	97.8%
Mechanical	38	38	Nil	100%
Fire Brigade Personnel	34	34	Nil	100%
Town Planning Authority	22	22	Nil	100%
Fire Victims	13	13	Nil	100%
Total	**726**	**705**	**21**	

Source: Field Survey, 2019.

Fig.4.2showsthe bar chart of the targeted/ focussed group. The sample size obtained for the Building Owner was determined using Cochran’s formula (Chapter 3.2.2). Other sample sizes were derived from the records of each of the professional bodies and the relevant authorities.

4.4 Established Cases of FireDisaster in Imo State.

Table 4.3:Established Cases of FireDisaster in Imo State.

S/No	Commercial Buildings gutted Fire	Causes of the fire event	Value of Property destroyed	Estimated Number of lives lost	Year of Occurrence
1	Chris Tee Filling Station, Road Safety Office, Egbu.	Electrical Fault	Multi-Million Naira	-	2010
2	G. Tower Hotel, Portharcourt Road	Electrical Fault	Multi-Million Naira	-	2012

3	Sea Master Industry, Orlu	Gas Explosion	Multi-Million Naira	4	2014
4	INEC Office, Nwaoruibi,	Petrol	Multi-Million	-	2015

Table 4.3: Continued: Established Cases of FireDisaster in Imo State.

5	Two Imo State Polytechnic Students at their lodge, Mgbirichi	Gas Explosion	Multi-Million Naira	2	2016
6	Pretoria Hotel and Suites, Owerri	Electrical Fault	Multi-Million Naira	-	2016
7	Stone Castle Hotel, Owerri	Electrical Fault	Multi-Million Naira	-	2017
8	Gas Explosion, Amawire, Okigwe Road, Owerri	Gas Explosion	Multi-Million Naira	2	2017
9	Newton hotel, Owerri	Electrical Fault	Entire Building	-	2017
10	Imo State Deputy Governor's House, New Owerri	Bush Burning	Multi-Million Naira	-	2018
11	Tetlow Plaza, Owerri	Faulty Electrical Appliances	Multi-Million Naira	-	2018
12	Night Club and Lounge, Owerri	Electrical Fault	Multi-Million Naira	-	2018
13	Old Stadium Plaza, Owerri	Electrical Fault	Multi-Million Naira	-	2018
14	All Progressive Congress (APC) Office, Okigwe Road, Owerri	Generator	Multi-Million Naira	-	2018
15	Ibari Ogwa Entertainment Spot, Portharcourt Road, Owerri.	Electrical Fault	Multi-Million Naira	-	2018
16	Imo State University, Faculty of Humanities, Owerri	Electrical Fault	Academic Documents	-	2019
17	Sam Mbakwe Airport, Owerri	Electrical Fault	Multi-Million Naira	-	2019
18	The Independent National Electoral Commission's (INEC) Office, Isiala Mbano, Imo North	Electrical Fault	Election Documents	-	2019

Source: Fire Service Owerri, 2019

Table 4.3 shows theestablished cases/ records of fire incidences in the study area from 2010 to 2019 (Objective One). The record was collected from Fire Service Station Headquarters, Okigwe Road, Owerri. The occurrence of fire in Imo State has been more pronounced in the last two decades. The causes of these fire events could be traced to majorly, electrical faults (98.7%) (table 4.4) which corroborates with Akomolede (2015).Based on the rapid and high level of industrial development in the study area.

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. Data in table 4.3 therefore, establishes the fact that fire disaster has been predominant in Imo State and this provides answer to objective and research question one, hence, the need for fire disaster preparedness.

4.5 Factors responsible for fire disaster in the Commercial Buildings Studied

Table 4.4: Factors responsible for fire disaster

Suggested Factors	N	Mean	Std. Deviation
Use of Substandard Electrical materials	462	4.5584	0.52264
Bad workmanship (Electrical installations)	462	4.6667	0.47192
Lack of knowledge of fire safety rules and regulations	462	4.1017	1.31256
Faulty Electrical appliances	462	4.8810	0. 32420
Smoking in unauthorized places	462	3.8658	1.38451
Unseemly storage of combustible materials	462	4.4035	1.01280
Gas Leakages	462	4.8680	0.33890
Improper disposal of lighted ends of cigarette and matches	462	4.6385	0.48095
Lightning and thunder strikes	462	4.1797	1.10813
Tolerating fuels in areas vulnerable to fire emergence	462	4.0065	1.23663

Source: Field Survey, 2019.

From table 4.4, it could be concluded that all the factors suggested could cause fire emergence in commercial buildings because the mean scoresare above 3.0 the agreed criterion. 88.1% respondents strogly agreed that faulty electrical appliances has the mean score of (4.88) with standard deviation of (0.324)followed by 86.8% respondents strongly agreed that gas leakages with mean score of (4.87) and standard deviation of (.339), were the major causes of fire disaster emergence in most commercial buildings. The results of the causes of fire disaster in commercial buildings in the study area corroborates with Akomolede (2015), thisindicates that the use of Sub-standard materials and faulty electrical appliances are the major causes of fire disaster in commercial buildings. This provides answer to objective and research question two.

4.5.1 Firefighting equipment available in the Commercial buildings studied

Table 4.5: 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.

Table 4.5 shows the decision rule of the respondents on the availability of fire safety equipment available in the commercial buildings. Itcouldbesummarized thatthe commonestfirefightingequipment available in all the commercial buildingswere dry chemical extinguisher, foam cylinders, wet chemical and sand with (462) respondents in each case.Since the major causes of fire outbreak arefaulty 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 ownerswere comparatively low.

4.5.2 Perception on availability of firefighting equipment in the Commercial buildings Studied

Table 4.5.1: 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**

Source: Field Survey, 2019.

From table 4.5.1, 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.

4.5.3 Perception on availability of firefighting equipment in the Commercial buildings Studied

Table 4.5.2: 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.

From table 4.5.2, 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 thatmost of the owners/ occupants of commercial buildings in the studied areacouldonly operatedry 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 used of different types of firefighting equipment. In determining the level of fire disaster preparedness of commercial building owers, availability of firefoghting equipment and the operation were variables measured. Tables 4.5 – 4.5.3 shows that the level of fire disaster preparedness of commercial building owers in the area studied were far below expectation. This answers objective and research question three.

4.6 Suggested ways by which fire disaster preparedness measures could be enhanced

Table 4.6: Ways fire disaster preparedness measures could be enhanced as suggested by some of 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 various fire equipment	105	22.7
Total	**462**	**100**

Source: Field Survey, 2019.

From table 4.6, the respondents prescribed four (4) suggestions: 105 (24.9%) respondents suggested that Firefighting Personnel should be employed in all the commercial buildings. 102 (20.1%) suggested that fire drill (training and education) should be put in place at regular interval. 140 (30.3%) 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 105 (22.7%) respondents viewed that every building should have various firefighting equipment since there are different type of extinguisher for different fire.

4.7 Determination of level of fire disaster preparedness of commercial building owners

Table 4.7: 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	0.52590
Burnt bricks	462	4.0758	0.56727
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 SUPPRESIVE 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 4.7 shows that the majority of the building materials, fire detective device, fire suppressive measures, fire spread control measures, and fire safety measures used were adequatein terms of facial appearance because they were all above (3.0) the mean score. Table 4.7showsbuilding 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"thenationhasnotbeenproperlyenlightened (education, training, awaremess and practice)ontheenormousimpactoffire onlivesandproperty".

4.7.1 Availability of fire safety strategies in case of fire outbreak

Table 4.8: 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 table 4.8, 84.5% and 46.3% of the respondents acknowlwedged that there were existence of Emegency communication system and fire assembly points, while 100% of the respondents attested that fire disaster kits, ire hydrants and traning and fire drills were not available at all. The respondents were not satisfied with the level of fire safety strategies adopted by commercial building owners as analysis in table 4.8depicts inadequate. The study concluded that the fire safety strategies were far below expectation. 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.

4.7.2 Perception on the level of fire safety strategies in the building

Table 4.8.1: 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.

From table 4.8.1, 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.

4.7.3 Fire Safety Policy in the commercial buildings in case of fire occurrence

Table 4.8.2: 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

Table 4.8.2 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.

4.7.4 Perception on the level of Fire Safety Policy in the commercial buildings

Table 4.8.3: 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.

From table 4.8.3, (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 4.8 – 4.8.3 there were no fire safety strategy and policy put in by the commercial building owners in the studied area. This provides answer to objective and research question four.

4.8 Analysis of Results from Targeted groups

4.8.1 Fire Victims

Table 4.9: Showing the results of Questionnaire alloted to Fire Victims

Fire disaster Preparedness measures	N	Mean	Std. Deviation
Fire outbreaks have occurred in this building before	13	4.8462	0.37553
The cause of the fire outbreak could be trace to i. Faulty Electricity Appliances ii. Gas leakage	13	4.7692	0.43853
Damage level was severe	13	4.6923	0.48038
The available firefighting equipment were satisfactory good.	13	1.4615	0.51887
The firefighting equipment was effective and	13	1.3077	0.48038

efficient			
There are fire assembly/evacuation point/emergency shelters forth is building	13	1.7692	0.43853
You have had fire safety training on the use of firefighting equipment in case of fire emergence	13	1.1538	0.37553

Source: Field Survey, 2019.

The result from Table 4.9 shows that 84.6%the fire victims with the mean score of 4.8462 strongly agreed that fire had occurred in their respective buildings before.76.9% with the mean score of 4.7692 strongly agreed that Faulty Electrical Appliance and Gas leakage were principal factors for the fire hazard. Meanwhile, 53.8% with the mean score of 1.4615 strongly disagreed that the firefighting equipment available were not good enough to suppress the fire, 84.6% with the mean score agreed that they have never had training on the use of firefighting equipment.

The SPSS result (pg. 178) shows that there is a low level of fire disaster preparedness in the study area. It is therefore expedient that the Owners of these commercial buildings should prepare adequately in other to reduced the risk of fire occurrence and its attendant loss of live and property.

4.8.2 Analysis of Results from the Archiects

Table 4.10: Showing the results of Questionnaire alloted toArchitects

Fire disaster Preparedness measures	**No of Resp.**	**Mean**	**Std. Deviation**
You are familiar with fire prevention and control measures for commercial buildings	65	4.8662	0.36361
At the design stage, provisions are made for fire safety in your building elements	65	4.9231	0.26854
The perception of your client in providing fire safety and control measures at the design stage and practical execution of construction work is satisfactorily good	65	3.4615	1.40398

The current rate of use of fire safety and control measures for Commercial buildings in Imo State is satisfactory good	65	2.6769	1.21331
The rate of the building elements (doors and windows) are satisfactorily good	65	2.3846	0.74356
These building elements (block walls, concrete and wood) are fire proofed	65	2.0462	0.21145

Source: Field Survey, 2019.

From table 4.10, the SPSS results show that 84.6% of the respondents strongly agreed that they were quite familiar with fire prevention and control measures for commercial buildings; while 92.3% strongly agreed that clients do make provisions for fire safety during the design stage. 46.2% disagreed that the perception of the client in making provisions for fire safety measures was satisfactorily good. 69.2% totally agreed that the rate of use of fire safety and control measures for commercial buidings was not satisfactorily good. 76.9% and 95.4% agreed that the building elements (doors and windows) were not satisfactoriy good and fire proofed. Therefore, there should be strict adherence to design standards and the provisions of Fire Safety Acts of 2003 as provided by Federal Government.The respondents asserted further that, clients' or developers' apathy to financial demands and fire safety is a major challenge and most fire safety and control measures in commercial buildings in imo state is an after thought rather than a pro-active implementation style.

4.8.3 Analysis of the results of Questionnaire alloted to Builders

Table 4.11: Showing the results of Questionnaire alloted to Builders

Fire disaster Preparedness measures	**N**	**Mean**	**Std. Deviation**
You have participated in the design and construction of Commercial buildings	26	4.8077	0.40192
You are familiar with the fire safety measures for commercial buildings	26	4.6154	0.69725

You have witnessed case(s)of fire disaster in commercial building before	26	4.4231	0.90213
As a builder, you do acquint your client on the need to install fire safety measures in the building during construction so as to prevent fire outbreak	26	4.5000	0.50990
The perception of your client in providing fire safety and control measures during Electrical design and practical installation of electrical accessories is satisfactorily good	26	2.5385	0.98917
The rate of the building elements (doors and windows) are satisfactorily good	26	2.5769	1.13747
These building elements are fire proofed	26	3.0769	1.23038

Source: Field Survey, 2019.

From table 4.11,the SPSS result shows that 80.8% of the respondent had participated in the design and construction of commercial buildings before. 69.2% are quite familiar with fire safety measures, while 57.7% had witnessed cases of fire disaster in various commercial buildings. 50% of the respondents agreed and 50% strongly agreed that they do give professional advice to clients on the need for the installation of fire safety devices in their respective buildings. However, 73.1% and 76.9% disagreed that the clients' perceptions were satisfactorily good in the sense thatclients do see the aspect of fire safety device installation as NOT ALL THAT NECESSARY. 53.8% agreed that the building elemnets installed in these buildings were not fire proof. Therefore, there should be strict adherence to design standards and the provisions of Fire Safety Acts of 2003 as provided by Federal Government and the National Building Code of 2006 should be passed into law, enforced and fire safety devices should be made compulsory for all the commercial buildings.

4.8.4 Analysis of the results of Questionnaire alloted to Electrical Engineers.

Table 4.12: Showing the results of Questionnaire alloted to Electrical Engineers.

Fire disaster Preparedness measures	N	Mean	Std. Deviation
You are familiar with the fire safety measures for commercial buildings	45	4.8667	0.34378
You have participated in the Electrical design of Commercial buildings before	45	4.8889	0.48721
You have witnessed case(s) of fire disaster in commercial building before	45	4.5556	0.89330
The cause(s) of the fire outbreak could be traced to: i. faulty electrical appliances, ii. gas leakage	45	4.8889	0.31782
The perception of your client in providing fire safety and control measures during Electrical design and practical installation of electrical accessories is satisfactorily good	45	2.5556	1.01255
The rate of current use of fire safety and control measures by Commercial buildings owners in Imo is satisfactorily good	45	2.8000	0.99087

Source: Field Survey, 2019.

Table 4.12 showsthe SPSS results of the respondent.100% of the respondents were very familiar with fire safety measures, while 93.3% had participated in the design of commercial buildings. 75.6% disagreed that the perception of clinets in making provision for the installation of fire safety and control measures was satisfactorily good.73.3% of the respondents strongly agreed thatfaulty electrical appliances and gas leakage were the major causes of fire outbreak in the study area. Also, 11.1% agreed, while, 88.9% strongly agreed that provision of electrical accessories were satisfactorily good. 60% of the respondents disagreed that the current rate of use of fire safety and control measures were satisfactorily good. Therefore, there should be strict adherence to design standards and the provisions of Fire Safety Acts of 2003 as provided by Federal Government and the National Building Code of 2006 should be passed into law, enforced and fire safety devices should be made compulsory for all the commercial buildings. The respondents suggested that relevant authorities should ensure that installation of fire safety and control devices are incorporated in the design without which approval should not be given.

4.8.5 Analysis of the results of Questionnaire alloted to Mechanical Engineers.

Table 4.13Showing the results of Questionnaire alloted toMechanical

Fire disaster Preparedness measures	N	Mean	Std. Deviation
You are familiar with the fire safety and suppressive measures for commercial buildings	38	3.6316	1.05064
You do make provisions for fire safety in the design of Commercial buildings	38	3.0526	1.13774
The perception of your client in providing fire safety and control measures mechanical design and practical installation of the designed suppressive system is satisfactorily good	38	2.6579	1.14553
The rate of current use of fire safety and suppressive measures by Commercial buildings owners in Imo state is satisfactorily good	38	2.7632	1.10121

Engineers.

Source: Field Survey, 2019.

Table 4.13 showsthe SPSS results of the respondent.57.9% of the respondents were very familiar with fire safety measures 47.4% agreed that they do not make provisions for fire prevention and control in the design of commercial buildings. While 73.7% agreed that the perception of clients in the provision and installation of fire safety and control measures was never satisfied. 65.8% agreed that the rate of use of fire safety and control devices were not satisfactorily good. The respondents suggested that there should be an enforcement of relevant laws that can aid the design, construction and use of fire safety and control devices so as to eliminate the emergence of fire or reduce its impact if occurs.

4.8.6 Analysis of the results of Questionnaire alloted to Development Control Officers (Town/Urban and Regional Planning Authority)

Table 4.14: Showing the results of Questionnaire alloted toDevelopment Control Officers (Town/Urban and Regional Planning Authority)

Fire disaster Preparedness measures	N	Mean	Std. Deviation
You do consider Environmental impact assessment of these commercial buildings before given approval	22	4.1818	0.39477
As a Town Planning Officer, you do ensure the incorporation of fire safety measures in the design of commercial building working drawings	22	4.0909	0.29424
These commercial buildings do secure government approval/authorization before building construction takes place	22	4.8182	0.39477
These Commercial buildings are located according to Town/Urban and Regional planning procedures	22	1.7273	0.45584
The level of compliance of these commercial buildings with the provision of fire safety	22	2.7727	1.19251

acts and design codes or standards is satisfactory	

Source: Field Survey, 2019.

Table 4.14 showsthe SPSS results of the respondent. 81.8% that they do consider Environmental Impact Assessment of the commercial buildings before issuing approval. While 90.9% agreed that the design teams (in most cases) who design these buildings do incorporate fire safety and control of clients in the drawing. 81.8% agreed that the clients do secure Government approval. Meanwhile, 72.7% of the respondents disagreed that these commercial buildings were not located according to Town/Urban and Regional planning.The level of compliance of these commercial buildings were to low, therefore, each building should have minimum three types of fire safety devices installation because each fire has its own extinguishing chemical.

4.8.7 Analysis of the results of Questionnaire alloted to Fire Brigade Officer

Table 4.15: Showing the results of Questionnaire alloted to Fire Brigade Officer

Fire disaster Preparedness measures	N	Mean	Std. Deviation
There is regular inspection on commercial buildings on compliance with the provisions of fire safety acts and regulation in Imo State	34	1.8788	0.33143
You do issue fire safety certificate for these commercial buildings	34	1.9118	0.28790
Commercial buildings in Imo State have the necessary firefighting equipment	34	2.7353	1.10943
The level of available firefighting equipment in these commercial buildings is satisfactory	34	1.6176	0.49327
The owners/occupants of commercial buildings do undergo fire safety training regularly	34	1.8529	0.35949

The readiness and capability of your firefighting station to handle fire emergencies is satisfactorily good	34	2.6765	1.00666
Your emergency communication system (alarm, telephone, mobile no.) is satisfactorily good.	34	2.8824	1.17460

Source: Field Survey, 2019.

Table 4.15 showsthe SPSS results of the respondent. 88.2% agreed that there is no regular inspection on compliance of these commercial buildings with the provision of fire safety standard and codes in the study area. While 91.2% agreed that fire safety certificates are not being issued because the clients do not care to submit their designs for inspection. 50% agreed that these commercial buildings have no adequate and required firefighting equipment and 61.8% disagreed with availability of the required firefighting equipment and where available, they are not functional. 85.3% of the respondents agreed that the owners/ users of these commercial buildings don't go for training. However, 61.8% agreed that the level of readiness to combat fire is adequately low, this is due to the fact that there is no functional fire truck (see pg. 179-180), and the fire stations in the study area lacked personnel characterized by ineffective communication sysytem. The results show that the level of compliance of the commercial building owners with design standard and code was significantly low.
From table 4.9 to 4.15, the results show that the level of compliance of the commercial building owners with design standard and code was significantly low. And this provides answer to objective and research question five.

4.8.8.1 Physical Observations and checklist ratings on Availability of Firefighting Equipment in the Commecial Buildings

Table 4.16a: Results of the Physical Observations and checklist ratings on Availability of Firefighting Equipment installed and measures adopted in the Buildings by the owners.

Descriptive statistics

Items Observed	N	Mean	Std. Deviation
A. FIRE FIGHTING EQUIPMENT			
Dry chemical extinguishers	153	2.0000	.00000
Halon or vaporizing liquids extinguishers	153	1.0000	.00000
Foam cylinders	153	1.1242	.33087
Carbon dioxide extinguishers	153	1.0000	.00000
Sprinklers/ Hose reels (pressurized water extinguishers)	153	1.0719	.25916
Wet chemical	153	1.0392	.19475
Fire blankets	153	1.0000	.00000
Fire hydrant (Internal and External)	153	1.0131	.11396
Sand	153	1.8758	.33087
B. FIRE SAFETY MEASURES			
Emergency communication system (alarm, telephone, mobile no.)	153	1.7386	.44086
Existence of fire assembly point/emergency shelters for this building	153	1.0131	.11396
Existence of Emergency population warning methods	153	1.0588	.23607

Source: Field survey, 2019

Table 4.16a shows the mean and standard deviation of the physical/ walkthrough observation that were undertaken on each of the firefighting equipment installed in each of the commercial buildings. The intent of this exercise is to examine how far commercial building owners have incorporated of fire safety devices into their buildings.Again, it was intended to know how best fire safety is being prcaticed in the study area. The physical observation guide covers all the important aspects of fire safety practiceswhich aided in the development of the fire disaster preparedness model/ template for commercial buildings in Imo State. The SPSS results revealed that dry chemical extinguishers were available as attested to by 100% of the respondents. Also, 100% of the respondents attested that Halon or vaporizing liquids, carbon dioxide extinguishers and fire hydrants were not available. Again, 87.6% attested that foam cylinders, 92.8% attested that sprinklers/ hose reel and 96.1% attested that wet chemical, 98.7% revealed that fire hydrants (internal and external) were not available. Meanwhile, sand was readily available as attested to by 87.6% of the respondents. Again, on the measures adopted by the owners of these commercial buildings, 73.9% of the respondents attested that they have their mobile phones (if only there is n network issues) to call for rescue in case of fire emergence. The results clearly indicated that the commercial building owners were not adequately prepared to fight fire emergence. The study therefore concluded that the firefighting equipment installed in the commercial buildings were not adequate to suppress the emergence of fire outbreak,so, the level of fire disaster preparedness of the commercial building owners were apparently poor. The template should be adopted by the clients, consultants, design and construction teams,Town Planning Development Authorities and Staff of Fire Service Stations in the Local Council Areas.

4.8.8.2 Physical Observations and checklist ratings on Functionability of Firefighting Equipment in the Commecial Buildings

Table 4.16b: Results of the Physical Observations and check listratings on Functionability of Firefighting Equipment installed and measures adopted in the Buildings by the owners.

Descriptive statistics

Items Observed	N	Mean	Std. Deviation
C. FIRE FIGHTING EQUIPMENT			
Dry chemical extinguishers	153	1.6667	.47295
Halon or vaporizing liquids extinguishers			
Foam cylinders	153	1.2105	.41885
Carbon dioxide extinguishers			
Sprinklers/ Hose reels (pressurized water extinguishers)	153	1.1818	.40452

Wet chemical	153	1.0392	.19475
Fire blankets	153	1.5000	.70711
Fire hydrant (Internal and External)	153	2.0000	.00000
Sand			
D. FIRE SAFETY MEASURES			
Emergency communication system (alarm, telephone, mobile no.)	113	2.0000	.00000
Existence of fire assembly point/emergency shelters for this building	113	2.0000	.00000
Existence of Emergency population warning methods	113	2.0000	.00000

Source: Field survey, 2019

From table 4.16b, the study revealed that most of the available equipment in the commercial buildings were not functional. 66.7% of the Dry Chemical Extinguisher were functional, Halon or vaporizing liquids extinguishers,Carbon dioxide extinguishersand fire blanket were not available in any of the buildings. 2.6% of the Foam Cylinder were functional, 1.3% of the available Sprinkler/Hose Reel, 3.9% of the Wet Chemical, 0.7% of the fire hydrants and 87.6 of sand being the most cheapest were functional. Again, the result in fig 4.14 shows that emergency communication system was the most functional among the measures suggested. 100% of the respondents agreed that they have functional mobile phones in case of fire emergence, but, the challenge is the functional mobile number of the authorities to call in case of eventuality. 1.8% fire assembly point and 8.0% Emergency population warning methods were functional. The study concluded that fire disaster preparedness level in the study area was not adequate.

4.9 Test of Hypotheses

i. Hypothesis 1

H_{O1}. The level of fire disaster preparednessof Commercial building owners in Imo State is not adequate.

H_{O2}. The level of compliance of commercial buildings in Imo State with the provision of fire safety acts, design standards and codes is not adequate.

Table 4.17: Showing T-test result on the level of fire disaster preparedness of Commercial building owners

S/N	N	$\bar{X}$	SD	Df	t.cal	t.crit	Decision	Significance
1.	462	3.07	0.45	461	2.15	1.960	Reject H_0	Significant
2.	462	3.71	1.03	461	1.09	1.960	Accept H_0	Significant
3.	462	4.18	0.45	461	2.89	1.960	Reject H_0	Significant
4.	462	3.54	0.63	461	1.01	1.960	Accept H_0	Not Significant
5.	462	3.68	0.81	461	2.19	1.960	Reject H_0	Significant
6.	462	4.03	0.66	461	0.18	1.960	Accept H_0	Not Significant
7.	462	4.06	0.54	461	2.49	1.960	Reject H_0	Significant
8.	462	3.30	0.77	461	1.08	1.960	Accept H_0	Not Significant
9.	462	4.12	0.45	461	0.78	1.960	Accept H_0	Not Significant
					1.54	**1.960**	**Accept H_1**	**Not Significant**

Source: Field survey, 2019

The results in Table 4.17 showed that the T-test value of 1.54 is less than the t-critical value of 1.960; the null hypothesis was accepted and concluded that the level of fire disaster preparedness of Commercial building owners in Imo State was not adequate.

ii. **Hypothesis II**

The level of compliance of commercial buildings in Imo State with the provision of Fire Safety Acts, Design Standards and Codes is not adequate.

Table 4.18: Showing Anova of Varianceresult on the level of compliance of commercial buildings in Imo State with the provision of Fire Safety Acts, Design Standards and Codes

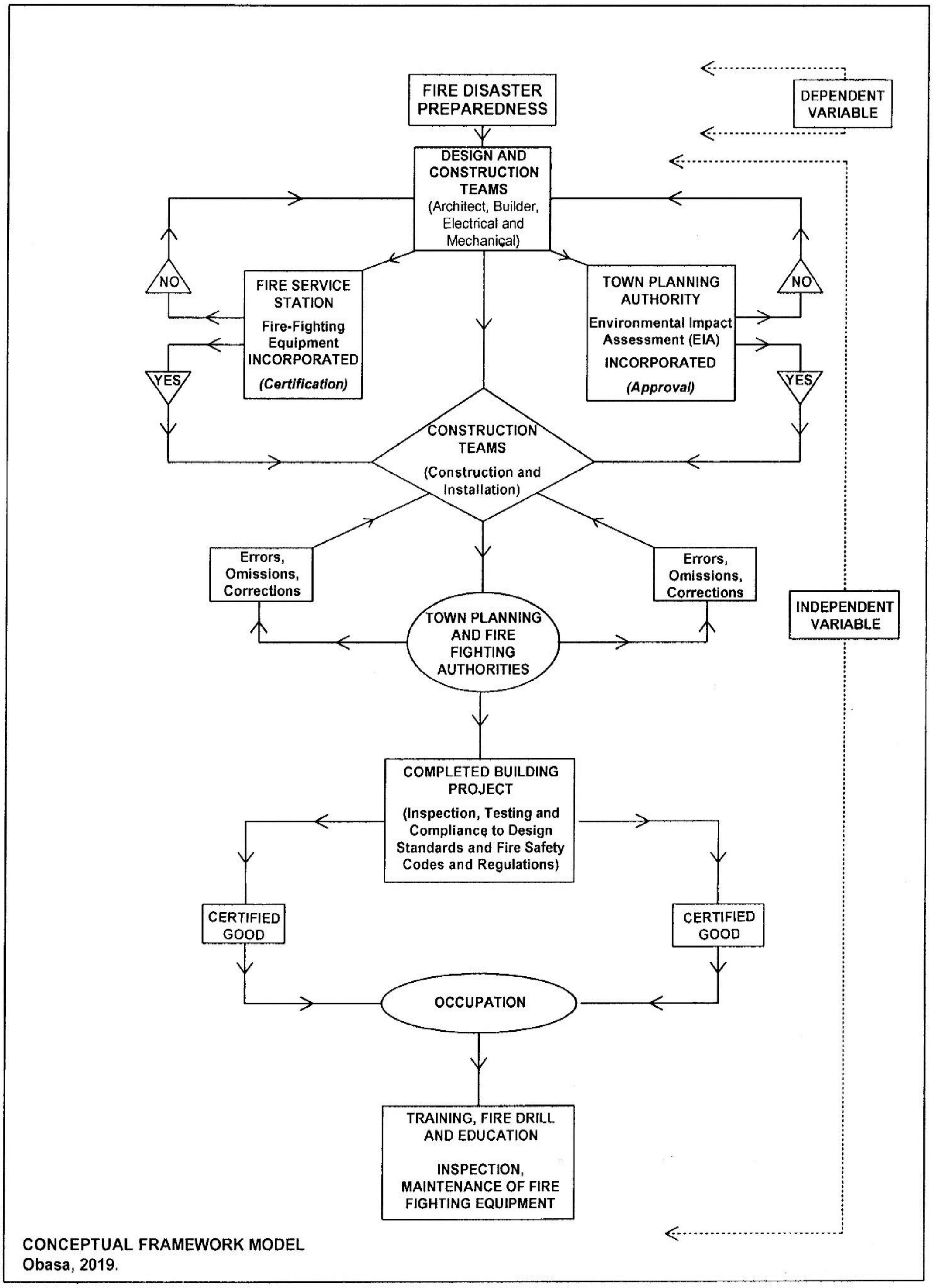
ANOVA

VAR00001

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.501	4	.625	1.452	.126
Within Groups	990.983	2305	.430		
Total	993.484	2309			

The p-value (0.126) of the ANOVA test is greater than the level of significance (0.05), the null hypothesis was accepted, which implied that the level of compliance of commercial buildings in Imo State with the provision of fire safety acts, design standards and codes was not adequate.

4.10 Developed Conceptual Framewok Modelfor Fire Disaster Preparedness for Commercial Buildings from Design, Costruction to Post Construction



CONCEPTUAL FRAMEWORK MODEL
Obasa, 2019.

Theobjectoffire disasterpreparedness fromtheconceptual framework model is to reduce or eliminatethe likelihoodofoutbreaks offire in Commercial buildings in the study area. Again, the model provides waystoavertthelikely effects of fire disaster or damage to buildingstructuresthrough properplanningsothatany impactfromafuture fire disasterwillbe ameliorated, oreliminated,ifpossible. The model, if adequately followed, will enhance occupants protection from the adverse effects of fire and losses.

From the model, fire disaster preparedness isidentifiedasthedependentvariablewhich is beinginfluenced by the key roles of the Fire service Personnel, Town Planning authorities and the Construction teams from the design to construction and to post construction stages.These various players will definitely influence the fireprotectionandpreventive measuresaswellaspreparedness measuresadoptedby commercial building owners.Similarly, changesinthe independent variables arelikelyto impact negatively on the levels offire disasterpreparednesso f any commercial building.

Once the building plans are submitted at the town Planning Office for registration and approval, the drawing mus be properly studied so as to ensure the inclusion of fir safety and control devices in the building. A copy of he rawing should be snt to fire service Station so as to ascertain compliance of the building drawings with fire safety codes and design statndards. Conversely, the construction teams are to ensure adequate and proper installation of firefighting equipment in the building right from the design concepts to construction of the physical building. Minimum of three different types of fire extinguishing devices should be installed in the building of which water sprinkler should be one. From studies, water sprinkler is the most effective amongst the firefighting equipment, so, the installation must be made compulsory in all the commercial buildings.

Firefighting servicesarerequired to train the oocupants, users and owners of these commercial buildings. The object is to train the users on howtoextinguishorcurtailfire outbreaks at inception.Firefighting personnel are to providefireapparatus,watersupply resourcessuchaswatermainsandfire hydrantsorthey mightuseAandBclassfoamdependingonwhatisfeedingthefire. Firepreventionisintendedtoreducesources ofignition.Firepreventionalsoincludes educationtoteachpeoplehowtoavoidcausingfires.Fire fighting personnel are toconductfire drillstoinformandprepareoccupants / usersonhowto reacttoabuildingfire. Buildings generally will requirepassivefireprotection andactivefireprotectionsystems (National Building Code table 2.1)tominimizedamage resulting fromafire.The most commonformofactivefireprotectioniswatersprinklers as mentioned earlier.Tomaximize passivefire protectionofbuildings,buildingmaterialsandfurnishingsshouldbetestedforfire-resistance,combustibility andflammability.

4.11 Developed Computerised Fire DisasterDigital Alarm through MobileApp.

Thesoftwareforimplementation oftheFrameworkischosentobeaMobileApp,to makeithandy,universalanduser-friendly.TheAppisdeignedtobeaonestopshop for fire-safetyreadinessfor allcommercialbuildingowners. TheAppisdevelopedwithJavaandXMLon AndroidStudio, targetingAndroid Phonessinceandroidphonesmakeupto 96%ofalltheSmartphonesinuse in Nigeria.

TheMobileAppincorporatesArtificialIntelligenceforevaluationoftheFramework andforgrading/advising oftheuseraftertheevaluation.It containsadvisory linkto firesafetytraining curriculum,the FireAuthorities InspectionChecklist, firesafety Act and Codesand method of examining the level of fire disaster preparedness of commercial building owners and compliance level of the commercial buildings with design standards. TheAppis so robust that FireAuthoritiescan useit during inspectiontoautomatetheirchecklist.Landlordcanalsouseitbeforeandaftertheir buildingtoensure fire disaster preventionandreadiness.

At thelandingpage, theApp have twooutstandingbuttons.Thefirstiscolouredwith fiery-redcoolerandmarked911. Thisbuttonisanemergencyalarmbuttonthat notifiesFire interventionpersonnelthatthereisafireoutbreak inso-soplace. It takesthe GPS Locationof the User,encodeit inaShortMessageService (SMS) and forwardittotheauthoritiesforquickrescue. The second buttonleadsdirectlytotheframeworkforevaluationandeducationofthe owner or user.

ThedesignoftheAppmaderoom forthe owner/ usertobeabletopurchasefiresafetyequipmentthroughthe App,as wellashirecertified and experiencedbuildingteam (Architect,Builder, Electrical and Mechanical Engineers).

See Appendix F for the Mobile App Interface.

4.11.1 Segments of the App Code

4.11.1 Just Another Virtual Accelerator (JAVA) Code

```
package com.example.fireintervention.ui.fireFramework;
 import android.app.AlertDialog;
 import android.content.DialogInterface;
 import android.graphics.Color;
 import android.os.Bundle;
 import android.view.LayoutInflater;
 import android.view.View;
 import android.view.ViewGroup;
 import
 android.widget.Button;
 import
 android.widget.CheckBox;
 import
 android.widget.TextView;
 import android.widget.Toast;
 import androidx.annotation.Nullable;
 import androidx.annotation.NonNull;
 import androidx.fragment.app.Fragment;
 import androidx.lifecycle.Observer;
 import androidx.lifecycle.ViewModelProviders;
 import com.example.fireintervention.R;
 public class SendFragment extends Fragment {
     CheckBox vs1, vs2, vs3, vs4, vs5, vs6, vs7, vs8, vs9, vs10, vs11,
     vs12; CheckBox s1, s2, s3, s4, s5, s6, s7, s8, s9, s10, s11, s12,
     s13, s14; CheckBox ns1, ns2, ns3, ns4, ns5, ns6, ns7, ns8, ns9,
     ns10, ns11, ns12
     CheckBox u1, u2, u3, u4, u5, u6, u7, u8, u9, u10, u11, u12, u13, u14;
     CheckBox vu1, vu2, vu3, vu4, vu5, vu6, vu7, vu8, vu9, vu10, vu11,
     vu12,
 vu13, vu14;
      private SendViewModel sendViewModel;
      public View onCreateView(@NonNull LayoutInflater inflater,
ViewGroup container, Bundle savedInstanceState) {sendViewModel =
ViewModelProviders.of(this).get(SendViewModel.class);
View root = inflater.inflate(R.layout.fragment_send,container,
false);u1 = (
CheckBox)root.findViewById(R.id.c1u); u13=
(CheckBox)root.findViewById(R.id.c14u); u14 =
(CheckBox)root.findViewById(R.id.c15u); vu1 =
(CheckBox)root.findViewById(R.id.c1vu); vu14 =
(CheckBox)root.findViewById(R.id.c15vu); s3 =
(CheckBox)root.findViewById(R.id.c3s);s4 =
(CheckBox)root.findViewById(R.id.c4s);
Button firebtn = (Button)root.findViewById(R.id.obtn);
         firebtn.setOnClickListener(new View.OnClickListener() {
             @Override
             public void onClick(View v) {double score=0.0;
```

```
if(vs1.isChecked()){
score = score + 5;
}
if(vs.isChecked()){
    score = score + 5;}
                if(s.isChecked()){
                    score = score + 4;
                }
                 if(ns.isChecked()){
                    score = score + 3;
                }
                if(u.isChecked()){
                    score = score + 2;
                }

                if(vu.isChecked()){
                    score = score + 1;
                }
double Grade;
                Grade = Math.round(100.0*score/65);

                String com = "";
                String comk = "";

                if(kk < 99){
                    if(kk > 50){
                        com="QUALIFIED!. " + Grade + "% means that
This House is safe but should make up the things lacking:";
                    }else{
                        com = "NOT QUALIFIED. " + Grade + "% means
Your House is not Safe. Please see Actions below: ";
                    }}else {
                    com="CERTIFIED! Kudos, Your House is " + Grade
                    +
"% Safe from Fire";
                }
              rep ="Your Score is " + Grade;
                final String[] items = {rep, comk, com};
                AlertDialog.Builder builder = new
AlertDialog.Builder(getContext());
                builder.setTitle("CHECKLIST RESULT")
                         .setItems(items,
                                new
DialogInterface.OnClickListener() {
                            public void onClick(DialogInterface
dialog, int which) {
                                Toast.makeText(getContext(),
             items[which] + " is clicked",
              Toast.LENGTH_LONG).show();
                            }
                        })
                        ;
```

```
                alertDialog.sho
                w(); Button
                button =
alertDialog.getButton(DialogInterface.BUTTON_NEGATI
                VE);
                button.setBackgroundColor(Color.BLA
                CK); button.setPadding(0, 0, 20,
                0);
                button.setTextColor(Color.WHITE);

            }
        });
        final TextView textView =
        root.findViewById(R.id.text_send);
        sendViewModel.getText().observe(this, new
        Observer<String>() {
            @Override
            public void onChanged(@Nullable String s) {
                textView.setText(s);
            }
        });
        return root;
    }
}
```

4.11.2 Extensible Markup Language (XML) Code

```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    android:layout_width="match_parent"
    android:layout_height="match_parent
    ">
    <ScrollView android:layout_width="fill_parent"
        android:layout_height="fill_parent"
        android:scrollbars="vertical"
        app:layout_constraintLeft_toLeftOf="parent"
        app:layout_constraintTop_toTopOf="parent"
        app:layout_constraintRight_toRightOf="parent"
        app:layout_constraintBottom_toBottomOf="parent
        ">

        <LinearLayout
            android:layout_width="fill_parent
            "
            android:layout_height="fill_paren
            t" android:layout_margin="20dp"
            android:orientation="vertical">
    <TextView
        android:layout_width="match_parent"
        android:id="@+id/t1"
        android:layout_height="wrap_conten
        t"
        android:text="Which Professional Team is involved in
your building design and construction? (Select all that apply)"
        android:layout_marginTop="20dp"
        />
    <CheckBox
        android:layout_width="wrap_content
        "
        android:layout_height="wrap_conten
        t" android:text="Architect"
        android:id="@+id/chkarchi"
        />
    <CheckBox
        android:layout_width="wrap_content
        "
        android:layout_height="wrap_conten
        t" android:text="Builder"
        android:id="@+id/chkbuild"
        />
    <CheckBox
    android:layout_width="wrap_content
    "
    android:layout_height="wrap_conten
    t" android:text="Electrical"
        android:id="@+id/chkelect"
    />
    <CheckBox
```

```
    android:text="Mechanical"
        android:id="@+id/chkme
        ch"
    />
    <TextView
        android:layout_width="match_parent"
        android:id="@+id/t2"
        android:layout_height="wrap_conte
        nt"
        android:text="Select the Fire Fighting Suite Available in
        your
house"
        android:layout_marginTop="20dp"
        />
    <CheckBox
        android:layout_width="wrap_conten
        t"
        android:layout_height="wrap_conte
        nt" android:text="Halon
        extinguishers"
        android:id="@+id/chk2h"
        /
        >
    <CheckBox
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="Dry chemical
    extinguishers" android:id="@+id/chk2d"
    /> <CheckBox
            android:layout_width="wrap_content"
            android:layout_height="wrap_conte
            nt" android:text="Foam cylinders"
            android:id="@+id/chk2f"
            /><CheckBox
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:text="Carbon dioxide
            extinguishers" android:id="@+id/chk2ca"
            /><CheckBox android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:text="Internal and external fire
            hydrants" android:id="@+id/chk2i"
            /><CheckBox
            android:layout_width="wrap_conten
            t"
            android:layout_height="wrap_conte
            nt" android:text="Sprinklers/Hose
            reels" android:id="@+id/chk2s"
            /><CheckBox
            android:layout_width="wrap_conten
            t"
            android:layout_height="wrap_conte
            nt" android:text="Fire blankets"
            android:id="@+id/chk2fb"
            /><CheckBox
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
```

```
            />
            <CheckBox
                android:layout_width="wrap_content"
                android:layout_height="wrap_content"
                android:text="Sand"
                android:id="@+id/chk2sa"
                />

 <CheckBox  android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:text="Coke and Sprite"
            android:id="@+id/chk2c"
            />
    <CheckBox
        android:layout_width="wrap_conten
        t"
        android:layout_height="wrap_conte
        nt" android:text="None"
        android:id="@+id/chk2n"
        />
    <TextV
      iew
        android:layout_width="match_paren
        t"
        android:layout_marginTop="20dp"
        android:id="@+id/t3"
        android:layout_height="wrap_conte
        nt"
        android:text="Have your building plan been inspected
and certified by the Town Planning Authority for
Environmental Impact Assessment?"
        />
    <Check
      Box
        android:layout_width="wrap_content"
        android:layout_height="wrap_conte
        nt" android:text="Yes"
        android:id="@+id/chk3y"
        />
    <Check
      Box
        android:layout_width="wrap_content"
        android:layout_height="wrap_conte
        nt" android:text="No"
        android:id="@+id/chk3n"
        />
    <TextV
      iew
        android:layout_width="match_parent"
        android:id="@+id/t4"
        android:layout_height="wrap_conte
        nt"
        android:text="Have your building been certified for
        occupation
by Fire Service/Brigade Authority?"
       android:layout_marginTop="20dp"
       />
```

```
        />
    <CheckBo
       x
        android:layout_width="wrap_content"
        android:layout_height="wrap_content
        " android:text="No"
        android:id="@+id/chk4n"
        android:layout_marginBottom="20dp"
        />
            <TextView android:layout_width="match_parent"
                android:id="@+id/t5"
                android:layout_height="wrap_content"
                android:text="Have your building occupants
                been
trained on Fire Safety, Control Measures and Emergency Evacuation
Procedure?"
                android:layout_marginTop="20dp" />
            <CheckBox
                android:layout_width="wrap_content"
                android:layout_height="wrap_content
                " android:text="Yes"
                android:id="@+id/chk5y"
                />
            <CheckBo
               x
                android:layout_width="wrap_content"
                android:layout_height="wrap_content
                " android:text="No"
                android:id="@+id/chk5n"
                android:layout_marginBottom="20dp"
                /> <Button
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:id="@+id/hbtni"
        android:layout_marginBottom="10dp"
        app:layout_constraintBottom_toBottomOf="parent
        " android:text=" RUN FRAMEWORK "
        android:background="@color/colorpnk"
        android:layout_gravity="center"
        />
    </LinearLayout>
    </ScrollView>

</androidx.constraintlayout.widget.ConstraintLayout
                         >
```

4.12 Developed Computerised Fire DisasterDigital Alarm through MobileApp Interface

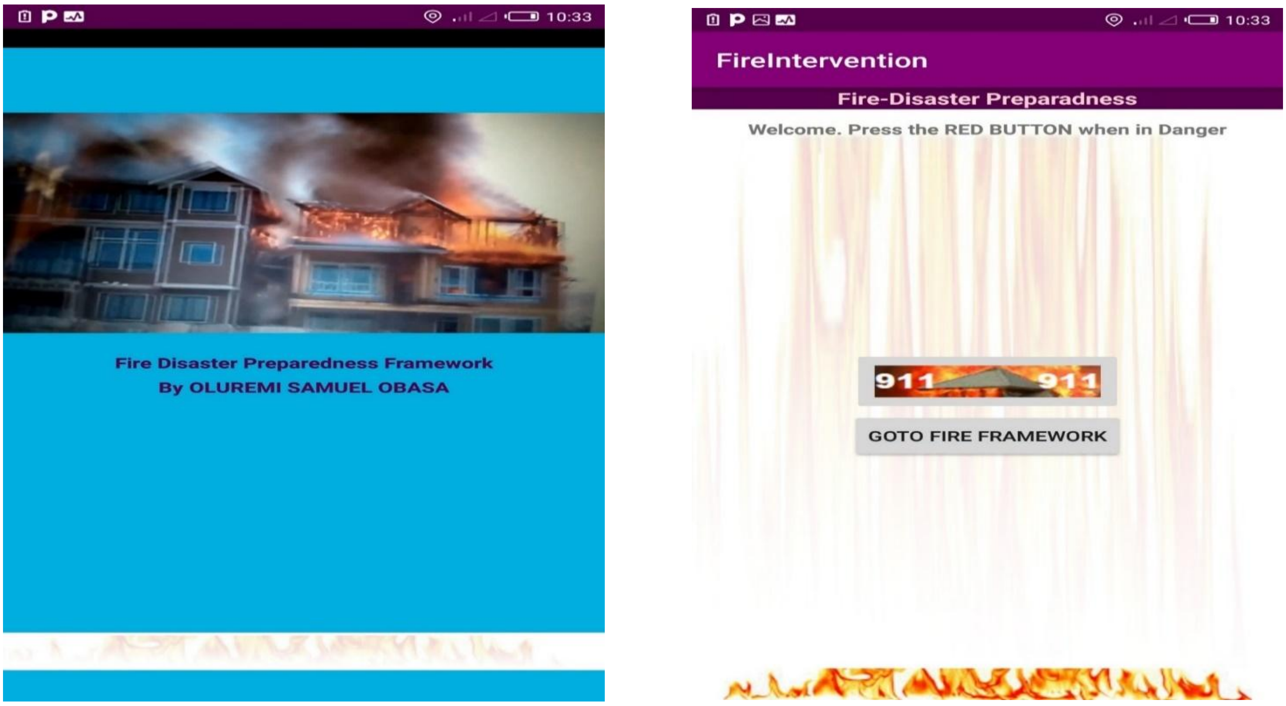


Fig. 4.2 showing Home Pages of the Mobile App
Source: Obasa 2019.

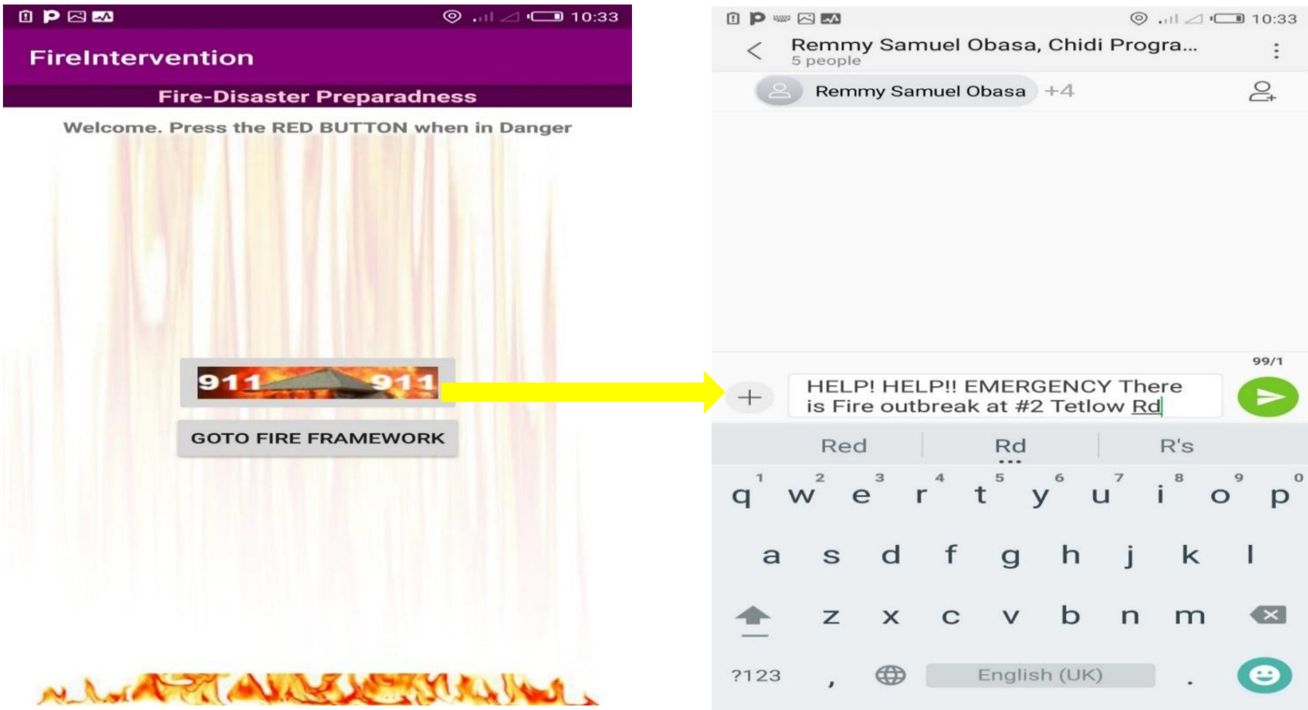


Fig. 4.3 showingText Message Platform of the Mobile App
Source: Obasa 2019.

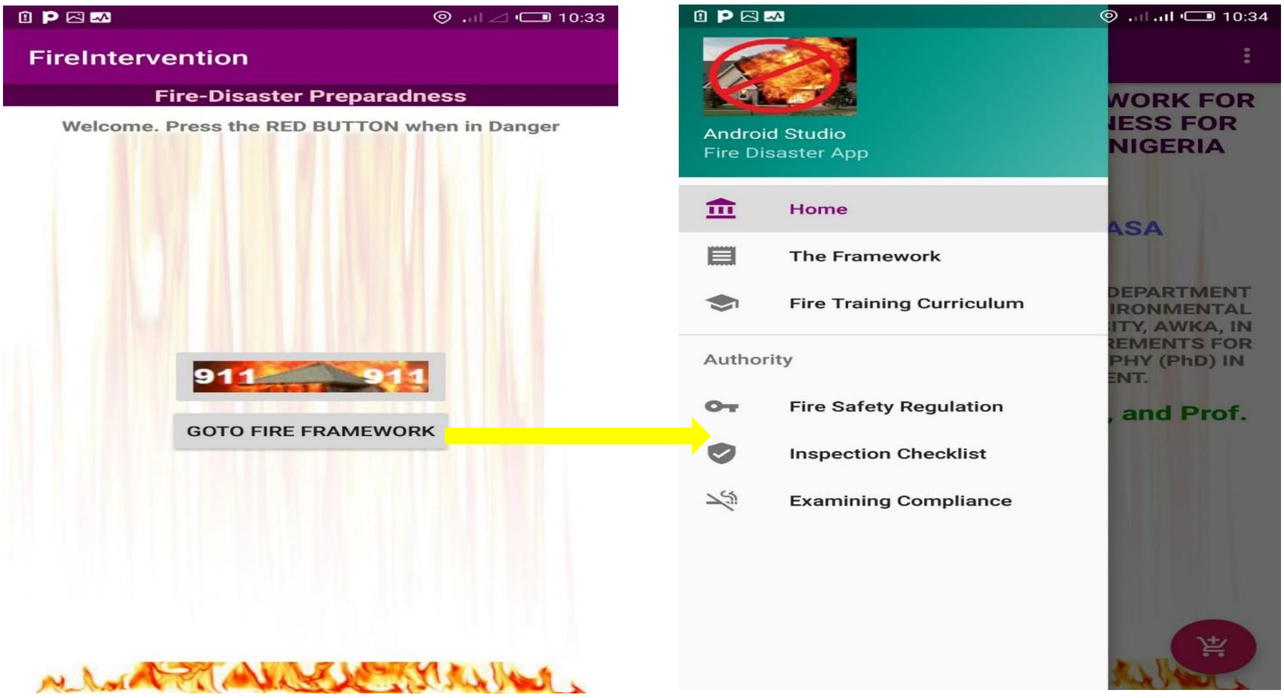


Fig. 4.4 showingText Message Platform and Curriculm contents of the Mobile App
Source: Obasa 2019.

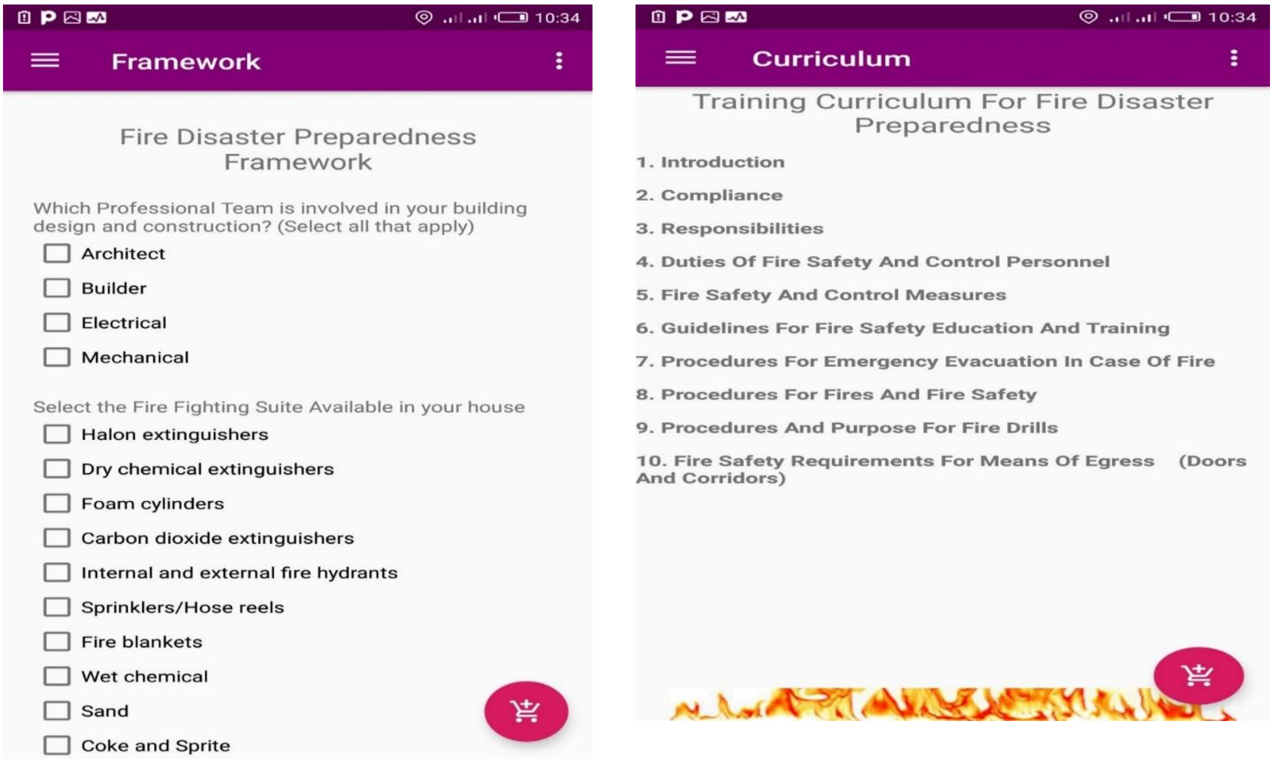


Fig. 4.5 Showing framework and Curriculum contents platform of the Mobile App
Source: Obasa 2019.

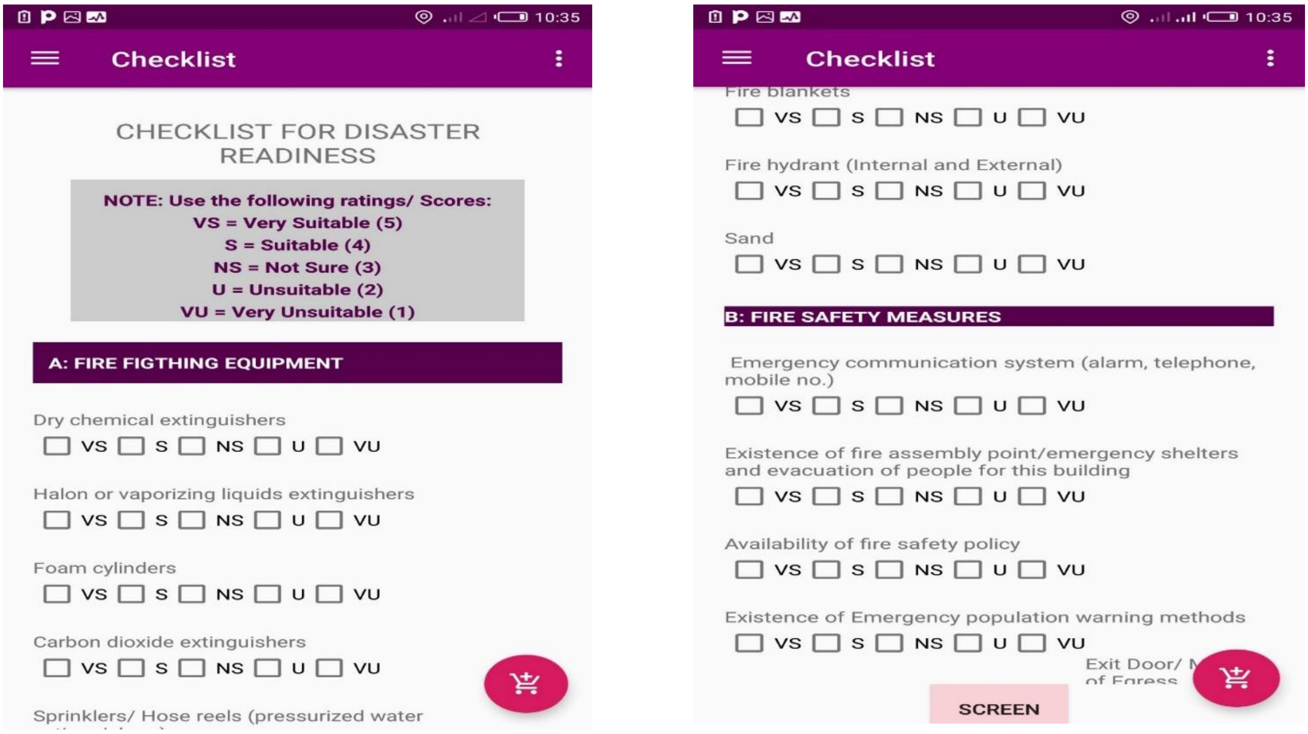


Fig. 4.6 Showing Checklist contents of the Mobile App
Source: Obasa 2019.

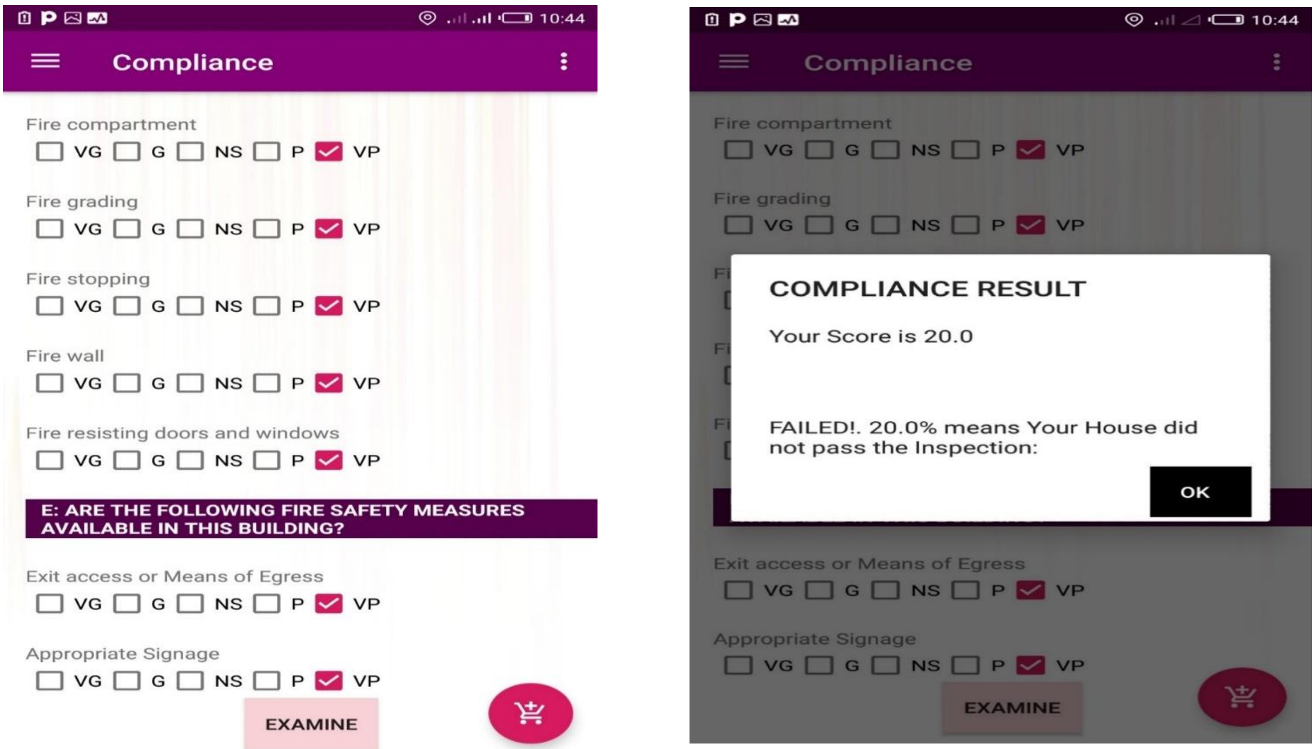


Fig. 4.7 Showing Compliance and result platform after examination.
Source: Obasa 2019.

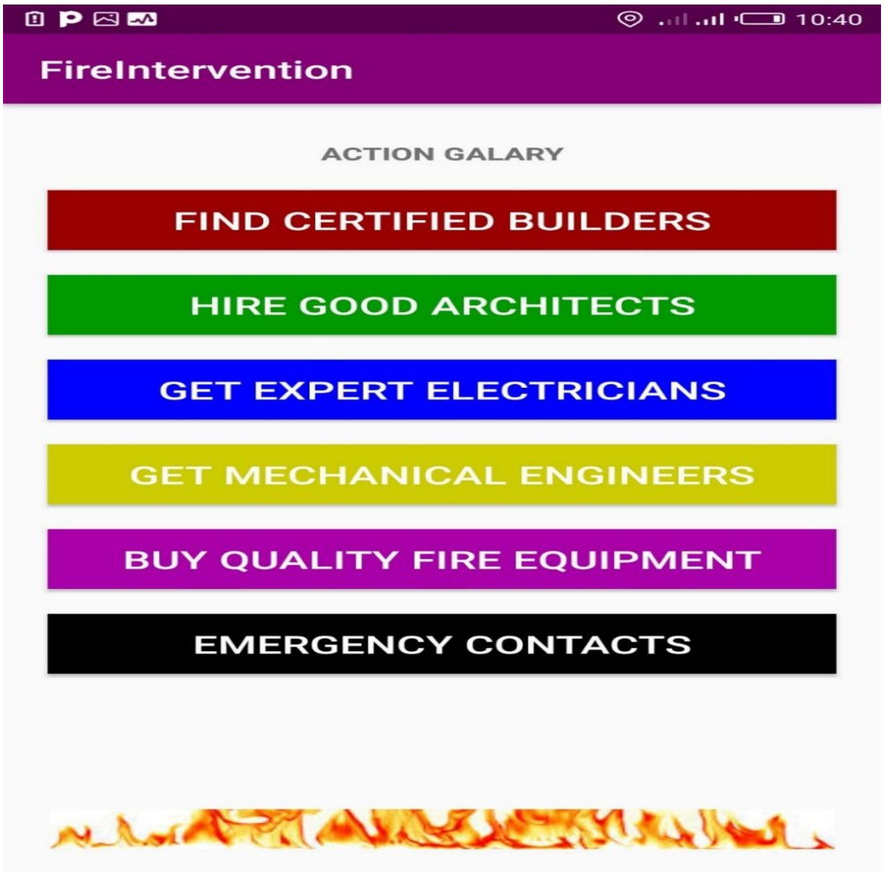


Fig. 4.8 Showing Fire Intervention and Market place for Fire Safety Equipment and various Construction Teams.
Source: Obasa 2019.

4.13 DevelopedFramework for Fire Disaster Preparedness for Commercial Buildings.

4.13.1 Introduction

The object of fire disaster preparedness frameworkistolargely increasefiresafetyawareness,lessentherisk andnumberoffire hazards,reducelossoflife,injuryanddamage of propertythrough education,trainingand inspectionaswellaspolicy implementationandstandarddevelopment. Thepotentialfor lossoflifeor injuryfromafire-relatedincidentisoneofthe mostseriousriskscommercial buildings face. Therefore, commercial buildingsmusthaveacomprehensivefiresafety framework. This will entail a great level of commitmentfrom all stakeholders through comprehensive planning, processes and procedures, policy implementation,supervision andmaintenanceofall essentialequipment that will foster asuccessfulfiresafety program.

4.13.2 Compliance

Owingtothedangerofloss of life, property and injuries sustainedfromfireemergencies,commercial building owners,occupants/ users, government agencies mustcomplywiththis fire disaster preparedness framework.The responsibilitiesforcommercial buildingsfire safety, control and preventionrest onall levelsof thestakeholders.

4.13.3 Responsibilities of Key Stakeholders

a. **The Government**: Asthe ChiefExecutive,hasultimateresponsibilityforestablishingandmaintaining firesafety laws and programsforcommercial buildings, andprovides continuing supportforthe Fire Safety Program.

b. **Fire Brigade Officers (FBO):** Theyshall be responsibleforenforcingfire safetyprogramsinareasundertheir control,andprovidingassistancetogovernmentinconducting safety inspections, maintenance of firefighting equipment,violation correction,andimplementation offirepreventionandevacuationpoliciesaswellasencourage andrequire commercial building ownerstoparticipateinfire safetytrainingsandawarenessprograms.

c. **Commercial Building Owners:** must brief occupants/ users on the specific hazards of their workarea, on fire reportingandevacuationplans,andfireextinguisherlocations.Theywillberequiredtoparticipateinfiredrillssothattheybecomefamiliar with the locations of exit routes and know how to operate firefighting equipment.

d. **Occupants/ Users:** all occupants/ users,must be taken through fire safety programsprovidedbyFBO. Occupants/ Users shouldfamiliarizethemselveswiththefiresafetyguidelines, firepreventiontechniquesintheworkplaceaswellaswhattodoincasethere isa fire emergency, comply withfire safetypoliciesand guidelines, report anyunsafecondition, andfire hazardsto firefighting personnelandreceive trainingasrequired.

4.13.3.1 Duties of Fire Safety and Control Personnel

These shall include:

i. Providesa fire-safe environmentforoccupants and users of commercial buildings
ii. Respondsto fire incidentsanddoesthe follow-up.
iii. Actsasliaison officertolocal andstate regulatoryagencies in matters that arerelatedto fire andlife safety.
iv. Issue fire safety/ development permit certificate to commercial building operators in compliance with section 137 sub-section 1-7 of the Federal Republic of Nigeria National Fire Safety Code of 2013.
v. Supervise the practical execution of the construction and installation of fire detection, suppressionandalarm systems and ensure standards.
vi. Developsfire safety programandpolicy.
vii. Providesfire safety drills, educationandtraining.
viii. Reviewplans, processes and policies.

4.13.4 FIRESAFETY AND CONTROLMEASURES

a ProgramStrategies

Thestrategiestofollowshallinclude the following:

i. Implementaprogramthattargetspreparedness planning,preventionandemergencyevacuation.
ii. Appropriatehandlingof combustible andflammable materials.
iii. Organize fire drill, training and education at regular intervals
iv. Devicesafeworking environmentpractice thatreducesthe riskof fire danger.
v. Install a good and reliablefire protectionsystemandmaintenance procedures.
vi. Disseminate fire safety information througheducation,training and other means of awarenessprogram.

b Fire Safety and PreventionPlan:

Thepurposeoffiresafety and preventionplanshall betoeliminate or reducethecausesoffireandpreventlossoflifeandpropertyby fire. Theplanprovidescommercial building owners, occupants/ userswithinformationandguidelineswhichwillassist inrecognizing, reportingandcontrollingaswellaseliminatingthe causesof firesandfire hazards. The programelements shallinclude:

i. Theproperhandling and storage of combustible and flammablematerials.
ii. Use of substandard electrical materials, faulty appliances, overloadingelectricaloutletsandextensioncords,misuseofheatproducing appliancesincludingspaceheaters,unsupervised cooking
iii. Improper disposalofsmoking materials.
iv. Gas leakages and storage of combustible materials

c. Fire PreventionMeasures to be engaged

i. Displayacopyofthe"FireandEmergencyProcedures" inaconspicuous location.
ii. Have an understanding and knowledge of the contents of the "Fire and

Emergency Procedures."

iii. Regularlyobserveemergencyevacuationroutes,fireextinguishers,andemergencyandexit lights. Immediatelyreportanymissingequipmentoranyotherproblemsdiscoveredto fire safety personnel.

iv. Encourage occupantsto activelyparticipateinfire drills.

v. Regularlyobserve the lobby, corridors, stairways, and keepthem clearof obstructions.

vi. Frequentlyobserve allexits routesto keepthemclear and safeof obstructionsatalltimes.

vii. Reportanytamperingwiththefirealarm,smokedetectionandsuppressionsystemsto Fire Safety Officers.

viii. Regularlyobservefiredoorstomakecertaintheyareclosedatalltimes.

ix. Inspectofficesinsearch of:

    i.Overloadedcircuits ordamagedelectricalcords

    ii.Improperlyusedextensioncords and appliances

x. Enforce the "No SmokingPolicy"inwithin the premises.

xi. EnforceallFiresafetyregulations. Contact Fire Brigade Office in case of any ambiguity.

d Electrical Wiring and Appliances

i. Fire safety personnelshouldperiodicallyinspectallelectricalequipmentandcordstoensureproper useandsafeconditions.Improperuseofelectricaldevicestoobtainmoreoutletcapacity canresultinoverloaded circuitsandfire.

ii. Theuseofextensioncordsshouldbeminimalandusedonlywhenaflexible,temporary connection isnecessary.

iii. Extensioncordsare not permittedtobeusedaspermanentwiringatanytime.However,surge protectorsarepermitted.

iv. Besureallelectricalequipmentisproperlygrounded.Ifanyevidenceisfoundoffrayed, crackedordamagedwiringorelectricaloutlets,theequipmentaffectedshouldbetaken out of service until repairsare made.

4.13.5 GUIDELINESFOR FIRESAFETYEDUCATION AND TRAINING

TheFire Brigade Office Departmenthas the responsibility ofaddressing allthe commercial building operators. This could be achievedthroughaneducationalprocessoftraining andother service-orientedprograms. Atthecore oftheprogramistheeducationandknowledgewith the object orkeyto save lives, testandtrainoccupantsinfiresafetyawareness,andbringahigherlevelofunderstandingofwhat isinvolvedinordertopreventandmoreimportantlysurviveafire. Inessence,thegoalisto provideknowledgesoastounderstandtheoriginoffires,sourcesoffires,howtopreventfires fromoccurringandfinallywhatto do ifone isfacedwith fire. Thefiresafetytrainingshall be organized insuchawayastomeetthe specificneedsofgroupsofpeople basedonthe kindof fire hazardsto which theyare exposed.

a. FireSafetyTrainingforOccupants/ Users

Occupants/ Users are to betrained periodicallyabout thefireprevention planandemergencyevacuationproceduresoftheirworkplace,understandthethreat andpoweroffire,andlearnwhattodoincaseoffire.Thisincludesbeing familiarwithbasicfire protection systemsincludingthebasicsoffireextinguishersandhowtousethem.

b. Fire Fighting Equipment Training

Section 44 of the Federal Republic of Nigeriastipulates thatwhereanemployerhasprovidedfirefighting equipmentfor occupants/ users intheworkplace, theemployershall provide an education/ trainingprogram tofamiliarize employeeswiththegeneralprinciplesof the firefighting equipment use andthe hazards. Theemployershallprovidetherequirededucationupon initialemploymentandatleastannually thereafter. The trainingprogram shall provideextensive informationonthe classification offires, the type fire extinguisher meant for each class of fire, how to operate, andthe hazards involvedin fighting anincipient stagefire.

4.13.6 PROCEDURES FOR EMERGENCYEVACUATION IN CASE OF FIRE

The purpose ofthisprocedures isto establish minimumrequirementsthat willprovideareasonable degreeoflife safetyfromfireandsimilaremergenciesinthebuildings. TheEmergencyEvacuationProcedureswillbeutilizedto evacuatealloccupantsduringafire emergency. Failuretoleavethebuildingwhena fireevacuation alarmsounds shall amount to a violationof law.

a. GeneralInformation EmergencyEvacuation

1. *Whatconditionsmay warrantevacuationofa building?*

   i. Fire,
   ii. Electricalfailure.

2. *Whatshould I knowabout the building evacuationplan?*

   i. Know the evacuationplanof the buildingand where to findit. (FireSafety Officer).
   ii. Know the locationof allexit routes and fire assembly pointsforthe building.
   iii. Know the locationsof emergencyequipment(i.e.,fire extinguishers, pull stations, emergencytelephones).

iv. Assistandparticipate infire drills.

3. *Whatshould Ido whenIhearafire alarm, orgetanordertoevacuate without an activated alarm?*

i. Turn off allhazardous materialsorproceduresbefore evacuating.If possible, take or secure all valuables**as quickly aspossible.**

ii. Close all doorsbehind you asyou exit.

iii. Check all doorsforheatbefore youopenor go through themto avoid walkinginto a fire.

iv. Evacuatethe building usingthe nearestexitorstairway. **Do not useelevators.**

v. Call fire service station (if telephone number is available) froma safe area andprovide name, location, and nature of emergency.

vi. Proceed to pre-determinedassemblyarea of buildingand **remain there** until you are toldto re-enter bythe fire safetypersonnel in charge.

vii. Donotobstruct accessof emergencypersonnel tothe area.

viii. Inform FireSafetyPersonnelof the fire event,conditionsand locationofindividualswho require assistance andhave not been evacuated.

4. *Whatshould Idotoinitiate afire alarm toevacuate a building?*

i. Activate fire alarm pullstationlocated atvarious placesalong exitroutes**.**

b. IndividualsRequiring Assistance

Whatshould I knowasanindividual requiring assistance during a building evacuation?

i. Study the locationsof exit routes, corridors, exitstairwaysand designatedareasofrefuge.

ii. Plan anescape route.

iii. Tella co-workerorinstructorhowto assist you incase of emergency.

iv. Wait nearthe closeststairway, entrance ordesignatedarea of refuge and waitfor assistance fromothers. Do not useelevators (where exist)

v. Know the needsand capabilitiesof people requiringassistance who are routinelyin your workarea.

vi. Ask how you canhelpanyone requiringassistancebefore givingit.

vii. Offerassistance verballyand guide to those that are blind or visually impairedto the nearestexit.

viii. Gettheattention of individuals who aredeaf or hard of hearing and conveyinformation byusinghand gesturesor writing what ishappeningand where to go.Guide themto the nearestexit.

ix. Individuals who maynot beableto respond to anemergency should becalmlyadvised and guided totheexit.

x. *Individuals who areimmobilized or havea mobilitydisability:* Should be givenassistance basedsolelyupontheirabilitytomaneuver through doorwaysandup/downstairstoreducetherisk of personal injury by Trained Fire Rescuepersonnel.

c. *Whatshould Idotoassistindividuals whocannotmaneuverup/down stairs?*

a. GUIDETHE INDIVIDUAL quicklyto reasonable safety, to a stairway entrance,outof way fromthe streamof trafficordesignatedarea of refuge.

b. ACCOMPANYANYACTIONbya verbal explanationso thatthe person being assisted understandswhat ishappeningand whythese actionsare beingtaken.

c. CONTACTFIRE SERVICE BRIGADE STATIONimmediately if a telephoneisavailable, andprovide the following:

i. Theindividual'sname andlocation withinthe building.

ii. The phone numberfromwhich thecallisbeingmade.

4.13.7 PROCEDURES FOR FIRESAND FIRESAFETY

a *Whatshould IdoifIdiscoverafire?*

i. ACTIVATE THE FIRE ALARMSYSTEM bypullingone of the nearest pull stationsthatare locatedalongthe exitroutes, **ifthe alarm isnotalready sounding**.
ii. FOLLOW YOUREVACUATION ROUTEandevacuatethe building through the nearestexit **ifthe alarm is sounding.DO NOT USE ELEVATORS.**
iii. PROCEED to the pre-determinedoutdoorassemblyarea forthe building.
iv. CALLto reportthe fire, after youevacuate the building.
v. REMAIN OUTSIDE attheassemblyarea until you arebeingtoldto re-enterthebuilding bythe emergencypersonnel incharge.

b. *WhatdoIneed to knowaboutportable fire extinguishers?*

i. Portable fire extinguishersare installedthroughoutthebuildings.
ii. Familiarize yourself withthe locationsof the fire extinguishersandreceive hands-on training.
iii. Fire extinguisherscanonly be usedforsmall firesthatcan be easilycontained.
iv. Multi-purpose ABC fire extinguishersareusedto fightClass“A”,“B”and“C”fires.

c. *HowdoIpreventfiresfrom occurring?*

Checkforthe followingfire hazardsatall timesandreportto Fire Safety Personnel:

i. Improperdisposal of smokingmaterials.
ii. Exitsnot clearlymarkedormeansof egressblockedby storage.
iii. Trash andother combustibleshave not beendisposedof regularlyorImproper storage of flammable andcombustible liquids.
iv. Electrical hazards, such asoverloadedoutlets, unapproved typesof extensioncords, exposedwiresandpowercordsthat are inpoorcondition.

v. Useof openflames/ candles.

4.13.8 PROCEDURES AND PURPOSE FOR FIREDRILLS

Fire Service Personnel or itsrepresentative shall conductfiredrills inall the commercialbuildingsas requiredbyStatelaw. Theprimaryaim offire drillistogeteveryoneoutofthe buildingasquicklyaspossible.Atrainedpeoplewillact morecalmlyunderemergency situations,thereby dispelling panic.

a. PurposeofFireDrills:

i. Toallowoccupantstofamiliarizethemselveswithdrill procedures,locationoffireexits, andthe soundof the fire alarm.

ii. To allowfire safety officer tomonitorthe suitabilityand effectivenessof evacuations. To detecttechnical problemswith the fire alarmequipment.

iii. To checkif fire protectionequipment, such asfire doorsare being usedproperly.

iv. To gauge howlongittakesto evacuate each building, and which exitsare generallyused.

b. FireDrillProcedures

Firedrillsarearrangedandsupervisedbythe FireSafetyOfficer,orrepresentative.

a. The date andtime will be scheduled whenmostoccupantsarein the building.

b. The Commercial Building Fire SafetyOfficer, orrepresentative, will inform Fire Brigade Office of the exacttimes forthe drill.

c. TheCommercial Building Fire SafetyOfficer, orrepresentative, will activate the fire alarm.

4.13.9 FIRESAFETYREQUIREMENTSFOR MEANSOF EGRESS (DOORS andCORRIDORS)

Ameansofegressisanexitpaththat occupantsmayusetosafelyexit abuilding.Itshall bedesignedto providesafeandeasytravelduringafireemergency sothattheriskofinjuryordeathis minimized.Mostbuildings mayhavemorethanone meansofegress,thoughthe exactnumberofexits dependsonthebuilding'sfunction,design,andoccupancyload. Once inplace,exitpathsshallbe carefullymaintainedtoensuretheyarenotblockedduringnormalbuilding operation.

Ameansofegressisacontinuousandunobstructedwayofexittravelfromanypointinabuildi ng or structuretoapublicway,whichallowsoccupantstopromptly exitabuilding or structure in the eventof fire occurrence.

All commercial building ownershavearesponsibility toprovideasafeenvironmenttoanyoneworking,learningorattendingeventswithinabuildin g.It isthereforeessentialthatthere isaccessforquick evacuation during anemergency andthe following guidelinesshall be sternlyobserved.

a BasicRequirementsfor MeansofEgress

i. Forany commercial buildingwith onlyone exita maximumoccupantload shouldnotexceed50 people.
ii. Forany commercial buildingwith onlytwo exits, themaximumoccupantload should notexceed 500 people.
iii. For commercial building with more than50 occupants, doorsmustswinginthe directionof egress.
iv. For commercial buildingmore than100occupants, doorsshouldbe equippedwith panichardware.
v. Exitdoorsshouldleadtoa corridor,anexitstairenclosure, ordirectlyto theexteriorof a building. Exitsshould notpassthrough adjacentroomsorthrough hazardousareassuch as kitchens,storage rooms, loadingdocksetc.
vi. Doorsactasa barrierforfire and smoke andto serve ascomponentsina meansof egress.
vii. Theself-closingdevicesshall not be disconnectedorrenderedinoperable.

viii. Fireandsmokerateddoorsshallnotbeblocked.Obstructionsthatwillprohibitfire and smokerateddoorsfrom closing andlatching withouthuman intervention shallnot be permitted.

ix. Exitdoorsmust not be equippedwith lockinghardware that wouldallowanoccupantto be lockedinside the roomorspace.

x. Exitdoorsshouldalso notbe equippedwith secondarylockingdevices,suchasa dead bolt orslide boltetc. It shouldbe possible toopenanydesignatedexitdoorusinga single motion, withoutthe use of key, tool orspecial knowledge.

xi. Themeansof egress includingthe exitdischargeshall be illuminatedatalltimesthe buildingisoccupied.

xii. Where requiredexitandexitaccessdoorsshall be marked byanapprovedexitsignreadily visible fromanydirectionof egress.

b Corridors/Hallways/Passageways/Ramps/Stairways

Corridors, hallways,passageways, rampsand stairwaysaredesignedandconstructed to allow peopletoexitthebuilding by the safestandquickest methodpossibledevoidofany obstructionsor protrusions.

c Basic Requirement

i. **MinimumWidths:** (whichincrease accordingto thenumberof people)range from, 600mmbetweendesks, to 1.20mforcorridorsdependingonthe occupancytype.

ii. Furniture, artwork, wall hangings, statuesetc., which protrude from wallsmay notobstruct the minimumwidth, norpresenta tripping, injuryorothersafetyhazard.

iii. Minimumaisle widthsmust be maintainedatall times.

d ObstructionsandProtrusions

i. No corridor, aisle wayorcomponentof ameansofegress may be obstructed.

ii. Non-combustible furniture inlobbiesmust notobstructthe minimumwidth of egressand must be arranged so there isa directpath throughthe lobbyto the EXIT.

iii. Minimumceilingheightinexitpassagewaysshall be 2.25m Lights, decorations,signsoranyother itemshungfromthe ceilingmay not be lowerthan2.00m.

iv. Wiresorcableshungfromtheceilingmust notpresenta safety hazard suchas snagging equipment beingtransportedthrough thecorridor.

e. The following itemsshallNot bePermittedinCorridors/Hallways

i. Anycombustible Flammable storagecabinetsof anysize.

ii. Carts, cabinets,shelvesorotheritemson which combustiblesor flammablesare likelytobe stored.

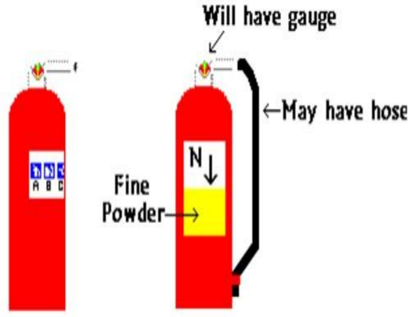
iii. Chemicals oranyotherhazardousmaterial.

iv Anyitemthatwill impedethe normal oremergencyflowof trafficor willobstructany emergencydevice.

v. Unprotectedhigh voltage,electrical or gaspoweredequipment of any sort, materialand overstuffed furniture boxes, etc.

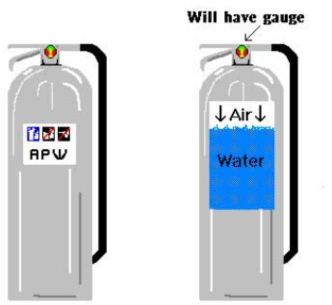
4.13.10 TYPESOFFIREEXTINGUISHERS

Differenttypesoffireextinguishersaredesignedtofightdifferentclassesoffire. Theextinguisher must be appropriate forthe type of fire beingfought.

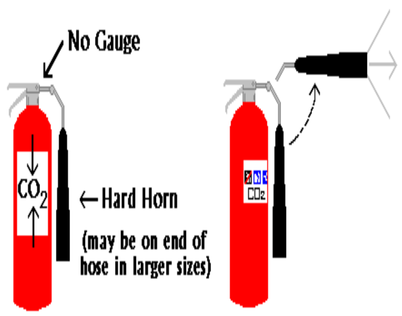


Pressurized waterextinguishersare being usedforordinary combustibles like wood, paper,manyplastics, cloth andrubber.

Carbondioxide extinguishersare generally used inareasof sensitive electricalorelectronic equipment since it isgasandleavesno residue that damagestheequipment.Carbondioxide functions byremovingordisplacingthe oxygenina fire. Itis a non-flammable gas, extremelycold.



Chemicalfire extinguishersare byfarthemost commononcampus. ABCormultipurpose fire extinguishersare effective onallthreeclassesof fires.Dry chemicalsfunction byinterruptingthe chainreactionof the fire tetrahedron. The extinguishersare pressurizedwith nitrogen gasas anexpellant. Theycan beusedonclassA, BandC fires. Dry chemical extinguishersputoutfiresby coatingthe fuel with thinlayerof chemical dust. Thisinturnseparatesthefuel fromthe oxygenin the air. The powderhasalso the abilitytointerrupt the chemical chainreactionof the fire. These are the mostcommonextinguishersfoundoncampus since theyare veryeffective atextinguishing fires.



K-ClassExtinguisher: K – Classextinguishercontainsa wetchemical thatiscomposedof potassium-basedsolution.Theyareusedon kitchenfiresthatinvolve high temperature cookingoils anddeepfatfryers.Thesolutionprovidesboth a coolingeffectonthe fire aswell asforminga blanketontopof the firecuttingoff the oxygen.

a. HowtoUsea FireExtinguisher

Itiseasyto rememberhowto use a fire extinguisherif you canrememberthеacronym**PASS**, which standsfor**PULL,AIM,SQUEEZE**, and**SWEEP**.

Pullthe pin.
Thiswill allow you to discharge the fire extinguisher.

Aim atthe base of the fire.
Ifyouaimattheflames(whichisusuallythetemptation),thee xtinguisher agent will flyrightthrough anddo no good. You have to hitthe fuel.

Squeeze the tophandle orlever**.**
Thisdepressesabuttonthatreleasesthepressurizedextingui shingagent inthe extinguisher.

Sweepfromside toside until the fire iscompletelyout.
Startusingthe extinguisherfroma safe distance awaymovingforward whilesweepingthe nozzle fromside to side.Once the fire isout, keepan eye onthe area incaseitre-ignites.

b. RulesforFightingFires

Firescan be verydangerousand you shouldalwaysmake certainto notendanger yourself orothers whenattemptingto putouta fire.Forthisreason,whena fire isdiscovered:

i. Assistanyperson,whoisinanyimmediatedangertosafety,ifitcanbeaccomplished withoutriskto you.
ii. Activatethebuildingfirealarmsystemornotifythefiredepartmentbycalling.
iii. Onlyaftercompletingtheabovetwo,youmayuseanextinguisherifyouaretrainedand the fire issmall.

c. **Before deciding tofightthe fire,these rules must be keptinmind: NEVER FIGHT A FIREIF:**

i. **Youdo notknowwhatisburningandyoudonotknowwhattypeoffire extinguisher touse.**
ii. **Thefireisspreadingrapidlybeyondthespotwhereitisstarted.**

d. **MountingFireExtinguishers**

Fireextinguishersshall bemountedonwallsor columnsbysecurelyfastenedhangerssothatthey are supported adequately, although somefireextinguishersare mounted in cabinets or wall recesses.Inany case,theoperating instructionsmustfaceoutward,andthe extinguishershouldbe placedso thatit can be removedeasily.

e. **ReportingDamagedorDischargedExtinguisher**

Neverputan extinguisherback initsplaceafteruse.Ifanextinguisherisdischarged,or if it is damagedinanyway,reportthefireextinguishertoFire Safety Office.

4.13.10.1 MAINTENANCE

Maintenanceshould includeathoroughexaminationoftheextinguisher's mechanicalparts,the extinguishingagentandthe expellingmeans. The purposeofthemaintenanceprogramisto make surethattheextinguisherwilloperate properly,and will not poseapotential hazard totheoperator or peoplenearby. Certified personnel will performmaintenanceonce every yearaccording to NFPA10.

a. **GuidelinesforInspectionandMaintenanceofFireExtinguishers**

Thisinformation isbased onOccupationalSafetyandHealth Standards1910.157 and NFPA10andproject specification.

Allfire extinguishersshallbeinspectedandmaintainedinaccordancewith themanufacturers establishedoperating standardsandapplicablecoderequirements.Any inspection,servicing, recharging,ortestingof fireextinguishersshall only beperformedbylicensedandcertifiedcompanies with qualifiedpersonnelnormallyengagedinthistype of work.

The annual inspectionshall include checkof the followingitems.

1. The extinguisherislocatedinitsdesignatedlocation.
2. There isno obstructiontoaccessor visibility.
3. Operatinginstructionsonthe name plate are legibleandfacing outward.
4. Sealsandtamperindicatorsare inplace and not brokenormissing.
5. The extinguisherisfull determined by weighingor “hefting”.
6. Extinguishershowsno obviousphysical damage,corrosion, leakage, or clogged nozzle.
7. Pressure gauge reading orindicatoris inthe operable range or position.
8. Extinguisherchemical isnotcaked. (drychemical only).
9. Tag isattachedthat indicatesthemonthandyearthemaintenance And recharging were performedandidentifiesthe personperformingthe service.
10. Eachfireextinguishershallbesubjecttoa periodic Maintenance.

11. All inspection, testing and maintenance shall be performed in Compliance with applicable NFPAstandardsanddocumented accordingly.

4.13.10.2 INSPECTION ANDTESTINGOF FIREPROTECTION AND FIRESAFETY SYSTEMS

Commercial Building Owners shall providealeveloffiresafetyandpropertyprotectionthatwillmeetthe needsofthepeopleoccupying itsbuildingswhile meetingthe safetyrequirementsof local building and fire safety codes. Fire detectiondevicesandalarm systems arethekeyelementsamongthefireprotectivefeaturesof anyfacility.Detectionandalarm systemshelp limit property lossesin buildingsregardless ofthetypeofoccupancy,and significantlyreducethelossoflifefromfire.

a. FireProtectionEquipmentandSystems

FireProtection Equipmentand Systemsare speciallydesigned,eitheraloneorasa system,to limitthe spreadoffireandsmokebyassisting inextinguishments,eitherbyautomatic,semi- automaticormanual means. This includes, but isnotlimitedto:

i. Portable fire extinguishers
ii. Fire hoses and reels
iii. Fire pumps and hydrants
iv. Wetanddrystandpipesystems
v. Automatic water sprinklersystems
vi. Halonsystemsandotherspecial extinguishingsystems
vii. Fire doors, dampersandotherfire protectionsystemsandappurtenances

viii. Fire alarm systems

Fireprotectionandlife-safetyequipmentand systemsshallbeinspected,testedand maintained inalloccupanciesandlocationswhere required,orinstalledassetforthinNFPA Codes, Federal,State, andLocalstandards, andasmay be required bythe StateFire Service Stations.

b. Servicing,Testing,andMaintenance

Qualified, certified and/orlicensed fire safety personnelshall conduct all servicing,testing,repair, maintenanceandtagging offireprotection andlife-safety equipment.Personnelnotlicensed, certified,orapprovedbytheFireBrigade Office may berequiredto provide documentation oflicensingor certification bysimilarapproved agencies or authorities, or identification as manufacturer's representative or authorized service personnel.

c. ServiceTags

After installation orservice,anapproval servicetagshallbecompleted in detail indicatingall workthathasbeendoneandthenattachedtotheequipmentorsysteminsuchapositionas topermitconvenientinspectionandnothamperitsactuationoroperation.Fire Service Stationshallbenotifiedassoon aspossible wheneverfireprotectionorlife-safetyequipment is TAGGED.

CHAPTERFIVE

5.0 SUMMARY, CONCLUSION ANDRECOMMENDATIONS

5.1 Summary of Findings

This study established Eighteen (18) different cases of fire disaster in the study area. The study, from the data collected from Fire Service Station Headquarters, revealed that the occurrence of fire disaster in the study area was more pronounced in the last two (2) decades. Despite the high level of technological advancement, fire diasater has been a threat to the built environment mostly, in the study area as attested to by 84.6% of the respondets.(Table 4.3).

Thesecondobjectiveofthisstudy wastodetermine thecauses offiredisastersin commercial buildings in Imo State. Data analysisandinterpretationrevealed that majority oftherespondentsstrongly agreed that all the factors suggested (table 4.4) could cause fire disaster in commercial buildings. However, 98.7% of the respondents identified the use of Substandard Electrical materials and Faulty Electrical appliances were identified by respondents as major causes of fire disaster in commercial buildings in Imo State.Sinceall factors were identified by the respondents, attention must be given to each factor so as to meet therequired standards.

Objective three of this studywastoexamine fire disaster preparedness level ofcommercial building ownersin Imo State. 65.8% of the respondents (table 4.5 - 4.7)were not satisfied with the level of availability of firefighting equipement. The respondents identified availability of two firefighting equipment; these include dry chemical extinguisher, foam cylinder and sand in majority of the commercial buildings. However, halon extinguisher, carbon dioxide extinguisher, wet chemical and fire blankest were not available in the majority of the commercial buildings. Data analysisand interpretation also revealed that owners, occupants,and users onlyknowhowtooperatetheavailable firefighting equipment. Since other firefighting equipment were not available, this means that the users cannot operate the equipment that were not in existence. Adequate provision of different types/ classes of firefighting equipment should be made available and training/ education of users should be encouraged.

Objective four was to determine fire safetymeasures adopted byownersofcommercial buildings in Imo State. To achieve this, various fire safety and control measures were suggested, these include: emergency communication, regular inspection and maintenance, regular training and fire drill, trained firefighting personnel (table 4.8 – 4.8.3). 84.5% of the repondents agreed that there is availability of emergency communication system and this is through their respective telephones. However, 89.8% of the respondents agreed that there is no regular inspection and maintenance of firefighting equipment. 86.2% of the respondents agreed that trained firefighting personneldoest not exist in these commercial buildings. Again, 46.5% of the respondents identified that majority of the commercial buildings have very good exit discharge/ egress but characterized by very poor appropriate signage.

Objective five was to evaluate the level of compliance of commercial buildings with theprovision offire safety acts, design standards and codesin Imo State. To achieve this, data were collected from the design and construction teams (Architects, Builders, Electrical and Mechanical Enginners); relevant authorities (Town Planning Officers (OCDA) and Fire Service Stations). 69.8% of the Architects revealed that clients do consider the installation of fire safety and controls measure as not all that required during the construction and installation. The Architects further revealed that most fire safety and control measures in commercial buildings in the study area is an after thought rather than a pro-active implementation style.So, clients apathy to financial demands and fire safety has been a major challenge. 73.1% of the Builders revealed that clients' perception on fire safety and control measureswas very low, hence, a major contributory factor for fire occurrence. 75.6% of the Electrical Enginners and 73.7%of the Mechanical Engineers agreed that clients' have been a major concern when it comes to the installation of fire safety devices.The design and construction teams further stated that most fire safety and control measures in commercial building is an after thought rather than a proactive implementation style. See tables 4.9 to 4.15. This study revealed that few studies have been conducted on fire disaster in Imo State by previous researchers but, the focus have been on the last three stages of fire development (mitigation, response and restoration/ rehabilitation).This study evaluated the previous fire disaster occurrences in commercial buildings in Imo State which had resulted to high level of fatalities, economic loss, and death among others. This study revealed three major causes of fire disaster occurrence amongst others in commercial buildings in Imo State. This study therefore, considered it imperative to put in place fire safety and control measures that could prevent the occurrence of fire disaster or minimize the effect if occured in these commercial buildings through the development of a framework as a measure for fire disaster preparedness.

5.2 Conclusion

This study established 18 different cases of fire incidences in the study area from 2010 to 2019(Table 4.3). Table 4.9 shows the record of fire victims that were interviewed in the course of this study. The records were collected from Fire Service Station Headquarters, Okigwe Road, Owerri. The occurrence of fire in Imo State has been more pronounced in the last two decades. 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. Data in tables 4.3 and 4.9 therefore, established that fire disaster occurence has been predominant in Imo State hence, the need for fire disaster preparedness.

The study determined the causes of fire disaster in the study area. It was revealed that all the factors suggested (See table 4.4)could cause fire emergence in commercial buildings. From the analysed data, the use of Sub-standard materials and faulty electrical appliances were the major causes of fire disaster in commercial buildings.

Thisstudy also examinedtheleveloffire disaster preparednessof the ownersof thesecommercialbuildings in other to ensure life's safety.Again, the level of fire disaster preparedness was not adequate, because, the data gathered from the respondents revealed that preparedness wereonly in building materials used for the construction of these buildings; there was inadequate provision of fire safety and suppressive devices, inavailability of fire safety trained personnel and lack of training and fire drill (see table 4.7).

The data collected and analyzed on fire safety strategies in table 4.8 revealed that emergencycommunicationsystem, regular inspection and maintenance of firefighting equipment, training of firefighting personnel, existence of assembly points, availability of fire disaster kits; accessibility of fire hydrants, existence of insurance policy and regular fire drills have not been given adequate attention. This clearly indicated thatthe availability of fire safety strategy was very poor in all the commercial buildings in the study area. It is therefore necessary for actions to be put in place by the appropriate authorityto adopt the framework developed in this work so as to prevent the emergence of fire or cushion the impact in case fire occurs.

This study assessedfiresafety and controlmeasures adopted by these commercial building owners, and revealed that dry chemical extinguishers, foam cylinder and sand were the most available and users lacked the requisite knowledge of how to operate the available equipment.Therefore, there is need to stress that adequate provisions of all the firefighting equipment be made and installed in all the commercial buildings since different fires have its own suppressive extinguisher. It is highly imperative that users be trained and educated on the use of various firefighting equipment in other to know what to do in case of fire emergence (see Table 4.8)

Evaluation ofthelevelof compliance of these commercial buildings with the provision of safety acts design standards and codes was carried outand the data collected from fire safety personnel revealed that they lack necessary firefighting equipment such as emergency truck. It was revealed that most times, the firefighting personnel could not handle fire outbreaks due to non-availability of capable hands (trained personnel) to fight fire. There is no access to water to handle casesoffire.Fire trucks usuallylackedwatertocombatfireand, in most cases, where firehad occurred especiallyin commercial Centre areas, theyarrived eitherlateor illequipped.Thus,fire trucksneedtobeequipped / made functionaltodealwithanyeventualityof fireoutbreaks.(Appendix B1-B3shows the level of degradation in one of the Fire Service Stations in the study areas). ItisthereforeimportantthattheFire Brigade Authority addressesthisto enhance fire disaster preparedness level.The respondents revealed the level of dissatisfaction on the level of strategies adopted by commercial building owners which was below expectation.The respondents proposed regulartraining for users, availability of firefighting personnel and that the building code should be passed into law and strictly followed.The respondents further suggested that appropriate signage be marked atexit access andinsurance policy shouldbeprovided by the owners of these commercial buidingsforthe occupants/ users. On the other hands, the ownersof commercial buildings suggested that, there should be regular inspection on firefighting equipment.

5.3 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.

This studyconcludesthatoccurrence of fireinbuildingsmaynotbe totally prevented butitsoccurrence and spread could be minimized. However,withtheuseof fire rateddoorsandwindows, compartmentalizing designedspacesandtreating them with fireretardantmaterials,the impacts offirecouldbegreatly curtailedto thebarestminimum.Therefore, thefollowingarethe recommendations:

i. Each commercial buildingshould have firefighting department and trained personnel adequately equipped to handle fire emergence at its inception stage.

ii. There should be publicenlightenment, orientation,training andeducation onfire disaster for commercial building operators so as to know their level of vulnerability to fire hazards and what to do when fire occurs.

iii. Relevant authoritiesshould make it compulsory forthe design team (Archiect, Builder, Electrical and Mechanical Engineers)to incorporate fire safety and control measures in their designright from the conceptual stage, make fire safety certificate one of the pre-requisites,otherwise, approval and fire safety certificate should not be granted (Seechapter 5.2 the conceptual framework model).

iv. Partsofabuilding vulnerableto fires shouldbeproperly monitoredinthecourseof construction.Mostly, kitchen areacouldbebuiltto havedualroofthatis,itisdecked first and laterroofed overwith otherpartsofthebuilding.

v. At least three different types of fire suppressive devices should be installed inallcommercial buildingsto automaticallyinterveneintheeventoffire. Among the three, water sprinkler should be made compulsory.

vi. Adequate provisions of functional firefighting equipment should be madeavailable to fire service stations so as to live up to their expectation in case of fire outbreak.

vii. Servicesoffiremen shouldbeaccessible through functional mobile linesto occupants/ users of these commercial buildingsfor immediate and effective communication whentheneeds arise.

viii. Government authorities in the area of Urban development should ensure that adequate air space is given between two buildings to avoidfiresspreadingfromonebuildingto another.

ix. 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.

5.4 Contribution toKnowledge

This research work have been able to unraaped a new dimension of fire disaster Preparedness in the study area. The key contributions to knowledge include:

(i). A conceptual framewok model was developed and the framework becomes a template to be adopted for the design and construction of commercial buildings. This framework for fire disaster preparedness will enhance the prevention or emergence of fire, curtail fire spread if occur or reduce the high level of lost of lives and property.

(ii) Asoftware (Computerised Fire Disaster Digital Alarm)was developedfor the implementation oftheframework – chosentobeaMobileApp in order to makeithandy,universalanduser-friendly. In the event of fire, the software will enable the owners/users to immediately contact the firefighting Agencies or Authorities for quick intervention or response.

5.5 Suggested Areas for further Study

This research serves as a pioneer for more reseaches to be carried out in this area of study. It is therefore recommended that further studies shouldbeconducted to:

(i) Determine the levelof fire safety awareness and practice inpublic institutionssuch as Schools, Hospitals and Gas Filling Stations

(ii) Assess the compliance of Residential and Purpose-made Buildings with Design Standards and Fire Safety Codes and Acts.

(iii) Evaluate market buildings to ascertain their proness to fire disaster.

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APPENDIX A

Plates showing cases of FireDisastersinImo State

(i) Gas plant explosion, killed four persons on Monday 11/9/2017 at Orji, a suburb town in Owerri, the Imo State capital.

Plate A1: The scene of the gas explosion that claimed four lives at Amawire, Orji Road in Owerri North Local Government Area of Imo State, yesterday. Photo: ChinonsoAlozie.
Source: https://www.vanguardngr.com/2017/11/gas-cylinder-explosion-kill-4-persons-imo/

(ii) Imo State Deputy Governor's House, Owerri

A building at the residence of Imo State Deputy Governor, Eze Madumereburnt down by fire on Thursday 18th January, 2018.

(iii) **Fire Razed Tetlow Plaza, Owerri.**

Tetlow plaza in Owerri, Imo State on January 25, 2018.

Plate A3b: showing one of the shops that was consumed by fire
Source:(https://www.nationalhelm.co/2018/01/tetlow-plaza-owerri-fire-goods-peoperties-destroyed-photos.htmlJanuary 25, 2018)

(iv) Orange Room Popular Night Club and Lounge, Owerri.

The popular Owerri night club and lounge, ORANGE ROOM, located along World Bank Road, New Owerri, Imo State capital gutted by fire.

Plate A4: Orange Room - night club and lounge
Source: (https://www.nationalhelm.co/2018/02/fire-guts-popular-night-club-lounge-owerri-properties-destroyed-photos.htmlFebruary 7, 2018)

(v) Stone Castle Hotel, Okigwe.

Stone Castle hotel at Okigwe area of Imo State.

Plate A5: Stone Castle hotel Okigwe

Source : http://dailypost.ng/2017/11/29/fire-razes-popular-hotel-imo/

(vi) Ibari Ogwa Entertainment Spotdestroyed by Fire from a nearby burning bush.

Plate A6: Ibari Ogwa, Owerri
Source : Ifeanyicy.com **18** Jan. 2018

According to the Commissioner for Public safety, Hon Chidi Nwaturocha, four fire outbreaks were recorded in Imo state on Wednesday.

1) Choco Foods Mbaitoli.
2) Ibari Ogwa, Port Harcourt Rd.
3) G.Towers Hotel. Port Harcourt Rd.
4) Chris Tee Filling Station, near Road Safety Office, Egbu.

(vii) A Two Storey Pretoria Hotel and Suites near Winners' Chapel, Owerri

Plate A7: Pretoria Hotel and Suites, Owerri
Source : http://nigeriapilot.com/byline/owerri/January 23, 2016

(viii) Newton hotelalong General hospital, Umuguma, New Owerri

Plate A8: Newton hotel, Owerri

Source: https://www.lindaikejisblog.com/index.php/2017/12/photos-newton-hotel-in-imo-gutted-by-fire.html

(ix) The before and after photos of the **Two Imo State Polytechnic Students died in a fire incident at their residence**

Plate: A9 - Two students of Imo State Polytechnic died in a fire incident.
Source: http://franshub.blogspot.com.ng/2016/08/two-imo-state-polytechnic-students-die.html

(x) Fire razes Independent National Electoral Commission (INEC) in Nwaorubi, Mbaitoli Local Government Area of Imo State.

Plate: A10INEC Office, Nwaorubi
Source: News Express, 2015

(xi) The Dean’s Office of Faculty of Humanities, Imo State University, Owerri.

Plate: A11Faculty of Humanities, Imo State University, Owerri.
Source: *Punch*, January 10, 2019.

(xii) All Progressives Congress (APC) Local Government Congress Secretariat Okigwe road, Owerri, Imo State.

Plate: A12Fire incident at APC Office, Okigwe road, Owerri.

Author: CLARA JANCITA

(xiii) **The Administrative Building of Sam Mbakwe International Cargo Airport, Owerri, Imo state.**

Plate: A13Arrival Section of Imo Airport gutted by Fire.
Source: *The Nation*, April 9, 2019.

(xiv) Fire razes the Independent National Electoral Commission's (INEC) office in Isiala Mbano, Imo North INEC office.

Plate: A14 The Independent National Electoral Commission's (INEC) office, Isiala Mbano**LGA., Imo State**
Source: https://www.vanguardngr.com/2019/02/fire-razes-inec-office-in-imo-official/

(xv) Report from Imo State Fire Service, Owerri

The Imo State Fire Service recorded 54 fire incidences between Dec. 13, 2016 and Feb. 7, 2017.The Director of fire service, made the disclosure in an interview with the News Agency of Nigeria, (NAN) in Owerri on Wednesday, **Feb 8 2017**. The Director said that one person died, seven people seriously injured, while property worth N500 million were destroyed. He added that his men saved property valued more than two billion Naira from being destroyed by fire during the period under review.The Director explained that the death and injuries were recorded in the fire incident that occurred at Ogbugba Str. Owerri, before the 2016 Christmas festivity.

The Director expressed regrets that in spite of the population of Owerri, only one functional fire fighting vehicle was currently servicing the Owerri head office, while the total staff strength across the state was 34.These 34 staff are working across the seven fire stations located at; Okigwe, Orlu, Aboh Mbaise, Mbano, Ideato, Government House Owerri, and Owerri Fire Service headquarters, in Okigwe Road.

In an ideal situation, the station supposed to have at least 200 workers. In addition, there is inadequate operational and utility vehicles because in the headquarters alone, there supposed to be up to four operational trucks and five utility vans to be able to attend to the four core services.

The most challenging problem currently faced by the Service is the disconnection of the electricity line at the state headquarters, Owerri by officials of Enugu Electricity Distribution Company (EEDC), which affects the pumping of water.

Due to the disconnection, our men now buy water they use to attend to fire cases from public sources, the standby generator available is currently faulty" he said. He stressed the need for corporate bodies and well to do individuals in the state to assist in funding the activities of the fire service for more effective and efficient operations.

Source: http://thenewsnigeria.com.ng/2017/02/in-2-months-imo-records-34-fire-cases/

APPENDIX B

PICTURES SHOWING THE LEVEL OF DEGRADATION OF ONE OF THE FIRE SERVICE STATIONS

Plate B1: **showing the level of degradation**

Plate B2: **showing the level of degradation**

Plate B3

Plates B1, B2 and B3 showing the level of infrastructural and utility decay of Imo State Fire Service Station Orlu.

APPENDIX C

SPSS Output of Reliability of the Instrument

Case Processing Summary

		N	%
Cases	Valid	30	6.8
	Excluded[a]	408	93.2
	Total	438	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.818	.811	19

Item Statistics

	Mean	Std. Deviation	N
QU1	4.0333	1.09807	30
QU2	4.1667	.87428	30
QU3	3.6000	.56324	30
QU4	4.1333	.93710	30
QU5	4.0667	.98027	30
QU6	3.9000	1.12495	30
QU7	4.1333	.89955	30
QU8	3.2667	.82768	30
QU9	3.2667	.73968	30
QU10	3.0333	.96431	30
QU11	3.2667	.73968	30
QU12	3.3667	.71840	30
QU13	3.0333	.80872	30
QU14	3.4000	.49827	30
QU15	3.2000	.71438	30
QU16	3.2667	.82768	30
QU17	3.4333	.56832	30
QU18	3.3333	.71116	30
QU19	3.1667	.91287	30

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.530	3.033	4.167	1.133	1.374	.162	19
Item Variances	.694	.248	1.266	1.017	5.097	.078	19

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
67.0667	58.547	7.65161	19

APPENDIX D

SPSS Output of Summary of Questionnaire for determining causes of fire disaster in commercial buildings

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
N	Valid	462	462	462	462	462	462	462	462	462	462
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		4.5584	4.6667	4.1017	4.8810	3.8658	4.2035	4.8680	4.6385	4.1797	4.0065
Std. Deviation		.52264	.47192	1.31256	.32420	1.38451	1.01280	.33890	.48095	1.10813	1.23663
Variance		.273	.223	1.723	.105	1.917	1.026	.115	.231	1.228	1.529
Sum		2106.00	2156.00	1895.00	2255.00	1786.00	1942.00	2249.00	2143.00	1931.00	1851.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	6	1.3	1.3	1.3
	A	192	41.6	41.6	42.9
	SA	264	57.1	57.1	100.0
	Total	462	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	154	33.3	33.3	33.3
	SA	308	66.7	66.7	100.0
	Total	462	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	49	10.6	10.6	10.6
	D	25	5.4	5.4	16.0
	NS	7	1.5	1.5	17.5
	A	130	28.1	28.1	45.7
	SA	251	54.3	54.3	100.0
	Total	462	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	55	11.9	11.9	11.9
	SA	407	88.1	88.1	100.0
	Total	462	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	55	11.9	11.9	11.9
	D	45	9.7	9.7	21.6
	NS	12	2.6	2.6	24.2
	A	145	31.4	31.4	55.6
	SA	205	44.4	44.4	100.0
	Total	462	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	30	6.5	6.5	6.5
	D	3	.6	.6	7.1
	NS	10	2.2	2.2	9.3
	A	219	47.4	47.4	56.7
	SA	200	43.3	43.3	100.0
	Total	462	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	61	13.2	13.2	13.2
	SA	401	86.8	86.8	100.0
	Total	462	100.0	100.0	

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	167	36.1	36.1	36.1
	SA	295	63.9	63.9	100.0
	Total	462	100.0	100.0	

Q9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	34	7.4	7.4	7.4
	D	15	3.2	3.2	10.6
	A	198	42.9	42.9	53.5
	SA	215	46.5	46.5	100.0
	Total	462	100.0	100.0	

Q10

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	50	10.8	10.8	10.8
	D	6	1.3	1.3	12.1
	NS	33	7.1	7.1	19.3
	A	175	37.9	37.9	57.1
	SA	198	42.9	42.9	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – Availability of Firefighting Equipment.

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
N	Valid	462	462	462	462	462	462	462	462
	Missing	0	0	0	0	0	0	0	0
Mean		4.4351	1.5887	3.8312	2.2792	1.6364	2.7468	1.8268	4.4307
Std. Deviation		.49630	.49259	1.31966	1.50269	1.01924	1.41066	1.12952	.70216
Variance		.246	.243	1.741	2.258	1.039	1.990	1.276	.493
Sum		2049.00	734.00	1770.00	1053.00	756.00	1269.00	844.00	2047.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	261	56.5	56.5	56.5
	SA	201	43.5	43.5	100.0
	Total	462	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	190	41.1	41.1	41.1
	D	272	58.9	58.9	100.0
	Total	462	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	36	7.8	7.8	7.8
	D	60	13.0	13.0	20.8
	NS	51	11.0	11.0	31.8
	A	114	24.7	24.7	56.5
	SA	201	43.5	43.5	100.0
	Total	462	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	213	46.1	46.1	46.1
	D	108	23.4	23.4	69.5
	A	81	17.5	17.5	87.0
	SA	60	13.0	13.0	100.0
	Total	462	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	272	58.9	58.9	58.9
	D	148	32.0	32.0	90.9
	A	22	4.8	4.8	95.7
	SA	20	4.3	4.3	100.0
	Total	462	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	139	30.1	30.1	30.1
	D	76	16.5	16.5	46.5
	NS	49	10.6	10.6	57.1
	A	159	34.4	34.4	91.6
	SA	39	8.4	8.4	100.0
	Total	462	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	232	50.2	50.2	50.2
	D	165	35.7	35.7	85.9
	A	43	9.3	9.3	95.2
	SA	22	4.8	4.8	100.0
	Total	462	100.0	100.0	

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	5	1.1	1.1	1.1
	D	9	1.9	1.9	3.0
	A	216	46.8	46.8	49.8
	SA	232	50.2	50.2	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – Operate Firefighting Equipment.

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
N	Valid	462	462	462	462	462	462	462	462
	Missing	0	0	0	0	0	0	0	0
Mean		4.4675	1.4502	3.6991	2.3182	1.8961	2.9416	1.8615	4.4848
Std. Deviation		.49949	.49805	1.34920	1.59189	.83187	1.41837	1.18114	.55772
Variance		.249	.248	1.820	2.534	.692	2.012	1.395	.311
Sum		2064.00	670.00	1709.00	1071.00	876.00	1359.00	860.00	2072.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	246	53.2	53.2	53.2
	SA	216	46.8	46.8	100.0
	Total	462	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	254	55.0	55.0	55.0
	D	208	45.0	45.0	100.0
	Total	462	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	47	10.2	10.2	10.2
	D	59	12.8	12.8	22.9
	NS	51	11.0	11.0	34.0
	A	134	29.0	29.0	63.0
	SA	171	37.0	37.0	100.0
	Total	462	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	221	47.8	47.8	47.8
	D	100	21.6	21.6	69.5
	A	55	11.9	11.9	81.4
	SA	86	18.6	18.6	100.0
	Total	462	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	125	27.1	27.1	27.1
	D	306	66.2	66.2	93.3
	A	16	3.5	3.5	96.8
	SA	15	3.2	3.2	100.0
	Total	462	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	91	19.7	19.7	19.7
	D	124	26.8	26.8	46.5
	NS	49	10.6	10.6	57.1
	A	117	25.3	25.3	82.5
	SA	81	17.5	17.5	100.0
	Total	462	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	227	49.1	49.1	49.1
	D	170	36.8	36.8	85.9
	A	32	6.9	6.9	92.9
	SA	33	7.1	7.1	100.0
	Total	462	100.0	100.0	

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	14	3.0	3.0	3.0
	A	210	45.5	45.5	48.5
	SA	238	51.5	51.5	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – Fire Safety Strategies.

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
N	Valid	462	462	462	462	462	462	462	462
	Missing	0	0	0	0	0	0	0	0
Mean		4.0498	1.8333	1.8766	2.9740	1.4719	1.5325	2.1320	1.5390
Std. Deviation		1.24264	1.04369	1.13126	1.46076	.49975	.49949	1.37134	.49902
Variance		1.544	1.089	1.280	2.134	.250	.249	1.881	.249
Sum		1871.00	847.00	867.00	1374.00	680.00	708.00	985.00	711.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	43	9.3	9.3	9.3
	D	29	6.3	6.3	15.6
	A	180	39.0	39.0	54.5
	SA	210	45.5	45.5	100.0
	Total	462	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	197	42.6	42.6	42.6
	D	218	47.2	47.2	89.8
	A	21	4.5	4.5	94.4
	SA	26	5.6	5.6	100.0
	Total	462	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	211	45.7	45.7	45.7
	D	187	40.5	40.5	86.1
	A	38	8.2	8.2	94.4
	SA	26	5.6	5.6	100.0
	Total	462	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	76	16.5	16.5	16.5
	D	172	37.2	37.2	53.7
	A	116	25.1	25.1	78.8
	SA	98	21.2	21.2	100.0
	Total	462	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	244	52.8	52.8	52.8
	D	218	47.2	47.2	100.0
	Total	462	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	216	46.8	46.8	46.8
	D	246	53.2	53.2	100.0
	Total	462	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	210	45.5	45.5	45.5
	D	137	29.7	29.7	75.1
	A	74	16.0	16.0	91.1
	SA	41	8.9	8.9	100.0
	Total	462	100.0	100.0	

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	213	46.1	46.1	46.1
	D	249	53.9	53.9	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – Fire Safety Policy.

Statistics

		Q1	Q2	Q3	Q4
N	Valid	462	462	462	462
	Missing	0	0	0	0
Mean		1.6840	2.0476	1.7078	4.3442
Std. Deviation		.46542	.92794	.75323	1.07856
Variance		.217	.861	.567	1.163
Sum		778.00	946.00	789.00	2007.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	146	31.6	31.6	31.6
	D	316	68.4	68.4	100.0
	Total	462	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	110	23.8	23.8	23.8
	D	286	61.9	61.9	85.7
	NS	12	2.6	2.6	88.3
	A	42	9.1	9.1	97.4
	SA	12	2.6	2.6	100.0
	Total	462	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	199	43.1	43.1	43.1
	D	216	46.8	46.8	89.8
	NS	32	6.9	6.9	96.8
	A	13	2.8	2.8	99.6
	SA	2	.4	.4	100.0
	Total	462	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	22	4.8	4.8	4.8
	D	28	6.1	6.1	10.8
	A	131	28.4	28.4	39.2
	SA	281	60.8	60.8	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – construction materials, fire detection devices, fire suppression devices, fire spread control strategies and fire safety.

A - Building Materials

Statistics

		QI	QII	QIII	QIV	QV	QVI	QVII	QVIII
N	Valid	462	462	462	462	462	462	462	462
	Missing	0	0	0	0	0	0	0	0
Mean		4.7944	4.5022	4.0758	4.8312	4.7511	4.8615	4.8853	4.0931
Std. Deviation		.40460	.52590	.56727	.37501	.43285	.34583	.31903	.56083
Variance		.164	.277	.322	.141	.187	.120	.102	.315
Sum		2215.00	2080.00	1883.00	2232.00	2195.00	2246.00	2257.00	1891.00

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	95	20.6	20.6	20.6
	VG	367	79.4	79.4	100.0
	Total	462	100.0	100.0	

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	6	1.3	1.3	1.3
	G	218	47.2	47.2	48.5
	VG	238	51.5	51.5	100.0
	Total	462	100.0	100.0	

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	58	12.6	12.6	12.6
	G	311	67.3	67.3	79.9
	VG	93	20.1	20.1	100.0
	Total	462	100.0	100.0	

QIV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	78	16.9	16.9	16.9
	VG	384	83.1	83.1	100.0
	Total	462	100.0	100.0	

QV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	115	24.9	24.9	24.9
	VG	347	75.1	75.1	100.0
	Total	462	100.0	100.0	

QVI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	64	13.9	13.9	13.9
	VG	398	86.1	86.1	100.0
	Total	462	100.0	100.0	

QVII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	53	11.5	11.5	11.5
	VG	409	88.5	88.5	100.0
	Total	462	100.0	100.0	

QVIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	53	11.5	11.5	11.5
	G	313	67.7	67.7	79.2
	VG	96	20.8	20.8	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – construction materials, fire detection devices, fire suppression devices, fire spread control strategies and fire safety.

B - Fire Detection Devices

Statistics

		QI	QII	QIII
N	Valid	462	462	462
	Missing	0	0	0
Mean		4.2273	4.1840	4.1494
Std. Deviation		.41952	.44518	.59041
Variance		.176	.198	.349
Sum		1953.00	1933.00	1917.00

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	357	77.3	77.3	77.3
	VG	105	22.7	22.7	100.0
	Total	462	100.0	100.0	

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	11	2.4	2.4	2.4
	G	355	76.8	76.8	79.2
	VG	96	20.8	20.8	100.0
	Total	462	100.0	100.0	

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	51	11.0	11.0	11.0
	G	291	63.0	63.0	74.0
	VG	120	26.0	26.0	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – construction materials, fire detection devices, fire suppression devices, fire spread control strategies and fire safety.

C - Fire Suppression Devices

Statistics

		QI	QII	QIII	QIV
N	Valid	462	462	462	462
	Missing	0	0	0	0
Mean		3.2294	4.1147	4.0779	3.2294
Std. Deviation		.58484	.31903	.32667	.58484
Variance		.342	.102	.107	.342
Sum		1492.00	1901.00	1884.00	1492.00

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	394	85.3	85.3	85.3
	G	30	6.5	6.5	91.8
	VG	38	8.2	8.2	100.0
	Total	462	100.0	100.0	

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	409	88.5	88.5	88.5
	VG	53	11.5	11.5	100.0
	Total	462	100.0	100.0	

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	8	1.7	1.7	1.7
	G	410	88.7	88.7	90.5
	VG	44	9.5	9.5	100.0
	Total	462	100.0	100.0	

QIV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	394	85.3	85.3	85.3
	G	30	6.5	6.5	91.8
	VG	38	8.2	8.2	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – construction materials, fire detection devices, fire suppression devices, fire spread control strategies and fire safety.

D - Fire Spread Control Strategies

Statistics

		QI	QII	QIII	QIV	QV
N	Valid	462	462	462	462	462
	Missing	0	0	0	0	0
Mean		4.3658	3.4870	3.2359	3.5519	3.1299
Std. Deviation		.48218	.50037	.53365	.73678	.33652
Variance		.232	.250	.285	.543	.113
Sum		2017.00	1611.00	1495.00	1641.00	1446.00

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	293	63.4	63.4	63.4
	VG	169	36.6	36.6	100.0
	Total	462	100.0	100.0	

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	237	51.3	51.3	51.3
	G	225	48.7	48.7	100.0
	Total	462	100.0	100.0	

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	P	24	5.2	5.2	5.2
	NS	305	66.0	66.0	71.2
	G	133	28.8	28.8	100.0
	Total	462	100.0	100.0	

QIV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	275	59.5	59.5	59.5
	G	119	25.8	25.8	85.3
	VG	68	14.7	14.7	100.0
	Total	462	100.0	100.0	

QV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NS	402	87.0	87.0	87.0
	G	60	13.0	13.0	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for examining fire disaster preparedness level of commercial building owners – construction materials, fire detection devices, fire suppression devices, fire spread control strategies and fire safety.

E - Fire Safety

Statistics

		QI	QII
N	Valid	462	462
	Missing	0	0
Mean		4.4134	3.1710
Std. Deviation		.49298	1.21406
Variance		.243	1.474
Sum		2039.00	1465.00

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	G	271	58.7	58.7	58.7
	VG	191	41.3	41.3	100.0
	Total	462	100.0	100.0	

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	P	215	46.5	46.5	46.5
	NS	45	9.7	9.7	56.3
	G	110	23.8	23.8	80.1
	VG	92	19.9	19.9	100.0
	Total	462	100.0	100.0	

SPSS Output of Summary of Questionnaire for the ARCHITECT

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6
N	Valid	65	65	65	65	65	65
	Missing	0	0	0	0	0	0
Mean		4.8462	4.9231	3.4615	2.6769	2.3846	2.0462
Std. Deviation		.36361	.26854	1.40398	1.21331	.74356	.21145
Variance		.132	.072	1.971	1.472	.553	.045
Sum		315.00	320.00	225.00	174.00	155.00	133.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	10	15.4	15.4	15.4
	SA	55	84.6	84.6	100.0
	Total	65	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	5	7.7	7.7	7.7
	SA	60	92.3	92.3	100.0
	Total	65	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	30	46.2	46.2	46.2
	A	10	15.4	15.4	61.5
	SA	25	38.5	38.5	100.0
	Total	65	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	2	3.1	3.1	3.1
	D	45	69.2	69.2	72.3
	A	8	12.3	12.3	84.6
	SA	10	15.4	15.4	100.0
	Total	65	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	50	76.9	76.9	76.9
	NS	5	7.7	7.7	84.6
	A	10	15.4	15.4	100.0
	Total	65	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	62	95.4	95.4	95.4
	NS	3	4.6	4.6	100.0
	Total	65	100.0	100.0	

SPSS Output of Summary of Questionnaire for BUILDERS

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6	Q7
N	Valid	26	26	26	26	26	26	26
	Missing	0	0	0	0	0	0	0
Mean		4.8077	4.6154	4.4231	4.5000	2.5385	2.5769	3.0769
Std. Deviation		.40192	.69725	.90213	.50990	.98917	1.13747	1.23038
Variance		.162	.486	.814	.260	.978	1.294	1.514
Sum		125.00	120.00	115.00	117.00	66.00	67.00	80.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	5	19.2	19.2	19.2
	SA	21	80.8	80.8	100.0
	Total	26	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	1	3.8	3.8	3.8
	A	7	26.9	26.9	30.8
	SA	18	69.2	69.2	100.0
	Total	26	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	1	3.8	3.8	3.8
	NS	1	3.8	3.8	7.7
	A	9	34.6	34.6	42.3
	SA	15	57.7	57.7	100.0
	Total	26	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	13	50.0	50.0	50.0
	SA	13	50.0	50.0	100.0
	Total	26	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	19	73.1	73.1	73.1
	NS	2	7.7	7.7	80.8
	A	3	11.5	11.5	92.3
	SA	2	7.7	7.7	100.0
	Total	26	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	20	76.9	76.9	76.9
	NS	1	3.8	3.8	80.8
	A	1	3.8	3.8	84.6
	SA	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	14	53.8	53.8	53.8
	A	8	30.8	30.8	84.6
	SA	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

SPSS Output of Summary of Questionnaire for ELECTRICAL ENGINEER

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6
N	Valid	45	45	45	45	45	45
	Missing	0	0	0	0	0	0
Mean		4.8667	4.8889	2.5556	4.5556	4.8889	2.8000
Std. Deviation		.34378	.48721	1.01255	.89330	.31782	.99087
Variance		.118	.237	1.025	.798	.101	.982
Sum		219.00	220.00	115.00	205.00	220.00	126.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	6	13.3	13.3	13.3
	SA	39	86.7	86.7	100.0
	Total	45	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	1	2.2	2.2	2.2
	A	2	4.4	4.4	6.7
	SA	42	93.3	93.3	100.0
	Total	45	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	34	75.6	75.6	75.6
	A	8	17.8	17.8	93.3
	SA	3	6.7	6.7	100.0
	Total	45	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	4	8.9	8.9	8.9
	A	8	17.8	17.8	26.7
	SA	33	73.3	73.3	100.0
	Total	45	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	5	11.1	11.1	11.1
	SA	40	88.9	88.9	100.0
	Total	45	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	27	60.0	60.0	60.0
	A	18	40.0	40.0	100.0
	Total	45	100.0	100.0	

SPSS Output of Summary of Questionnaire for MECHANICAL ENGINEER

Statistics

		Q1	Q2	Q3	Q4
N	Valid	38	38	38	38
	Missing	0	0	0	0
Mean		3.6316	3.0526	2.6579	2.7632
Std. Deviation		1.05064	1.13774	1.14553	1.10121
Variance		1.104	1.294	1.312	1.213
Sum		138.00	116.00	101.00	105.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	10	26.3	26.3	26.3
	A	22	57.9	57.9	84.2
	SA	6	15.8	15.8	100.0
	Total	38	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	18	47.4	47.4	47.4
	NS	5	13.2	13.2	60.5
	A	10	26.3	26.3	86.8
	SA	5	13.2	13.2	100.0
	Total	38	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	28	73.7	73.7	73.7
	A	5	13.2	13.2	86.8
	SA	5	13.2	13.2	100.0
	Total	38	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	D	25	65.8	65.8	65.8
	A	10	26.3	26.3	92.1
	SA	3	7.9	7.9	100.0
	Total	38	100.0	100.0	

SPSS Output of Summary of Questionnaire for TOWN PLANNING OFFICER

Statistics

		Q1	Q2	Q3	Q4	Q5
N	Valid	22	22	22	22	22
	Missing	0	0	0	0	0
Mean		4.1818	4.0909	4.8182	1.7273	2.7727
Std. Deviation		.39477	.29424	.39477	.45584	1.19251
Variance		.156	.087	.156	.208	1.422
Sum		92.00	90.00	106.00	38.00	61.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	18	81.8	81.8	81.8
	SA	4	18.2	18.2	100.0
	Total	22	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	20	90.9	90.9	90.9
	SA	2	9.1	9.1	100.0
	Total	22	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	4	18.2	18.2	18.2
	SA	18	81.8	81.8	100.0
	Total	22	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	6	27.3	27.3	27.3
	D	16	72.7	72.7	100.0
	Total	22	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	3	13.6	13.6	13.6
	D	9	40.9	40.9	54.5
	A	10	45.5	45.5	100.0
	Total	22	100.0	100.0	

SPSS Output of Summary of Questionnaire for FIRE BRIGADE OFFICER

Statistics

		Q1	Q2	Q3	Q4	Q5	Q6	Q7
N	Valid	33	34	34	34	34	34	34
	Missing	1	0	0	0	0	0	0
Mean		1.8788	1.9118	2.7353	1.6176	1.8529	2.6765	2.8824
Std. Deviation		.33143	.28790	1.10943	.49327	.35949	1.00666	1.17460
Variance		.110	.083	1.231	.243	.129	1.013	1.380
Sum		62.00	65.00	93.00	55.00	63.00	91.00	98.00

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	4	11.8	11.8	11.8
	D	30	88.2	88.2	100.0
	Total	34	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	3	8.8	8.8	8.8
	D	31	91.2	91.2	100.0
	Total	34	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	3	8.8	8.8	8.8
	D	17	50.0	50.0	58.8
	A	14	41.2	41.2	100.0
	Total	34	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	13	38.2	38.2	38.2
	D	21	61.8	61.8	100.0
	Total	34	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	5	14.7	14.7	14.7
	D	29	85.3	85.3	100.0
	Total	34	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	2.9	2.9	2.9
	2	21	61.8	61.8	64.7
	4	12	35.3	35.3	100.0
	Total	34	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	11.8	11.8	11.8
	2	13	38.2	38.2	50.0
	4	17	50.0	50.0	100.0
	Total	34	100.0	100.0	

SPSS Output of Summary of Questionnaire for FIRE VICTIMS

Statistics

		QI	QII	QIII	QIV	QV	QVI	QVII
N	Valid	13	13	13	13	13	13	13
	Missing	0	0	0	0	0	0	0
Mean		4.8462	4.7692	4.6923	1.4615	1.3077	1.7692	1.1538
Std. Deviation		.37553	.43853	.48038	.51887	.48038	.43853	.37553
Variance		.141	.192	.231	.269	.231	.192	.141
Sum		63.00	62.00	61.00	19.00	17.00	23.00	15.00

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	2	15.4	15.4	15.4
	SA	11	84.6	84.6	100.0
	Total	13	100.0	100.0	

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	3	23.1	23.1	23.1
	SA	10	76.9	76.9	100.0
	Total	13	100.0	100.0	

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	4	30.8	30.8	30.8
	SA	9	69.2	69.2	100.0
	Total	13	100.0	100.0	

QIV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	7	53.8	53.8	53.8
	D	6	46.2	46.2	100.0
	Total	13	100.0	100.0	

QV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	9	69.2	69.2	69.2
	D	4	30.8	30.8	100.0
	Total	13	100.0	100.0	

QVI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	3	23.1	23.1	23.1
	D	10	76.9	76.9	100.0
	Total	13	100.0	100.0	

QVII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	11	84.6	84.6	84.6
	D	2	15.4	15.4	100.0
	Total	13	100.0	100.0	

SPSS Output of Summary of thephysical observations and check list ratings on Availability of Firefighting Equipment installed and measures adopted in the Buildings by the owners.

Statistics

	QI	QII	QIII	QIV	QV	QVI	QVII	QVIII	QIX

N	Valid	153	153	153	153	153	153	153	153	153
	Missing	0	0	0	0	0	0	0	0	0
Mean		2.0000	1.0000	1.1242	1.0000	1.0719	1.0392	1.0000	1.0131	1.8758
Std. Deviation		.00000	.00000	.33087	.00000	.25916	.19475	.00000	.11396	.33087
Variance		.000	.000	.109	.000	.067	.038	.000	.013	.109
Sum		306.00	153.00	172.00	153.00	164.00	159.00	153.00	155.00	287.00

Frequency Table

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	AV	153	100.0	100.0	100.0

QII

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid NAV	153	100.0	100.0	100.0

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	134	87.6	87.6	87.6
	AV	19	12.4	12.4	100.0
	Total	153	100.0	100.0	

QIV

	Frequency	Percent	Valid Percent	Cumulative Percent

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	153	100.0	100.0	100.0

QV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	142	92.8	92.8	92.8
	AV	11	7.2	7.2	100.0
	Total	153	100.0	100.0	

QVI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	147	96.1	96.1	96.1
	AV	6	3.9	3.9	100.0
	Total	153	100.0	100.0	

QVII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	153	100.0	100.0	100.0

QVIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	151	98.7	98.7	98.7

	AV	2	1.3	1.3	100.0
	Total	153	100.0	100.0	

QIX

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	19	12.4	12.4	12.4
	AV	134	87.6	87.6	100.0
	Total	153	100.0	100.0	

SPSS Output of Summary of Questionnaire on Fire Safety measures

Statistics

		QI	QII	QIII
N	Valid	153	153	153
	Missing	0	0	0
Mean		1.7386	1.0131	1.0588
Std. Deviation		.44086	.11396	.23607
Variance		.194	.013	.056
Sum		266.00	155.00	162.00

Frequency Table

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	40	26.1	26.1	26.1
	AV	113	73.9	73.9	100.0

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	40	26.1	26.1	26.1
	AV	113	73.9	73.9	100.0
	Total	153	100.0	100.0	

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	151	98.7	98.7	98.7
	AV	2	1.3	1.3	100.0
	Total	153	100.0	100.0	

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NAV	144	94.1	94.1	94.1
	AV	9	5.9	5.9	100.0
	Total	153	100.0	100.0	

SPSS Output of Summary of thephysical observations and check list ratings on Functionability of Firefighting Equipment installed and measures adopted in the Buildings by the owners.

Statistics

		QI	QIII	QV	QVI	QVII	QVIII
N	Valid	153	19	11	153	2	134
	Missing	0	134	142	0	151	19
Mean		1.6667	1.2105	1.1818	1.0392	1.5000	2.0000
Std. Deviation		.47295	.41885	.40452	.19475	.70711	.00000

Variance	.224	.175	.164	.038	.500	.000
Sum	255.00	23.00	13.00	159.00	3.00	268.00

Frequency Table

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NF	51	33.3	33.3	33.3
	F	102	66.7	66.7	100.0
	Total	153	100.0	100.0	

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NF	15	9.8	78.9	78.9
	F	4	2.6	21.1	100.0
	Total	19	12.4	100.0	
Missing	System	134	87.6		
Total		153	100.0		

QV

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NF	9	5.9	81.8	81.8
	F	2	1.3	18.2	100.0
	Total	11	7.2	100.0	
Missing	System	142	92.8		
Total		153	100.0		

QVI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NF	147	96.1	96.1	96.1
	F	6	3.9	3.9	100.0
	Total	153	100.0	100.0	

QVII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NF	1	.7	50.0	50.0
	F	1	.7	50.0	100.0
	Total	2	1.3	100.0	
Missing	System	151	98.7		
Total		153	100.0		

QVIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	134	87.6	100.0	100.0
Missing	System	19	12.4		
Total		153	100.0		

SPSS Output of Summary of Question B in Section D1B

Statistics

		QI	QII	QIII
N	Valid	113	2	9
	Missing	0	111	104
Mean		2.0000	2.0000	2.0000
Std. Deviation		.00000	.00000	.00000
Variance		.000	.000	.000
Sum		226.00	4.00	18.00

Frequency Table

QI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	113	100.0	100.0	100.0

QII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	2	1.8	100.0	100.0
Missing	System	111	98.2		
Total		113	100.0		

QIII

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	9	8.0	100.0	100.0
Missing	System	104	92.0		
Total		113	100.0		

APPENDIXE

RESEARCH QUESTIONNAIRE

TOPIC: DEVELOPMENT OF FRAMEWORK FOR FIRE DISASTER PREPAREDNESS FOR BUILDINGS IN IMO STATE, NIGERIA.

<u>SectionA</u>

General Information: (Tickon the appropriate box)

Status ofRespondent.

i. Owner of Property ☐
ii. Tenant/ User ☐
iii. Architect ☐
iv. Builder ☐
v. Electrical Engineer ☐
vi. Mechanical Engineer ☐
☐

vii. Fire Brigade Personnel

viii. Town Planning Authority

ix. Fire Victim

1. Agebracket?

Below 30 31-39 40-49 50years andabove

2. Gender?

Male Female

3. Level of Education attained?

Primary Secondary Tertiary

4. Forhow longhaveyou been practicing in your field of profession?

Less than 3years 4- 6 7-9 above10

QUESTIONNAIREFOR COMMERCIAL BUILDING OWNERS/ OCCUPANTS/ USERS

1. How would you rank your agreement with the following as causes of fire in commercial buildings?

Use the following ratings/ Scores:

Note: SA = Strongly Agree (5)

A = Agree (4)

NS = Not Sure (3)

D = Disagree (2)

SD = Strongly Disagree (1)

(Tick Appropriately).

S/N	SUGGESTED CAUSES OF FIRE IN COMMERCIAL BUILDINGS	SA	A	NS	D	SD
		5	4	3	2	1

1	Use of Substandard Electrical materials					
2	Bad workmanship (Electricalinstallations)					
3	Lack of knowledge offire safety rules and regulations					
4	Faulty Electrical appliances					
5	Smokingin unauthorizedplaces					
6	Unseemlystorageof combustible materials					
7	Gas Leakages					
8	Improper disposal of lightedendsofcigarette andmatches					
9	Lightningandthunderstrikes					
10	Undue method of fuel storageinareasvulnerabletofire emergence					

QUESTIONNAIREFOR BUILDING OWNERS,OCCUPANTS/ USERS

1. The followingfirefighting equipment are availablein this building

(Tick appropriately)

S/No	Suggested Fire Safety Equipment	SA	A	NS	D	SD
		5	**4**	**3**	**2**	**1**
1	Drychemical extinguishers					
2	Halon extinguishers (vaporisingliquids)					
3	Foam cylinders					
4	Carbondioxide extinguishers					
5	Sprinklers/ Hose reels (pressurized water extinguishers)					
6	Wet chemical					

7	Fireblankets					
8	Sand					
	Anyother (specify)					

2. Areyou satisfied with thenumberof firefightingequipment available in this building?

Satisfied ☐ Not satisfied ☐ Not Sure ☐

3. You can Operate the followingFireFighting equipment enumerated below.

(Tickappropriately)

S/No	**Suggested Fire Safety Equipment**	**SA**	**A**	**NS**	**D**	**SD**
		5	**4**	**3**	**2**	**1**
1	Drychemical extinguishers					
2	Halon extinguishers (vaporisingliquids)					
3	Foam cylinders					
4	Carbondioxide extinguishers					
5	Sprinklers/ Hose reels (pressurized water extinguishers)					
6	Wet chemical					
7	Fireblankets					

8	Sand					
	Anyother (specify)					

4. The following fire safety strategies is/are available in this buildingin caseof fireoutbreak?

	Suggested Fire Safety Strategies	SA	A	NS	D	SD
		5	4	3	2	1
1	Emergencycommunication system (alarm, telephone, mobile no.)					
2	Regular inspection andmaintenanceof firefightingequipment					
3	Trained fire-fighting personnel in caseof fire outbreak					
4	Existenceof fire assemblypoint/emergency shelters forthis building					
5	Availabilityof anemergencyfiredisasterkit					
6	AccessibilitytoFirehydrants					
7	Existenceof insurance policy or cover for the occupants/tenants or users					
8	Regular Training and FireDrills					
	Anyother (specify)					

5. What isyourperceptionon the level of fire safety strategiesin this building?

Satisfied ☐ Not satisfied ☐ Not Sure ☐

6. The following fire safety measures are available in this building in case of fire occurrence?

	Suggested Fire SafetyMeasures	SA	A	NS	D	SD
		5	4	3	2	1
1	Fireinsurancepolicy					
2	Firesafetypolicy					
3	Evacuation plans					

4	Sanctions againstthose who disobeyfire safety regulations.					
5	Anyother (pleasespecify)					

7. What isyour perceptionon firecontrol and safety measures in this building?

Satisfied ☐ Not satisfied ☐ Not Sure ☐

8. (Write in the spaces provided)

In your opinion, how doyou think fire disaster preparednessmeasures in commercial building can be enhanced?

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QUESTIONNAIRE FOR **FIRE DISASTER VICTIMS**.

S/No	Fire Preparedness measures	SA	A	NS	D	SD
		5	4	3	2	1
1.	Fire outbreaks have occurred in this building before					
2	The cause of the fire outbreak could be trace to i. Faulty Electrical Appliances ii. Gas leakage					
3.	Damage level was severe					

4.	This firefighting equipment available during the fire event was satisfactorily effective					
5.	The firefighting equipment was effective and efficient					
6.	There are firefighting personnel in your work place in case of fire outbreak					
7.	You have had firesafety training on the use of firefighting equipment in case of fire emergence					

In your opinion, what doyou think could be done toimprovingfiredisaster prevention in commercial building design in Imo State?..

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QUESTIONNAIRE FOR **REGISTERED ARCHITECTS**

How would you rank your agreement with the following as causes of fire in commercial buildings?

Use the following ratings/ Scores:

Note:	SA	=	Strongly Agree	(5)
	A	=	Agree	(4)
	NS	=	Not Sure	(3)
	D	=	Disagree	(2)
	SD	=	Strongly Disagree	(1)

(Tick Appropriately).

S/No	Fire Preparedness measures	SA	A	NS	D	SD
		5	4	3	2	1
1.	You are familiar with fire prevention and control measures in commercial buildings					
2	At the design stage, provisions are made for fire safety in your building elements					
3.	The perception of your client in providing fire safety and control measures during Electrical design and practical installation of electrical accessories is satisfactorily good					
4.	The current rate of useof fire safety and control measures in Commercial buildings in Imo State is satisfactory good					
5.	The rate of the building elements (doors and windows) are satisfactorily good					
6.	These building elements (blockwalls, concrete and Wood) are fire proofed					

In your opinion, what doyou think could be done toimprovingfiredisaster prevention in commercial building design in ImoState?.....................................…………………………………………………………
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QUESTIONNAIRE FOR **REGISTERED BUILDERS**

How would you rank your agreement with the following as causes of fire in commercial buildings?

Use the following ratings/ Scores:

Note:
SA = Strongly Agree (5)
A = Agree (4)
NS = Not Sure (3)
D = Disagree (2)
SD = Strongly Disagree (1)

(Tick Appropriately).

S/No	Fire Preparedness measures	SA	A	NS	D	SD
		5	4	3	2	1
1.	You have participated in the design and construction of Commercial buildings					
2	You are familiar with thefire safety measures in commercial buildings					
3.	You have witnessed case(s)of fire disaster in commercial building before					
4.	Asabuilder, you do incorporate fire safety measures in commercial building during construction and electrical installation to prevent fire outbreak					
5.	The perception of your client in providing fire safety and control measures practical installation of electrical accessories is satisfactorily good					
6.	The rate of the building elements (doors and windows) are satisfactorily good					
7.	These building elements are fire proofed					

In your opinion, what doyou think could be done toimprovingfiredisaster prevention in commercial building design in ImoState?...
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QUESTIONNAIRE FOR **REGISTERED ELECTRICAL ENGINEER**

How would you rank your agreement with the following as causes of fire in commercial buildings?

Use the following ratings/ Scores:

Note:	SA	=	Strongly Agree	(5)
	A	=	Agree	(4)
	NS	=	Not Sure	(3)
	D	=	Disagree	(2)
	SD	=	Strongly Disagree	(1)

(Tick Appropriately).

S/No	Fire Preparedness measures	SA	A	NS	D	SD
		5	4	3	2	1
1.	You are familiar with thefire safety measures for commercial buildings					
2	You have participated in the electrical design of Commercial buildings before					
3.	The perception of your client in providing fire safety and control measures during Electrical design and practical installation of electrical accessories is satisfactorily good					
4.	You have witnessed case(s)of fire disaster in commercial buildings before					
5.	The cause(s) of the fire outbreak could be traced to: i. faulty electrical appliances, ii. use of substandard materials, iii. wrong wiring iv. gas leakages					
6.	The rate of current useof fire safety and control measures by Commercial buildings owners in Imo is satisfactorily good					

In your opinion, what doyou think could be done toimprovingfiredisaster prevention in commercial building design in Imo State?...

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QUESTIONNAIRE FOR **REGISTERED MECHANICAL ENGINEER**

How would you rank your agreement with the following as causes of fire in commercial buildings?

Use the following ratings/ Scores:

Note:	SA	=	Strongly Agree	(5)
	A	=	Agree	(4)
	NS	=	Not Sure	(3)
	D	=	Disagree	(2)
	SD	=	Strongly Disagree	(1)

(Tick Appropriately).

S/No	Fire Preparedness measures	SA	A	NS	D	SD
		5	4	3	2	1
1.	You are familiar with thefire safety and suppressive measures for commercial buildings					
2	You do make provisions for fire safety in the design of Commercial buildings					
3.	The perception of your client in providing fire safety and control measures mechanical design and practical installation of the designed suppressive system is satisfactorily good					
4.	The rate of current useof fire safety and suppressive measures by Commercial buildings owners in Imo state is satisfactorily good					

In your opinion, what doyou think could be done toimprovingfiredisaster prevention in commercial building design in Imo State?..

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QUESTIONNAIRE FOR **DEVELOPMENT CONTROL OFFICERS (TOWN/URBAN AND REGIONAL PLANNING AUTHORITY** – OWERRI, ORLU AND OKIGWE - OFFICES)

How would you rank your agreement with the following as causes of fire in commercial buildings?

Use the following ratings/ Scores:

Note:	SA	=	Strongly Agree	(5)
	A	=	Agree	(4)

NS	=	Not Sure	(3)
D	=	Disagree	(2)
SD	=	Strongly Disagree	(1)

(Tick Appropriately).

S/No	Fire Preparedness measures	SA	A	NS	D	SD
		5	4	3	2	1
1.	You do consider Environmental Impact Assessment of these Commercial buildings before given approval					
2.	Asa Town Planning Officer,you doensurethe incorporation of fire safety measures in the design of commercial building working drawings					
3.	These commercial buildings do secure government approval/ authorization before building construction takes place					
4.	These Commercial buildings are located according to Town/Urban and Regional planning procedures					
5.	The level of compliance of these commercial buildings with the provision of fire safety acts and design codes or standards is satisfactorily good					

In your opinion, what doyou think could be done toimprovingfiredisaster prevention in commercial building design in Imo State?...

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QUESTIONNAIRE FOR**FIRE SERVICE PERSONNEL**

How would you rank your agreement with the following as causes of fire in commercial buildings?

Use the following ratings/ Scores:

Note:	SA	=	Strongly Agree	(5)
	A	=	Agree	(4)
	NS	=	Not Sure	(3)

D	=	Disagree	(2)
SD	=	Strongly Disagree	(1)

(Tick Appropriately).

S/No	Fire Preparedness measures	SA	A	NS	D	SD
		5	4	3	2	1
1.	There is regular inspection and maintenanceoffirefightingequipment of commercial buildings in compliance with the provisions of firesafety acts and regulation in Imo State					
2	You do issue fire safety certificate for these commercial buildings					
3.	Commercial buildings in Imo State havethenecessary firefightingequipment					
4.	The level of availablefirefightingequipment in these commercial buildings is satisfactory					
5.	The owners/occupants of commercial buildings do undergo firesafety training regularly					
6.	The readiness (Utility vehicles/ trucks)andcapabilityofyourfirefighting personnel and equipment to handle fire emergencies is satisfactorily good					
7.	Your emergencycommunication system (alarm, telephone, mobile no.) is satisfactorily good					

In your opinion, what doyou think could be done toimprovingfiredisaster prevention in commercial building design in Imo State?..

....

QUESTIONNAIRE FOR EXAMINING FIRE DISASTER PREPAREDNESS AND COMPLIANCE LEVEL OF COMMERCIAL BUILDING OWNERS WITH DESIGN STANDARDS, FIRE SAFETY ACTS AND CODES

(Tick Appropriately)

Under the followingheadings:

i. Constructionmaterials

ii. Firedetection devices
iii. Firesuppression devices
iv. Firespread control strategies
v. FireSafety

Use the following ratings/ Scores:

VG	=	Very Good	(5)
G	=	Good	(4)
NS	=	Not Sure	(3)
P	=	Poor	(2)
VP	=	Very Poor	(1)

S/NO	**FIRE DISASTER PREPAREDNESS MEASURES**	**RATING/ SCORING**				
		VG	**G**	**NS**	**P**	**VP**
		5	**4**	**3**	**2**	**1**
A.	**HOW WOULD YOU RANK THE CONSTRUCTION MATERIALS USED FOR THIS BUILDING?**					
i.	Hard Wood					
ii.	Sand Crete block					
iii.	Burnt bricks					
iv.	Concrete					
v.	Reinforcement bars					
vi.	Glass					
vii.	Aluminum					
viii.	Polyvinylchloride (PVC)					

B.	**HOW WOULD YOU RANK THE EFFECTIVENESS OF THESE FIREDETECTION DEVICES?**					
i.	Fire alarms					
ii.	Smokedetectors					
iii.	Smoke vents					
C.	**WHAT IS YOUR AGREEMENT WITH FIRESUPPRESSIVE MEASURES IN THIS BUILDING?**					
i.	Watersprinklers					
ii.	Firehydrants					
iii.	Fire extinguishers					
Iv	Hose reels					
D.	**HOW WOULD YOU RANK THE FIRESPREADCONTROL MEASURES PROVIDED IN THIS BUILDING?**					
i.	Fire compartment					
ii.	Firegrading					
iii.	Firestopping					
iv.	Firewall					
v.	Fire resisting doors and windows					
E.	**WHAT IS THE LEVEL OF YOUR PERCEPTION ON THE AVAILABILITY OF THE FOLLOWING FIRESAFETY MEASURES IN THIS BUILDING?**					
i.	Exitaccess or Means of Egress					
ii.	Appropriate Signage					

OBSERVATION/CHECK LIST FOR AVAILABILITY OF FIREFIGHTING EQUIPMENT INSTALLED AND MEASURES ADOPTED BY COMMERCIAL BUILDING OWNERS

(Tick appropriately)

S/NO	ITEMS TO BE OBSERVED	AVAILABLE	NOT AVAILABLE
A.	**FIRE FIGTHING EQUIPMENT**		
i.	Dry chemical extinguishers		
ii.	Halon or vaporizing liquids extinguishers		
iii.	Foam cylinders		
iv.	Carbon dioxide extinguishers		
v.	Sprinklers/ Hose reels (pressurized		
vi.	Wet chemical		
vii.	Fire blankets		
viii.	Fire hydrant (Internal and External)		
ix	Sand		
B	**FIRE SAFETY MEASURES**		
i.	Emergency communication system (alarm, telephone, mobile no.)		
ii.	Existence of fire assembly point/emergency shelters and evacuation of people for this building		
iii.	Existence of Emergency population warning methods		

OBSERVATION/CHECK LIST FOR FUNCTIONABILITY OF FIREFIGHTING EQUIPMENT INSTALLED AND MEASURES ADOPTED BY COMMERCIAL BUILDING OWNERS

(Tick appropriately)

S/NO	ITEMS TO BE OBSERVED	FUNCTIONAL	NOT FUNCTIONAL
A.	**FIRE FIGTHING EQUIPMENT**		
i.	Dry chemical extinguishers		
ii.	Halon or vaporizing liquids extinguishers		
iii.	Foam cylinders		
iv.	Carbon dioxide extinguishers		
v.	Sprinklers/ Hose reels (pressurized [illegible]		
vi.	Wet chemical		
vii.	Fire blankets		
viii.	Fire hydrant (Internal and External)		
ix	Sand		
B	**FIRE SAFETY MEASURES**		
i.	Emergency communication system (alarm, telephone, mobile no.)		
ii.	Existence of fire assembly point/emergency shelters and evacuation of people for this building		
iii.	Existence of Emergency population warning methods		

NOTES
