Chapter9: Implications of the Human Factor Approach Pertaining to Fire Safety Management in Public Leaning Institutions: Case of the University of Zimbabwe

TAPERA S. MAKAZA

9.1 CHAPTER SUMMARY

The aim of this study is to assess the level of inclusion of the Human Factor (HF) approach in fire safety management (FSM) system at the University of Zimbabwe (UZ). The HF approach is the basis of substantial outcomes achievement in terms of human-centred development and evasion from hazardous risk events in any society. Likewise, in any property type (commercial, residential, industrial or institutional), the efficacy and efficiency of FSM is determined by the level of incorporation of HF competences which include readiness, preparedness, ability, awareness and capacity to deal with fire issues without any probing. The occurrence of fire incidents in public learning institutions is exceptional, but in case of its emergency, it results in catastrophic destructions of both occupants and valuables. Regardless of the existence of modern and advanced fire safety equipment in public learning institutions fire hazards are recorded and continue to be a potential hazard mainly due to the failure to adopt the HF approach by the responsible team

to ensure that occupants have the technical expertise on how to operate the equipment. In a bid to achieve the aim of the study, the triangulation research approach was utilised through integration of primary and secondary (documentary review) research methods. To obtain primary data, 50 questionnaires were administered to both students and staff, interviews were conducted with the fire safety department and department heads, as well as observation by the researcher. The outcomes of the study reflected that the level of the HF concept inclusion in FSM at UZ is at the infancy stage. Thus, to ensure that institutional building occupants are free from fire risk, the study suggests the fire safety management team to provide skills through training and educating building occupants towards the use of fire safety equipment.

9.2 INTRODUCTION

From the industrial revolution era, fire has been regarded as an essential human need that people cannot live without (Pauly, 1984; Pires, 2004; Rahim, Taib and Mydin, 2014). However, if it is uncontrollable, it can be dangerous. Building fire is a potential hazard in each building category (residential, commercial, industrial and institutional). Sabramaniam (2004) and Kobes, Helsloot, De Vries and Post (2010) suggest that fires cause serious or fatal injuries to building occupants and inflict direct material damage to buildings and valuables, and at the same time, cause indirect consequential losses such as loss of production and employment.

Unlike industrial properties, education institutional buildings are perceived as low fire risk due to their designation of purpose which refers to the intended use as may be stipulated in the building by-laws (Walton, Carpenter and Wood, 2016). The possibility of fire occurrence in such buildings tends to be low but in case of its emergency, the gravity tends to be high which can result in mass destruction. Generally, such buildings have advanced fire safety systems installed, but incidences of fire become the greatest threat to health and safety of occupants because of scant knowledge towards fire safety (Mydin, Sani, Abas and Khaw, 2014). In support of the idea, Proulx and Richardson (2002) state that there is inadequate recognition of the importance of the behaviour and reactions of building occupants in relation to their knowledge of fire safety hence exposes them as potential victims. Thus, the purpose of this study is to assess the relationship between the HF approach and FSM system at the UZ. The university staff (teaching and ancillary) and students were the target respondents in this study.

9.3 Background to the Study

Building premises are enclosed by a large body of legislation designed primarily to protect the rights, health and safety of occupants (Atkins and Brooks, 2009). The major reason is that it is morally unethical for the occupants to be exposed to unnecessary and avoidable risks. By their nature, building operations are dynamic, highly capricious and complex. They

are prone to various types of risks which can be viewed as wickedness that can be avoided. Of the risks associated with building operations, fire is regarded as the most harmful, though it rarely occurs. Every building is at risk of fire and complete safety is not possible, hence the call for an establishment of fire precautions within buildings (Stollard and Abrahams, 2002). The materialisation of fire safety in buildings came after a prominent number of fire cases like the Great Chicago Fire (October 8, 1871); the Great Boston Fire (November 9, 1872) and Our Lady of the Angels School Fire (December 1, 1958), among others (Pauly, 1984), caused loss of hundreds of lives and mass destruction of property worth millions of dollars.

As opined by Pires (2005), Furness and Muckett (2007) and Kobes *et al.* (2010), each year a notable number of building damages, loss of property and lives due to fire hazards are recorded across the globe. Most of these fires are less preventable especially in the case of lack of attention towards fire safety by building occupants, hence exposing them as potential victims (Kobes *et al.*, 2010). In all property categories (residential, commercial, industrial and institutional), fire hazards arise unexpectedly but the efficacy towards its management is usually centred on the HF concept. Therefore, is an understanding of the HF concept which may enable the organisations to manage the effects that humans have upon risks control systems. The safety of occupants depends largely

on their skills, capacity and ability to use the building or work 'safely', based on risk awareness, knowledge and experience (Furness and Muckett, 2007). The major question is, does lack of technical knowhow by occupants on the use of fire equipment make them potential victims of fire hazards?

Existing literature on health and safety in facilities management for example (Meacham, 1999; Sabramaniam, 2004; Kobes *et al*., 2010), generally, seems to suggest that the occurrence of fire in public learning institutions is minimal. But, when occurs, it results in destructive consequences for both occupants and valuables (Pires, 2005). Despite advanced fire safety systems being installed in buildings, incidences of fire are regarded as the greatest threat to safety and health as well as property in any society (Rahim, *et al.*, 2014). Fire disasters still occur in public learning institutional buildings regardless of the presence of fire-fighting equipment. Nevertheless, lack of HF development aggravates damage and rate of fatality during fire events. It is still recognised that many basic HF principles, guidance, elements and techniques are not incorporated into safety system design and management of various premises. This study seeks to explore the level at which the HF concept is incorporated in managing fire safety issues as well as the effectiveness and efficiency of the FSM at the UZ. Unless a vigorous system which includes full orientation and training of all staff and students as well as regular checks and servicing of

fire safety equipment is done properly in relation to fire safety standards, building occupants will always be at risk.

The chapter assess the level of inclusion of the human factor approach in fire safety management system at the UZ. The study objectives include assessing the level of availability and the condition of existing fire safety systems in university buildings; to evaluating the level and degree of unification of the human factor approach in university's fire safety management; assessing stakeholders' perceptions on the operations of the institutional fire safety team; identifying and explaining the challenges faced in adopting the human factor approach in fire safety systems at the institution and suggesting possible alternatives for the enhancement of the human factor concept in fire safety management at the UZ. The International Standard Organisation's Occupational Safety and Health (OHSA: 18001) in Kobes *et al*. (2010) states that awareness of the fire system by building occupants is desirable as limited appreciation may lead to grave results in an emergency. Therefore, there is need for effective methods to improve awareness and efficacy of fire safety levels, for instance, through participation in related fire safety programmes, distribution of pamphlets or brochures on fire safety and appointing specific personnel to an emergency response team in buildings (Meacham, 1999; Rahim, *et al*., 2014). The adoption of these strategies may boost positive safety culture within

organisations, hence reduction of wastages and costs and improving productivity and social wellbeing.

The motivation of this research is based on the paucity of reported data on the level of HF concept fusion in buildings' fire safety. There is scant literature on the level of fire safety knowledge of the building users (staff and students) and the effectiveness of the FSM in Zimbabwean public learning institutions. Therefore, this study seeks to show how the HF concept explains and influences the effectiveness of fire safety management system at the UZ. The findings might act as a reminder that can enlighten the university technical staff to ensure that occupants of various buildings are aware of fire-fighting procedures and systems in case of a fire outbreak. Furthermore, it will aid managers of non-institutional properties (commercial, residential and industrial) to make sure that their tenants are aware of the fire risk to minimise impact. This will also act as an informer to government authorities on the public learning institutions' levels of compliance to fire safety regulations and then mapping ways to enforce them.

The University of Zimbabwe is the oldest and one of the largest of 12 Zimbabwean universities. Infrastructure wise, the university has many buildings which include administration and office blocks, hostels, dining halls, lecture theatres, staff quarters, libraries and workshops. It has a population of more than 17 000 including both students and staff (ancillary and

teaching) and these are the main occupants of university buildings.

9.4 Literature Review and Theoretical Underpinnings

Fire risk refers to the likelihood of a fire occurring in a building multiplied by its severity, that is, the 'harm potential' and consequences in terms of loss of lives, fire spread and damage of property (Pires, 2005). Fire Safety Management is described as an avenue of preventing outbreaks of fire and mitigating the direct consequential damages by early detection, reducing spread by structural containment, providing escape routes, emergency evacuation procedures and means for fighting (Sabramaniam, 2004). Human Factor was defined by Adjibolosoo (1995) as the spectrum of personality characteristics and other dimensions of human performance that enable social, economic and political institutions to function and remain functional over time. It also refers to the person's awareness, ability and capacity to deal with a task without any probing and he/she knows what to do, when to do it, why it is done as well as the likely consequences of doing or not doing the task (Mararike, 2014).

Occupational Safety and Health is described by Furness and Muckett (2007) as factors and conditions that can affect the well-being of persons within the workplace, i.e. employees, contractors, temporary workers and visitors. It involves the science of the anticipation, recognition, evaluation and control

of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on surrounding communities and the general environment (Ridley and Channing, 2008) and, finally a public learning institution, also known as an educational institution, is a place where people gain an education, including preschools, childcare, primary-elementary schools, secondary-high schools, and universities. They provide a variety of learning environments and learning spaces (Davidson and Goldberg, 2009).

Conceptual Framework

Generally, the major aim of fire safety is to: reduce fire outbreaks; provide sufficient fire-fighting facilities and escape of building users; reduce fire spread in buildings and to their neighbouring buildings; and reduce property damages (McFadden, 1989, Stollard and Abrahams, 1999; Furness and Mucket, 2007). Further, Stollard and Abrahams (1999) argue that fire prevention is intended to reduce sources of ignition and is associated mostly with equipping the building occupants with education on how to minimise fire causation. The effectiveness and efficiency of fire safety in buildings are recognised as reliant attributes of the HF approach. That is, the availability of fire-fighting facilities, fire protection and/or prevention measures adopted by various stakeholders as well as awareness, capacity, ability and technical knowhow on the utilisation of fire safety systems by the occupants, determine the effectiveness of fire

safety management. Changes in these autonomous variables, impinge on the level of fire safety within a building (Drysale, 2003).

According to Subramaniam (2004), there are several variables that affect occupants' fire safety behaviour and lifestyle which include predisposing factors, reinforcing factors and enabling factors as portrayed in Figure 9.1 and these need to be well coordinated in order to have adequate fire safety. The predisposing factors constitute individual characteristics such as knowledge, beliefs, attitudes and perceptions that impinge on safety behaviour motivation of individuals, whilst reinforcing factors include feedback, societal influences, repercussion and societal opportunities for a specific behaviour (*ibid.*). He further states that enabling factors, like availability of fire safety resources, access, policies, as well as skills in fire-fighting influence motivation towards human behaviour on fire safety.

However, it has been noted that, though legislation encourage building occupants to be well versed in building fire safety operating systems, management of several public institutional buildings take this for granted, hence leaving occupants exposed to potential fire risks (McFadden, 1989; Drysale, 2003). Thus, for public institutions to achieve the goal of fire safety as reflected in Figure 9.1, they must constitute HF competences which aid the occupants to react and act positively in case of fire emergencies without any probing because failure

to contain fire and escape from affected areas might result in loss of lives and valuable properties.

Basically, in a bid to ensure efficient and effective FSM in any building type, it is important to understand the fire science in buildings that gives an insight into the chemistry of fire (mechanism of ignition and fire growth); classification and causes of fire; as well as typologies of fire spread (Furness and Mucket, 2007). According to Drysdale (2003), the key features of fire are common, even if they emanate from different causes.

Fire is a result of a series of very rapid chemical reactions between fuel and oxygen (combustion) and application of sufficient heat to originate ignition (Stollard and Abrahams, 1999; Furness and Mucket, 2007). According to Stollard and Abrahams (1999), for combustion to occur, adequate sources of oxygen, heat and fuel shown on the fire triangle must all be in existence and the removal of any one of the three (heat, fuel or oxygen) will stop the reaction. A "fire triangle" refers to a pictorial illustration of the three determinants for a fire to start and once started, to continue to burn (Todd, 2008). Basically, all materials have ability to burn provided they get ample heat to cause molecules to break down and give off vapour which ignites. As the material that is involved with the combustion or fire decomposes, the material that is left has less ability to react, ultimately causing the fire to die down or decompose on a process called pyrolysis (Sabramaniam, 2004).

Figure 9.1: *Fire Triangle* (Furness and Mucket, 2007, p. 117)

It is crucial to have an understanding on how fires occur within different spaces (open and enclosed) as well as stages in development, particularly of an enclosed fire (Stollard and Abrahams, 1999). Having that understanding helps building occupants to know if they can control the fire on their own or call the Fire Brigade. Figure 9.2 shows fire growth or combustion process which has four main phases. The commencement phase is the induction or incipient stage which arises when constituent parts of the triangle consolidate and instigate reactions. It is then followed by the growth stage where if there is a continuous supply of oxygen or fuel, the reactions become rapid and grow in concentration, while producing huge volumes of smoke (unburnt products of

pyrolysis). Furness and Mucket (2007) opine that the time taken in the growth of fire may be from a few minutes to several hours, dependent on prevailing conditions (size of the room, the surface linings, the availability of oxygen and a variety of complex chemical reactions). It is at that stage of growth that the "flashover point" is experienced, noted as the point at which the fire involves all the combustible materials within the room or area and that transition usually represents the start of the stable phase of the fire (*ibid.*).

Nevertheless, Stollard and Abrahams (1999) state that if there is inadequate ventilation during the growth phase, the fire will not reach the flashover point due to oxygen starvation, hence it may decompose or continue to smoulder (only occur in porous materials such as paper, cardboard, sawdust, fibreboard). Smouldering fire, as suggested by Mydin *et al.* (2014), can be extremely dangerous as enclosures fill with flammable vapours which, when getting a new a supply of oxygen (for example, by a door being opened) especially when fire fighters trying to rescue victims, may ignite with an eruption of flame. High or wide compartments , have functional sprinklers and limited materials to burn; the smoke is unlikely to reach temperatures that might result in flashover (Karlsson and Quintiere, 1999).

The third phase is the "fully developed" stage, which is characterised by reactions that are not as rapid as in the growth stage but the fire persists to burn the available oxygen supply

and fuel sources. Stollard and Abrahams (1999) opine that this "fully developed stage" is characterised by massive flames and very high temperatures (in excess of 300^0C), usually controlled by the amount of oxygen supplied rather than the fuel. The final phase is the decay stage, where after having consumed all the available fuel, the fire dies down and is eventually extinguished. It can be as a direct result of fire service intervention or can occur naturally when there is no further oxygen or fuel to support the combustion process (Stollard and Abrahams, 1999; Della-Giustina, 2014).

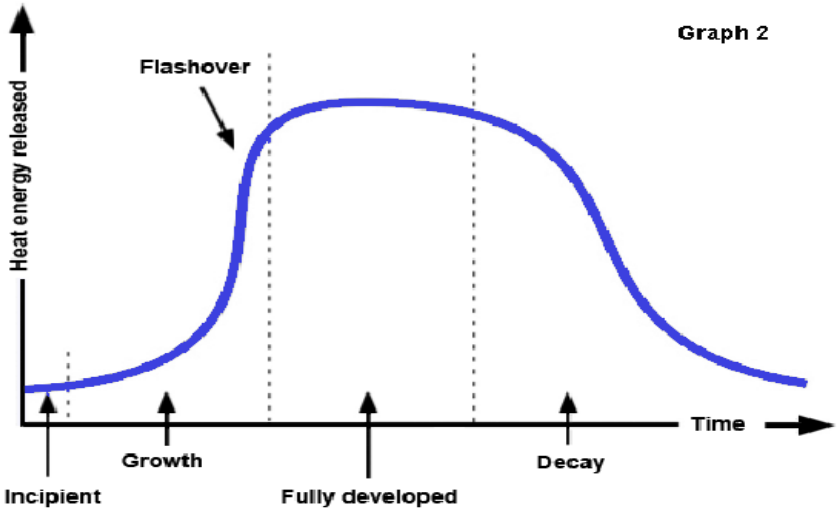

Figure 9.2: *Fire development process* (Furness and Mucket, 2007:117)

To classify fire, it is essential to understand the sources of fuel. Having an understanding of the fire typologies helps the occupants when it comes to firefighting to use the appropriate

extinguishing equipment that include: dry chemical; carbon dioxide; wet chemical, dry powder; pressurised water/foam and halon extinguishers. Fire, according to Della-Giustina (2014), is generally broken down into the following main groups:

CLASS "A" – These are fires fuelled by solid materials or carbonaceous (carbon-based) which include wood, cardboard, paper, hardboard, soft furnishings such as carpets and curtains and materials such as plastics, foam rubber and even metal. These materials usually turn into ashes after burning and can be best extinguished by removing the heat aspect of the triangle. Extinguishers suitable for such typical fires must be water or foam extinguishers usually labelled with letter "**A**".

CLASS "B" – These are fires fuelled by flammable liquids that release vapour and these include petrol, paraffin, white spirit, thinners, varnish and paints. The best way to extinguish them is by blanketing or smothering. Suitable extinguishers are identified by a square containing the letter "B", or must be red in colour. Water must not be used.

CLASS "C" – Common throughout workplaces, flammable gasses which include natural gas and liquefied petroleum gas (LPG) (butane and propane) stored in pressurised cylinders for cooking, heating, plumbers' torches, fuel these fires. Blanketing or smothering extinguish fires in this category, and the

extinguisher suitable should be dry chemical or carbon dioxide, identified by a circle containing the letter “C”.

CLASS “D” – These are fires involving combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium. Dry powder is usually used as an extinguishing agent and the suitable extinguisher should be identified by a star containing the letter “D”.

CLASS “F or K” – This refers to fires that involve cooking mediums such as vegetable or animal oil and fats in cooking appliances, Such fires are particularly difficult to extinguish as they retain considerable heat allowing the chemical reaction to restart. Wet chemical is regarded as the most appropriate extinguishing agent and the extinguisher should be identified with the letter “F” or “K”

Fire Safety Management

Basically, from the field of property investment, facilities management deals with a lot of issues, including lease agreements, janitorial services, maintenance services, finance management, risk management as well as health and safety management (Atkins and Brooks, 2009). These aspects are of essence towards effective operations of any type of property. Health and safety of building users are very important so much that governments, through various regulatory authorities and statutory instruments, that issue to ensure that the welfare of

occupants is not undermined (Stollard and Abrahams, 1999). Among the facets that health and safety management deals with, FSM is of paramount importance. If tenants recognise that the building is not complying with fire safety standards as may be stipulated by by-laws, they may terminate their lease contracts and vacate the premises, which may lead to loss of market share (Vanier, 2001; Furness and Mucket, 2007).

Similarly, in the context of public learning institutional properties, if it is discovered that the institutional FSM policies are not in compliance with the set standards, there is a possibility of high turnover of both student and staff at such institutions (Sabramaniam, 2004). In support of the notion, Kobes *et al.* (2010) assert that an institution characterised by premises with inadequate and malfunctioning fire safety systems as well as occupants with limited knowledge of firefighting is at great risk of fire. That is, in case of a fire outbreak, entire buildings and valuables might be ravaged and occupants fatally affected. This means that fire safety is very important because the occurrence of fire is unpredictable, and the management team must always be alert; provide adequate fire-fighting and service equipment and educate occupants on the use of equipment.

To tackle FSM from another angle, Sabramaniam (2004) and Mydin *et al*., (2014) suggest that the effectiveness and efficiency of FSM in institutional buildings are centred on the

capability of being acquainted with HF development which is centred on human behaviour and knowledge about fire issues. Nonetheless, as opined by Proulx and Richardson (2002), there is inadequate recognition on the importance of the behaviour and reactions of the human occupants in relation to knowledge about fire safety in public learning institutions. Therefore, it means that the fire safety team has an obligation of providing adequate knowledge to occupants of the fire safety issues (firefighting and evacuation), such that they can help themselves in fire emergency (Mydin *et al.,* 2014). Thus, the HF approach (Adjibolosoo, 1995; Mararike, 2014) is not something that can be disregarded in the design and evaluation of fire management systems.

The Human Factor Concept

The main proponent of the HF Approach is Senyo Adjibolosoo, a Ghanaian scholar who is also a founder and Director of the International Institute for Human Factor Development (IIHFD) (Mararike, 2014). From the socio-economic development perspective as pointed out by Adjibolosoo (2000), a lot of relief programmes in the form of food aid, clothing, pharmaceutical drugs and evacuation aid from hazardous risk areas are being done in Third World nations in a bid to improve living standards, but these activities do not seem to achieve substantial outcomes in terms of desired sustained economic growth and human-centred development. He further suggested that the reason for failing to improve social and economic conditions by

both government organisations (GOs) and non-governmental organisations (NGOs) is their inability to recognise the significance of appropriate HF activities and how to go about developing them. That failure is fuelling overdependence on assistance from various societies during hazardous risk events in the long run and render them victims. It, therefore, means that there is need to develop the creative potential of people so that they can rely on their own efforts and be innovative in case a need arises (Chivaura and Mararike, 1998). Most importantly, the people may become independent, fully responsible and accountable for their successes when encountering difficult issues (Adjibolosoo, 1995; 1998; 2000; Chivaura and Mararike, 1998).

In a bid to eradicate overdependence and develop the creative potential of people, there are certain universal principles that society needs to recognise which include: personal responsibility, accountability, integrity, commitment, selflessness and liberty (Adjiboloso, 2000). These doctrines are attained only if the HF approach is adopted since it is the only avenue of success for any organisation or society (Mararike, 2014). As far as risk management is concerned, focusing on the HF inculcate knowledge and skills in people (potential victims) so that they can save themselves in case of hazardous events like fires and floods (Chivaura and Mararike, 1998; Beijerse, 1999; Adjibolosoo, 2004).

The HF is "the spectrum of personality characteristics and other dimensions of human performance that enable social, economic and political institutions to function and remain functional over time…" (Adjibolosoo, 1993:142). The HF concept is, therefore, about the impact of personality characteristics on a person's performance, effectiveness as well as efficiency towards tackling a certain task, hence it is concerned with the quality of people (Mararike, 2014).

Elements of the Human Factor Approach and Fire Safety

The emphasis of the HF approach is on the quality of people involved in an activity, their commitment to the ideals of their society, and their remaining in position and following a set agenda (Mararike, 2014). For the application of the HF approach to be possible in the context of health and safety, there must be consideration of some elements which include HF content, HF competence and HF engineering (*ibid.*).

Human Factor Content

This constitutes personality characteristics such as discipline, commitment, reliability and dedication. In public learning institutions, the building occupants (staff and students) must be disciplined, committed, reliable and dedicated when it comes to their own safety. Nevertheless, Mydin *et al.* (2014) suggest that in most institutional buildings, occupants lack discipline and dedication as they misuse the fire safety equipment yet the occurrence of fire is unpredictable and, therefore, in the event

of a fire emergency, the facilities might not be in good condition. Stollard and Abrahams (1999) add that some turn water in hose reels to their own personal, hence leaving them vulnerable the need arise.

Human Factor Competence

This refers to a person's organisational skills and capacity to deal with tasks which one will have set for himself/herself or by an organisation or society of which one is a member (Maraike, 2015). Basically, individuals achieve intended goals because of the use of their HF competences which include readiness, preparedness, ability, willingness, awareness and capacity to act and react to both internal and external stimuli. In case of fire safety management, these aspects play a pivotal role as they determine its efficacy and efficiency. It is encouraged that occupants must have technical knowhow towards operations of fire safety equipment to fight for themselves in case of fire outbreak (Mydin, 2014). However, Furness and Mucket (2007) argue that, in most public learning institutions, students and staff lack the skills and knowledge of operating fire-fighting facilities despite their availability.

Human Factor Engineering

According to Adjibolosoo (1998), HF engineering refers to how a person responds to the demands of a task and at the same time it is an indication of how motivated a person is to tackle the task. In addition, a person whose HF engineering is sound

carries out tasks without any probing and he/she knows what to do, when to do it, why it is done, how it is done and the likely consequences of doing or not doing the task (Mararike, 2014). In the context of safety and health management, HF is regarded as of great importance as many institutional buildings contain advanced fire safety equipment, but most of the occupants do not have the technical 'knowledge of how to operate the equipment as well as the appropriate procedures to vacate affected areas.

Legislation on Fire Safety in Zimbabwe

In Zimbabwe, there are a number of statutes that provide for fire safety management in buildings. The principal act governing health and safety issues is the Factory and Works Act Chapter 14:08, governed by the National Social Security Authority (NSSA) Occupational Health and Safety Department. In accordance with the provision of section 13 of the subject act, building owners are obligated to ensure efficient and effective management of fire safety issues in a property of any category and failure to abide by the prescribed demands attracts a criminal liability which may result in fines and/or imprisonment.

In addition, the Model Building By-laws (MBBL) (1977) used to provide clear guidelines on fire safety related issues in all building types, both non-institutional and institutional. That legal document was enforced by local planning authorities (LPAs) in their areas of jurisdictions. Chapter 11 of MBBL

stipulates that all building must have fire-fighting equipment and escape means. The scope and nature of equipment is determined by the size and use of a building. Generally, in the larger the building, the more sophisticated equipment and designs required for public learning institutional buildings. Examples of fire-fighting equipment required in buildings as stated in the by-laws include: fire alarms; fire extinguishers; fire blankets; sprinklers; fire hose reels and fire retardants, in accordance with provision of sections 49, 50 and 51. Additionally, it is stated under section 33 of Chapter 11 that the escape routes and emergency exit points should be distinctively and conspicuously marked in green letters of at least 15 cm in height to ensure visibility.

The by-laws suggest that public buildings must have hose reels, and these must be checked on yearly basis subject to the provision of section 52. The responsible team must also ensure that there is no illegal use of water since it must be available in case of a fire outbreak (Stollard and Abrahams, 1999). In addition, fire safety managers, with the help of facilities managers, must make sure that no partitions interfere with fire escape routes to lessen the evacuation time during a fire as according to section 33. Kobes *et al*. (2010) state that at some points occupants might be ignorant and stack objects on fire equipment which may pose accessibility problems when the need arises. This reflects lack of positive HF quality which will

require the management team to alert and educate new occupants.

The by-laws in accordance with sections 6 and 54 requires the installation of fire sprinklers, normally fixed in the ceiling and activated by heat-sensitive fire alarm. Their positions is strategically important as they reduced the effect of converted (hot gases and smoke) heat from the fire (Shields *et al.*, 1999). However, despite that the by-laws emphasising the installation of smoke detectors and fire alarms to alert occupants, some occupants are not familiar with fire alarm signals and do not know what they mean, yet they are supposed to commence evacuation to the outdoor fire assembly point in accordance with the provision of section 33. In turn, this is a requirement for fire safety team to educate occupants about the meaning of the alarm and evacuation procedures as according to section 20. the section also mandates the fire safety team to educate occupants on the use of the fire safety equipment in order to protect themselves in case of fire outbreaks (Rahim, *et al*., 2014)

Fire Risk Assessment

In any property, the FSM team must carry out fire risk assessment that will lend a hand to making certain that the fire safety procedures, fire prevention measures, and fire precautions (plans, systems and equipment) are all in place and working properly. According to Stollard and Abrahams (1999),

the Health and Safety Authority of United Kingdom recommended the following procedure for undertaking risk assessments: identifying potential fire hazards like ignition sources and fuel sources that might contribute to ignition and initial fire growth as this is an important part of traditional hazard analysis; carrying out a fire risk assessment and preparing a written safety statement to deal with fire safety risk to alert occupants to take necessary procedures during a fire emergency.

Fire Fighting

Since fire is a combination of triangle components (heat, oxygen and fuel) as demonstrated earlier in Figure 9.2, the removal of one of these components douses the fire. Different fire extinguishers are designed specific types of fire. Knowing the classes of fire helps the occupant to choose the appropriate extinguisher. Also, labelling on the fire extinguisher identifies which class of fire it is appropriate for; Class A, B, C, D or K and instructions on how to use it. Further, if the occupants discover a fire in the building, they should follow 3 As':- Activate; Assist and Attempt (Walden, 1989).

Activate – in this scenario building occupants should activate the buildings fire alarm system to alert others and at the same time notify the emergency services. *Assist* – the occupants should assist those who are in immediate danger or who are incapacitated but this must not done at the helper risk. *Attempt*

–occupants should attempt to fight fire only after the first two steps have been completed and if they feel confident to do so. They must always have an exit to their back in case they need to escape. They should never attempt to fight a fire if there is heavy smoke since it can be extremely toxic and reduces visibility. They should only fight small emerging fires, since it is those small fires that might grow big and become dangerous.

According to Walden (*ibid.*) a fire extinguisher should be used when: the fire is contained and not spreading; the extinguisher is readily available; the occupant knows how to use it properly; personal safety is not compromised; and there is a clear path for escape. Thus, having such an understanding is very crucial as far as fire safety is concerned and this determines the level at which the human factor is incorporated in institutional premises. The management team should be in a position of making sure that all property occupants are well versed in and understand the basic principles of fire safety.

Emergency Evacuation

According to Stollard and Abrahams (1999), the primary aim of fire safety is to safeguard human life and, in the case of most buildings, the protection of property is a secondary consideration. So, for to safeguard the lives of building occupants in case of fire, they must vacate the affected premises. Provision is made for a safe means for all occupants to escape since a fire emergency usually involves evacuation to

a place of safety and the efficacy of the means of escape in any building is relied upon during an outbreak (Kobes *et al.,* 2004; Mydin *et al.*, 2014). In simple terms, this means that there should be well and properly marked fire safety labels to ensure that occupants escape safely to assembly points. During the early stages of fire, people should escape by themselves or be rescued by others, hence understanding of fire safety is important (Sabramaniam, 2004). However, in case of advanced fire stages (growth and fully developed), assistance from fire safety experts must be sought.

Training and Education of Building Occupants

From a scholarly view, public institutional buildings are equipped with modern fire-fighting equipment but the lack of technical expertise by occupants towards the use of the equipment undermines the effectiveness of fire safety management (Sabramaniam, 2004; Furness and Mucket, 2007; Mydin *et al*, 2014). This means that management are failing to recognise the need for understanding of fire safety issues by the occupants. This influences the lack of safety proficiency, which is a combination of knowledge, skills and experience that ensure roles are fulfilled and tasks completed regarding the hazards involved and the risk control measures necessary to achieve the required levels of safety (Furness and Mucket (2007). Thus, the fire safety team must train and educate building occupants to

ensure that they have necessary information and skills to deal with fire issues on their premises.

Human Factor in Fire Safety

Developed Countries Context

There has been an outbreak of fires since the industrial revolution, as shown by the Great Chicago and Boston Fires of 1871 and 1872 respectively (Pauly, 1984). These fires resulted in the loss of hundreds of lives and destruction of properties (both real estate and valuables) worth billions of dollars. The study undertaken by United States Department of Environmental Health and Safety (DEH/S) in 2001 indicated that between 1.5 and 2 million fires occur each year in the United States with many other fires going unreported. Between 3 500 and 4 000 Americans lose their lives each year, and another 20 000 to 30 000 are injured because of fires (*ibid.*).

Additionally, data from United Kingdom reveals that in 2006, there were about 2 000 fires reported in hotels, boarding houses and public learning institutions and other similar facilities (Klemola, 2008). In United States of America (USA), Ahrens (2008) found that property(ies) with sprinklers did not have any fire-induced deaths in the years 2003-2007, and material losses were 73% lower than in those properties which

without sprinklers. This emphasised the importance of installing sprinklers in any building to manage and control fires.

However, Harris (2004) has revealed that occupants of several institutions or residential dwellings with fire escape/evacuation plans may not know how to use them in the event of a fire outbreak. A study conducted on adults living in private households as well as educational institutions in the USA found that most of Americans interviewed had an escape plan for use in case of a fire, and among them, a larger percentage had not implemented the plans. Three quarters (75%) of the respondents believed it took 10 minutes or less for a fire to turn deadly, meaning that they were aware that practising an escape drill would shorten the time of escape for people to a safe environment, meaning knowledge was not corresponding to people's practices.

Moreover, it has also been indicated that some institutions of higher learning have not yet complied with fire safety preparedness standards, putting many people at fire risks. This was evidenced by a study conducted by the Ministry of Education in Malaysia which found that fire safety preparedness in the institutions was at 76% in compliance level. Poor staff attitude on the importance of fire safety preparedness and

knowledge on the same were some of the fire safety preparedness elements identified (Chandrakankan, 2004).

Developing Countries Context

Africa as well has been affected by fire disasters. For instance, in 2011 Ghana recorded 53 institutional fire outbreaks (Ghana National Fire Services, 2011). Buildings compliance to fire safety preparedness regulations should be observed to reduce the impact of fires. A study on disaster risk assessment at the University of Ghana in Balme library found that the library annex had no balconies and had one exit for a three-storey building. The presence of balconies as a vital component in disaster response by acting as landing pads for trapped victims awaiting rescue, was therefore, overlooked (Adinku, 1999).

In the same study, library staff had not been trained on disaster management. The library annex did not have fire extinguishers and most of the fire extinguishers available in the main library were not working (*ibid.*). This is not an unusual phenomenon in most buildings in which inadequate infrastructure and fire-fighting equipment hinder timely and effective fire emergency management.

Another study on disaster readiness in academic libraries in Ghana revealed that none of the academic libraries had a plan in place to prevent or mitigate the impact of fire (Akussah and Fosu, 2001). It is in this light that institutional commitment is deemed paramount in fire safety preparedness in terms of writing policies/guidelines and enforcing the fire policy implementation strategies. This ensures that fire safety preparedness practices are fully integrated in the institution's administration (Adinku, 1999).

Local Context

Zimbabwe has been affected by fire outbreaks in various parts of the country with most of them going unreported. This makes it difficult for managers and policy-makers to quantify the impact of fires on the nation. There are limited national statistics on fire outbreaks in the country and no significance study has been conducted to assess compliance to fire safety guidelines and knowledge and attitudes of staff and students in various learning institutions. One of the remarkable fires which got wide coverage was the one that razed a Mukaro Girls High School hostel (Gutu) on the 16th of March 2016. It destroyed property worth more than $100 000 (*Newsday*, 17 March, 2016). Pupils lost all their belongings – beds, uniforms, lockers, books – with no casualty recorded. The fire was identified in its

early stages, but the hostel had inadequate fire-fighting facilities, and it has be also noted that students could not operate the few facilities that were available.

9.5 RESEARCH METHODOLOGY

To accomplish a scientific and systematic search for information on this topic, two research approaches were employed, namely quantitative and qualitative, their combination resulting in a mixed approach (Cresswell, 2003). That amalgamation was done to give a better understanding of the research problem than either one. For this study, HF approach in fire safety management is more of qualitative in outlook, attracting descriptive research, but for the rationale of its validity, the quantitative method was adopted, ensuring the possibility of a triangulation approach. Bush (2007) opines that methodological triangulation involves using similar data set from multiple research methods and analysed from different perspectives in order to enhance a better understanding of the research problem. In this study, as far as data collection is concerned, both primary and secondary methods of research were employed. The researcher collected primary data through visiting various university departments (both academic and non-academic). The researcher first administered questionnaires to building occupants before approaching the fire

safety department as the occupants were the fundamental respondents of the research. This was done to enable the researcher to collect data from more than one respondent at a time. After obtaining data from the questionnaires, the researcher carried out interviews (structured and semi-structured) with departmental heads and the Security Department (university fire safety department) to ensure a comprehensive understanding on HF issues, as well as its level in the university fire safety. The fire safety department was the key informant in this study. In addition, the method of last resort for the study, direct participant observation was utilised. Finally, the researcher collected secondary data from institutional health and safety reports obtained from the Security Department.

9.6 RESULTS OF THE STUDY

Demographic patterns of the sampled population

This study's survey of HF approach on FSM sought to reveal how socio-economic attributes of individual building occupants shape the university landscape. The survey noted demographic aspects that include gender, age, marital status and educational levels of the respondents. Of the 50 respondents interviewed, 35 were students and 15 were staff members. The respondents

further categorised into 21 male and 14 female students and as nine male and six female staff members as shown on Figure 9.3. From the study, it can be concluded that a majority of 30 (60%) the respondents were male, while 20 (40%) were female. Nevertheless, the data collected was free from bias as far as gender is concerned since gender balance was effectively considered.

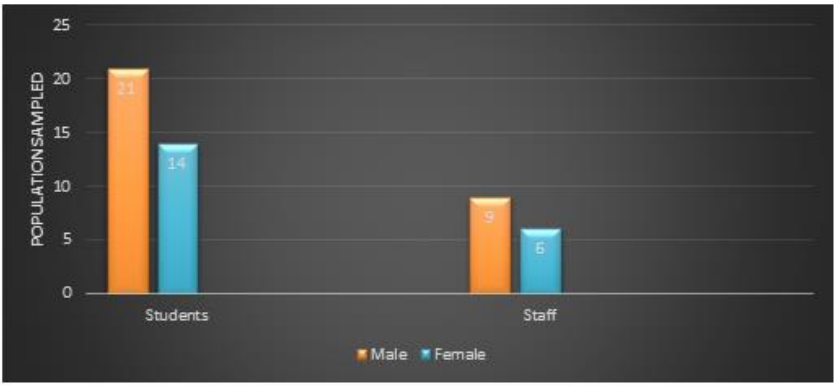

Figure 9.3: *Sex of respondents (Research Findings, 2017)*

Respondents were asked to indicate their ages and this assisted the researcher to be aware of the age groups being accommodated in the institutional buildings. As reflected in Figure 9.4, the age composition of respondents was skewed to towards young adults of the age bracket 18-30 years with 64% (32 respondents comprising 29 students and three staff members). The age group 31-40 accounted for 20% (10 respondents consisting of four students and six staff members),

and, lastly 16%, (eight respondents comprising two students and six staff members) was above 41 years. The findings portrayed that most of respondents were young adult students who occupy fire risky institutional premises, and were expected to have a thorough understanding of the fire safety skills.

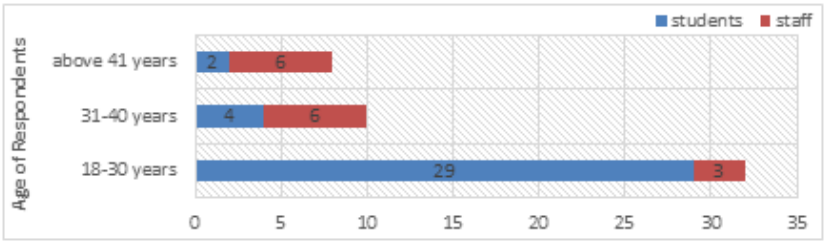

Figure 9.4: *Age Groups of the respondents* (Research Findings, 2017)

Levels of education of the respondents are highlighted in Figure 9.5, showing that the majority, 30 (60%), were undergraduates. Thirty-two percent (32%) were postgraduates who had attained their first degrees and were pursuing further studies, some staff members, while only four (8%) were of the none higher educational levels. Thus, from the study it can be concluded that the majority were undergraduates.

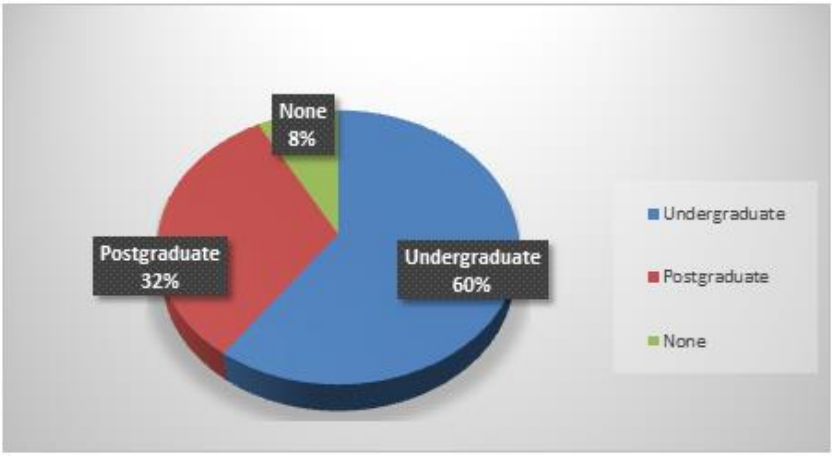

Figure 9.5: *Educational levels of the respondents* (Research Findings (2017)

Respondents were asked how long they had been at the institution. The outcome from the survey, as reflected in Figure 9.6, indicates that 26% (13 students) of the respondents have been at the institution for less than two years. The majority (46%) of the respondents (19 students and four staff members) had been at the institution for a period ranging from three to five years. Nine respondents (18%) made up three students and six staff members had been at the institution for a period of six to 10 years and, lastly, only 10% had been at the institution for over 10 years. This study clearly indicates that most of students and staff had been at the university for quite a number of years (at least three years), hence they were in a better position of understanding how the university fire safety issues were managed as well as the level at which their safety was being recognised by the fire safety team.

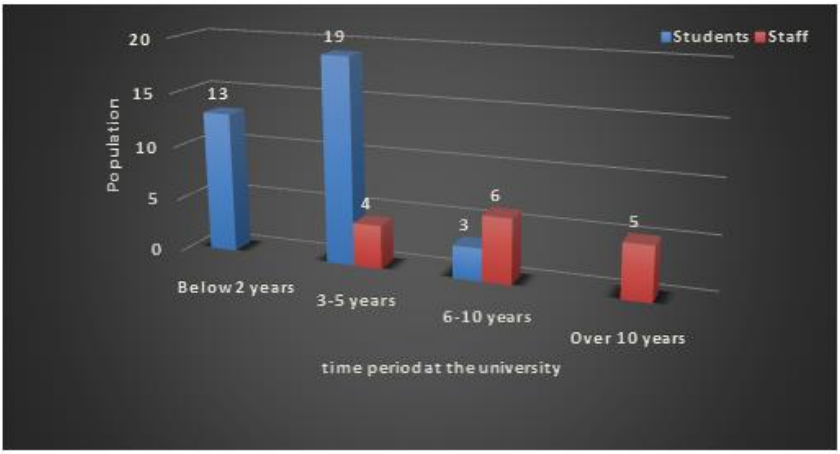

Figure 9.6: *Length of time at the institution* (Research Findings, 2017)

The possible fire sources in the university buildings

The study area, the UZ, consists of many buildings including administration and office blocks, hostels, dining halls, lecture theatres, staff quarters and libraries. In those buildings, generally, the occurrence of fire is unpredictable due to different materials stored and activities undertaken housed in them. Whenever there is adequate sources of oxygen, heat and fuel, as shown on the fire triangle, combustion may take place. In addition, the existence of different sources of fuel that determine fire typologies (Furness and Mucket, 2007) signifies that there are numerous likely causes of fire in the mentioned university buildings.

Possible causes of fire in university buildings

In a close-ended question, respondents were asked to highlight likely causes of fire in their department buildings and the intention of providing close-ended question was to avoid unnecessary responses. Their responses, in line with subject research question one, is presented below.

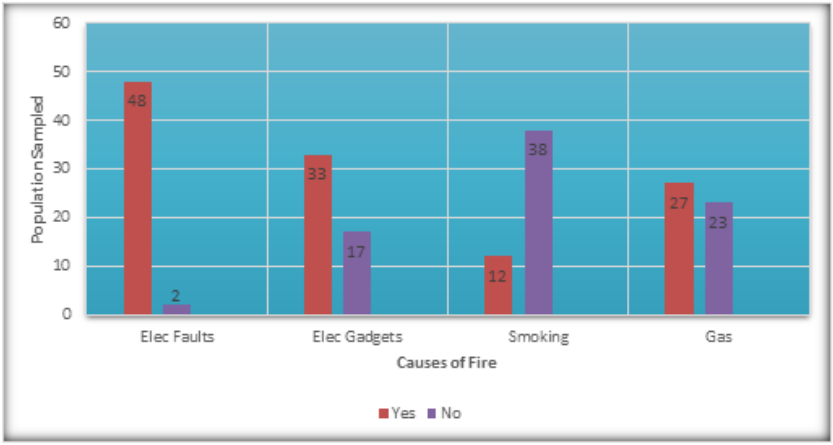

Figure 9.7: *Possible causes of fire in university buildings* (Research Findings, 2017)

Forty-eight (48) respondents (96%) stated that electric faults and exposed cables were the major possible causes of fire in their department buildings. Almost two thirds (66%) of the respondents indicated that the use of electric gadgets like irons and heaters played a significant role in fire causation, while 38 (76%) disagreed with the assertion that smoking may influence

an outbreak of fire in university buildings. On gas and other flammable chemicals, 27 (54%) respondents highlighted that there was a possibility that these could result in fire, especially in laboratories. Thus, from the study, it can be concluded that electricity can result in catastrophic fires in university buildings if not handled properly. These findings concur with Gold and Koigi (2009) who indicated that most of institutional fires are because of the use of electrical gadgets as well as electrical faults and exposed cables. Similarly, Adinku (1999), who carried out a study on fire risk assessment at the University of Ghana, pointed out that most of the fires experienced at the institution were caused by electric faults and misuse of gadgets.

Fire experienced in department buildings

Respondents were asked to indicate if they had experienced fire in their department buildings for the period they have been at the institution. Figure 9.8 shows their responses.

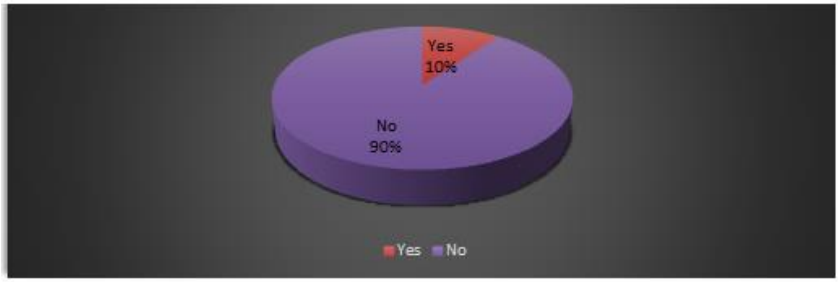

Figure 9.8: *Fire in department buildings* (Research Findings, 2017)

Asked about whether their department buildings have experienced fire, only 10% (five) of the respondents acknowledged its occurrence while 90% (45) stated that they had not experienced any fire. This can be supported by the data obtained from the interview with the key informant, as well as the university fire safety records obtained from the Security Department. The researcher noted that there were very few minor fires that occurred in halls of residents because of misuse of electric gadgets like water heaters and irons. However, it was revealed that there was one major fire incident caused by an electric fault at the Central University Kitchen in 2005 . The findings reflect that there was no any casualty recorded since it happened during the night but property worth thousands of dollars was damaged.

Existing fire safety facilities in university buildings

Respondents' view on existing fire safety equipment

Respondents were asked to highlight fire-fighting facilities found in their respective buildings and their responses are shown below.

Table 9.1: *Existing fire safety equipment* (Field Survey, 2017)

Fire safety feature	Exists	%	Not exist	%	Not sure	%	Respondents
Water or foam extinguishers	45	90%	2	4%	3	6%	50
Carbon dioxide extinguishers	45	90%	2	4%	3	6%	50
Dry chemicals extinguishers	42	84%	8	16%	0	--	50
Halon extinguishers	6	12%	7	14%	37	74	50
Sprinkler and alarm system	3	6%	40	80%	7	14%	50
Hose reel system	50	100%	0	--	0	--	50
Fire blankets	0	--	40	80%	10	20%	50
Fire hydrants	0	--	41	82%	9	18%	50
Well labelled fire safety signs	50	100%	0	--	0	--	50
Fire alarm system	4	8%	35	70%	11	22%	50

Out of the 50 respondents, a majority 90% stated that water or foam and carbon dioxide extinguishers existed in their department buildings, compared to 4% and 6% who stated, respectively that it did not exist and that they were not quite sure. Similarly, 84% of the acknowledged the existence of dry chemical extinguishers against 16% who mentioned that there was none. However, on halon extinguishers, 74% of were not certain about their existence and only 12% confirmed their existence while, 14% disagreed. There were no sprinkler and alarm systems, fire blankets and fire hydrants in most university buildings, as highlighted by more than 80% of the respondents. Respondents were unanimous on the existence of

hose reel systems and well labelled fire safety signs in their respective buildings. So, from the study, it can be concluded that majority of the university buildings had fire-fighting facilities.

Fire safety department's view on existence of fire safety equipment

During the study, the fire safety department as the key informant was interviewed to highlight its view on the existence of fire-fighting equipment in the university buildings. It was stated that several university buildings had basic fire safety equipment as requested by the MBBL and the key informant was not certain on the actual figures hence provide estimates as shown below.

Table 9.2: *Fire safety equipment in buildings as stated by fire safety team* (Research Findings, 2017)

Fire Equipment	Percentage/Number of Buildings
Portable Extinguishers	About 80%
Hose reel	About 75%
Sprinkler and fire alarm system	3 buildings only
Well labelled exit signs	About 80%

Like the outcome obtained from the questionnaires, the key informant also highlighted that the water or foam extinguishers, carbon dioxide extinguishers, dry chemicals extinguishers, hose

reel systems and well labelled fire safety signs were commonly found in most of university buildings, according to the inventory of the facilities. Similarly, from the observation, the researcher noted that portable extinguishers were in almost every building, except for a few halls of residents like Manfred and Carr Saunders that were experiencing challenges of theft of facilities once installed. The key informant also indicated that functional hose reel systems and well labelled exit signs were in place in approximately 75% and 80% of the university buildings, respectively.

The fire Safety Department highlighted that functional sprinkler and fire alarm systems were existed in three buildings only, in the administration block, main library and Faculty of Engineering. Nevertheless, subject to the provision of Chapter 11 of MBBL, section 50 subsection (9) paragraph (c), every occupancy unit with a high fire load (potential severity of fire commencement and spread) should have sprinklers installed to ensure fire suppression in case of emergency. The findings from the study reflect that some buildings like departmental libraries and offices, as well as laboratories with high fire load due to combustible materials they hold ,did not have sprinklers as required by the MBBL. This clearly shows that the institution had very few buildings with adequate and enough extinguishing equipment, most probably because it was where most relevant university assets and information were housed.

Condition and state of the existing fire safety equipment

During the analysis of the outcomes, the researcher managed to discover the state and condition of the fire safety equipment installed in the university buildings. The maintenance strategy utilised to service the facilities was also ascertained based on interviews undertaken with departmental heads and fire safety department as well as the data gathered through questionnaires.

Regularity of servicing fire safety facilities

The frequency of servicing the fire-fighting facilities determines their condition. Results on the time taken to maintain fire safety facilities are depicted in Figure 9.9.

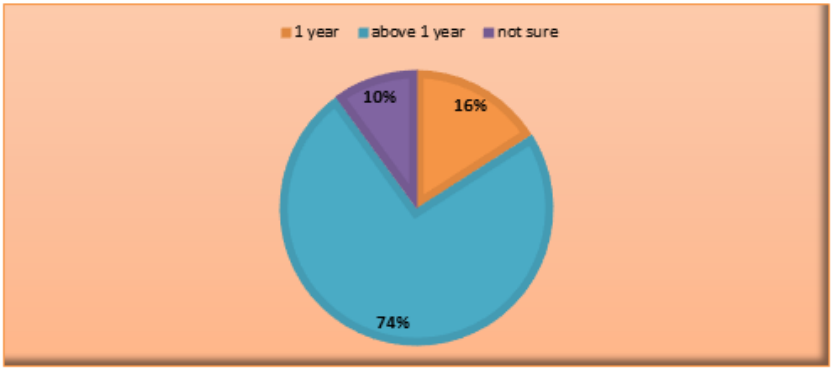

Figure 9 9: *Regularity of equipment service* (Research Findings, 2017)

According to the provision of Chapter 11 of MBBL, section 49 subsection (3), inspection and servicing of fire-fighting equipment should be performed after every 12 months to maintain its proper working condition. Asked about the frequency of maintenance of equipment, eight (16%) respondents indicated that it was performed on a yearly basis while, 37 (74%) said the maintenance was carried when it was already overdue, in most cases after two years. Only five respondents were not sure about the time frame. Consolidating the outcome with the findings obtained from the key informant, it was established that the university outsources the service to fire engineering companies like Allied Fire Authority (Pvt) Ltd, Pioneer Fire Company and AFA Fire Engineers. It was ascertained that the university was using a piecemeal maintenance approach to service the equipment. This shows that equipment in several buildings was due for maintenance, and this can be supported by the researcher's observations, that dates for inspection and servicing had already lapsed by about two years. Therefore, from the study, it can be concluded that the maintenance of equipment in buildings by the Fire Safety Department towards was not in compliance with the provision of Part V of Chapter 11 of MBBL.

Condition of fire safety equipment

Respondents were requested to highlight the state and condition of fire-fighting facilities in their respective buildings and their responses are shown in Table 9.3

Table 9 3: *State and condition of fire equipment in university buildings* (Research Findings, 2017)

Fire safety feature	Good Condition	Not in Condition	Not Sure
Portable fire extinguishers	30%	64%	6%
Sprinkler and alarm systems	6%	--	94%
Hose reel systems	68%	14%	18%
Well labelled fire exit signs	92%	8%	--

From the data gathered using questionnaires, most of the respondents (92%) stated that functional exit points were clearly and prominently marked by well labelled signs, while 8% indicated that signs in their department buildings were damaged. Furthermore, 68% and 30% of the respondents mentioned that the hose reel system and portable fire extinguishers were in good condition, respectively. However, on the same aspect, 14% and 64% highlighted that facilities were not in good condition, respectively, since their dates of service were already due, while 18% and 6% were not sure. On the sprinkler and alarm system, only 6% of the respondents indicated that it was in the good working condition whilst 94% stated that they were not certain. Likewise, since the inspection and servicing of the facilities were performed haphazardly, the researcher observed that several facilities were not in good condition as they were already due for servicing. Also, the researcher found out that in several hostels (New Complexes 1

and 3) and lecture theatres (New Lecture Theatre 400 and Engineering Lecture Theatre), extinguishers were vandalised.

Thus, it can be concluded that several basic fire-fighting facilities were not in good condition as they were vandalised and due for service hence lives of occupants were in danger. This requests preventative maintenance to keep the facilities in top condition as well as to avoid substantial costs that might be incurred for refurbishments as stipulated under the theory of De Sitters Law of Fives (Vanier, 2001). The theory states that a major repair can be expected to cost roughly five times what routine maintenance would have cost, and in turn, an all-out replacement will cost five times what major repair would have cost.

Level at which the university's fire safety accommodate the HF approach

Importance of Human Factor Approach in FSM

The respondents were asked to state whether the HF approach is of essence towards FSM in public learning institutions. They were given a description of the concept and their duty was to indicate if it is important to incorporate it or not.

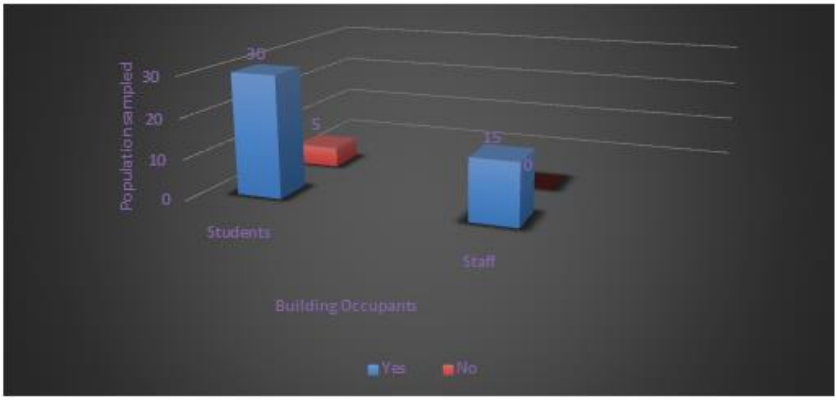

Figure 9.10: *Significance of HF approach in FSM* (Research Findings, 2017)

Out of the 50 respondents, most of 30 (60%) students and all staff members (30%) stated that the HF is very paramount as far as FSM is concerned. Asked for justification, they indicated that incorporation of HF in managing fire safety issues offer the following benefits: loss of life reduction; property damages reduction and quick responses during fire emergencies. Nevertheless, only five (10%) respondents indicated that the concept was not important for effective and efficient FSM and did not provide any justification for their response. In addition, during an interview with the key informant, it was indicated that the institutional fire safety team must ensure a marriage of HF approach and FSM in order to lessen the fatality rate during fire events.

Ability to operate fire-fighting facilities

The researcher further asked the respondents to highlight if they were able to operate the existing fire-fighting equipment in their department buildings.

Table 9. 4: *Ability to operate fire safety equipment* (Research Findings, 2017)

Fire Equipment	Able		Not able		Not sure		Total Responses
Dry chemical extinguishers	8	**16%**	40	**80%**	2	**4%**	**50**
Halon extinguishers	5	**10%**	43	**86%**	2	**4%**	**50**
Carbon dioxide extinguishers	8	**16%**	40	**80%**	2	**4%**	**50**
Hose reels	11	**22%**	12	**24%**	27	**54%**	**50**
Fire blankets	32	**64%**	5	**10%**	13	**26%**	**50**
Any other (specify)	0	**--**	0	**--**	0	**--**	**0**

Most of the respondents indicated that they were unable to use any type of the fire extinguishers. The outcomes reflected that 40 (80%) respondents were not able to operate both dry chemical and carbon dioxide extinguishers, whilst only eight (16%) indicated that they were able and 4% were not sure. Halon extinguishers received the largest number of responses in which 92% of respondents highlighted that they did not have the technical expertise to operate them, while 10% could operate them. Further, 22% indicated that they were able to

operate hose reels and 54% were not sure while, 12 (24%) respondents indicated that they could not, at all. Fire blankets received most respondents as 64% indicated that they could handle them, while 10% could not and 26% were unsure. Further probing indicated that this was due to its simplicity in use after they were given a hint by the researcher. There was no any other fire equipment specified. Therefore, from the study it can be concluded that most of the building occupants at the university were not able to operate the fire-fighting facilities despite their existence in buildings, hence there is a lot that needs to be done to train staff and students on how to operate these facilities. Though the occurrence of fire risk in the buildings in question is minimal, inability to use fire-fighting equipment can result in great loss of valuables and occupants.

The level of incorporating HF approach in FSM

The respondent's opinion on the level at which the fire safety team was incorporating the HF approach in managing fire safety issues in university buildings was indicated in the questionnaires. Figure 9.11 shows how the respondents responses.

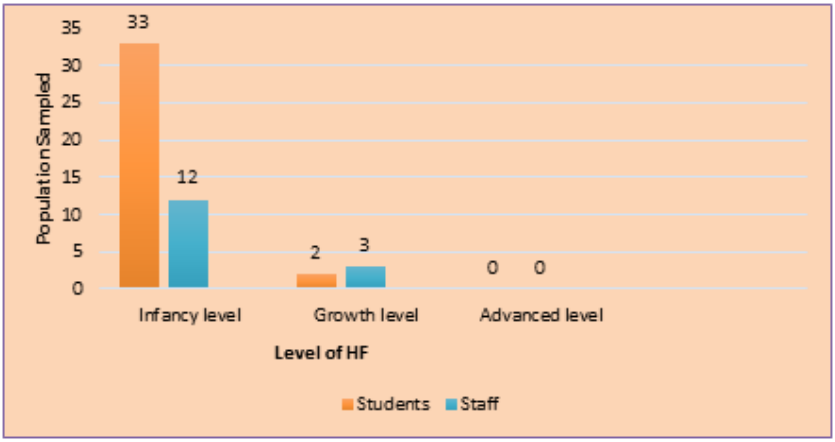

Figure 9.11: *Level of HF Approach in FSM* (Research Findings, 2017)

Nearly all respondents (45) (90%) indicated that incorporation of the HF concept in FSM was at the infancy level. However, 10% of the respondents, constituting two students and three staff members, highlighted that the incorporation was at the growth stage whilst none of the respondents acknowledge the existence of the advanced level. Asked to give their opinion over the matter, the majority indicated that the fire safety team were not taking into consideration whether building occupants were able to utilise the fire-fighting facilities during emergencies despite the availability of those facilities in their buildings. Further, the key informant indicated that the level of incorporating the HF concept was at an early stage since very few building users were able to operate the equipment. Outsourcing of fire safety service and shortage of experts to educate occupants were cited as the problem influencing the

low level of accommodating the HF philosophy. Nevertheless, the situation at the institution contradicts what has been stated by Adjibolosoo (1995; 1998; 2004), Mararike (1998) and Adu-Febiri (2001) on HF competence towards goal achievement of fire safety. In their works, the scholars state that individuals achieved their intended goals due to the use of their HF competences which include readiness, preparedness, ability, awareness and capacity to act and react to both internal and external stimuli.

Stakeholders' perspective on the operations of institutional fire safety management

Perception on the level of preparedness

Figure 9.12 depicts the perception of respondents on the preparedness level of the fire safety management in university department buildings.

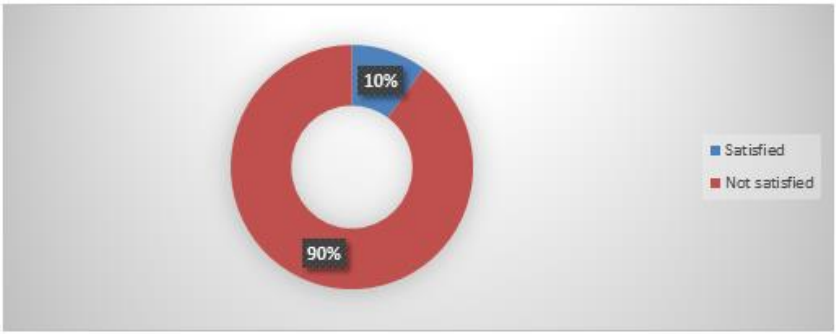

Figure 9.12: *Satisfaction on level of preparedness* (Research Findings, 2017)

The findings show that most of the respondents(45) (90%) were not satisfied, whereas five (10%) were. Asked to justify their responses, most of the respondents highlighted that the responsible fire safety department was undermining their safety since most of the facilities were not in good condition as well as their inability to operate the fire-fighting equipment. This is supported by the information obtained from the key informant as the fire safety department testified that it was also not convinced by the preparedness level towards fire safety in university buildings. It has been noted from the literature that fire is one of the most common disasters that causes more deaths than any other type of disaster (Stollard and Abrahams, 1999). But fire would not be that deadly if occupants had early warning from smoke detectors and everyone knew how to act in case of a fire emergency. This means that more needs to be done to ensure high levels of preparedness.

Compliance with fire safety legal framework

The study aimed at ascertaining the compliance of the FSM in institutional buildings with fire safety rules and standards stated by the MBBL. According to MBBL standards, every learning institutional building must be serviced with advanced and adequate fire prevention, protection and suppression systems, depending on the purpose of the building. However, from the observation undertaken by the researcher in collaboration with findings obtained from the key informant, it was revealed that

about 55% of institutional buildings like lecture rooms and departmental offices had inadequate facilities except for few buildings like Rural and Urban Planning (RUP), Main Library and Administration block. This clearly indicates that the level of compliance was very low. Moreover, most buildings' emergency exit routes were locked and the keys were not available in their boxes, meaning that in case of fire, no one was able to use those exit points. According to Subramaniam (2004) and Pires (2005), it is the mandate of the fire safety personnel to ensure that building occupants know how to use the equipment in case of fire emergencies. However, in this case, it was the reverse, as most of the respondents acknowledged their inability to use them as reflected by their responses in Table 9.4. Thus, from the study, it can be concluded that more must be done to ensure 100% compliance with the legal framework.

Challenges faced by fire safety team in managing the fire safety systems

In relation to the incorporation of the HF approach towards managing fire issues in university buildings, some incredible challenges that were faced by the fire safety department were noted. The respondents were asked to mention their opinions on the constraints whether they were agreeing or not as well the justification on chosen answers. As shown in table 9.5 the university fire department faces several challenges.

Table 9. 5: *Challenges encountered by fire safety team* (Research Findings, 2017)

Challenge	**Agree %**	**Not agree %**
Financial incapacities	26	74
Lack of skills and competences by safety team	62	38
Theft and negligence by occupants	56	44
Lack of legal enforcement	84	16

From the total number of 50 respondents studied, 37 (74%) were not in agreement with the assertion that the institution was lacking financial capacities to ensure high standards in fire safety. Asked for justification, the occupants stated that it was negligence by the university authorities as the institution was receiving a lot of funds from its stakeholders and was prioritising other issues like walkaways renovations at the expense of human safety. On theft and negligence, 28 (56%) respondents agreed, mentioning that several facilities were misused and at the same time several facilities were stolen, especially in hostels. Moreover, 31 (64%) respondents agreed on the skills and competences lacking by the fire safety team, whilst 19 (38%) disagreed. The other remarkable challenge noted was lack of legal enforcement and most of respondents (84%) agreed with that assertion since no follow-ups were being done by the local authorities to ensure that systems were operating efficiently.

Findings obtained from the key informant indicated the same problems. On the financial incapacities, it was indicated that the institution was facing budgetary constraints which led to the adoption of piecemeal maintenance strategies on servicing equipment whilst prioritising critical areas. It was highlighted that this lack of adequate funding restricted the programmes of educating both students and staff on the use of fire safety equipment since the university had no in-house fire safety experts. This simply means that the team responsible for fire safety was not quite versed with adequate knowledge on fire and, in case of fire, little help could be expected from them. The negligence problem was also mentioned by the key informant since several students were stealing fire extinguishers particularly in halls of residents, which put them at risk in case of fire. Rahim *et al.* (2014) indicated the same problem of theft and negligence by occupants in malls and that there is need to educate those occupants on the benefits of having the equipment for their welfare and safety. Thus, the aforementioned challenges need to be rectified to ensure effective incorporation of the HF concept in FSM.

9.7 DISCUSSION

The first and foremost theme of the study assesses the level of availability and the condition of existing fire safety systems in university buildings. Harris (2004) states that after the occurrence of the great fire incident at Our Lady of the Angels Schools (USA) on the 1st of December 1958, which killed 95

people (both students and teachers) and demolished property worth millions of dollars, stricter codes were enacted globally in public learning institutions. These statutes were to ensure that fire safety facilities were adequate and in good condition since the investigations after the fire incidence indicated that the school was lacking fire sprinklers and detectors and there were no fire doors on all floors and there was only one fire escape. However, that research contradicts the results obtained from this study in that several facilities were in existence in various department buildings but their maintenance was overdue, hence were not in good condition, putting occupants at risk. Consistent with the findings of this research Adinku (1999) at the University of Ghana who revealed that adequate fire-fighting facilities were installed in university buildings, but they were not in good condition since their dates for servicing had lapsed.

The level and degree of unification of the human factor approach in the university's fire safety management has been discussed as the second theme of the study. Although it was noted that advanced fire safety equipment was installed in the university, the study revealed that the FSM was inefficient and ineffective without the incorporation of the HF. The HF concept adoption in managing fire safety issues was at the premature level due to lack of knowledge, awareness, capacity and ability to operate the equipment by both students and staff, endangering themselves in case of fire emergencies. In

addition, the findings revealed that the occupants were not aware of the emergency evacuation plan, yet it is very essential as far as fire safety is concerned, hence signifying complete absence of HF. The research findings partially correlate with the study undertaken by Harris (2004) in the USA, revealing that several institutions and residential dwellings had fire escape/evacuation plans and fire-fighting facilities, but occupants did not know how to use them in the event of a fire outbreak. Similarly, the findings revealed that the adoption of the HF approach in FSM at the UZ was at the infancy stage, and challenges like budget constraints, lack of skills and negligence by occupants, were also noted.

Another issue raised in this study was the stakeholders' perceptions on the operations of institutional fire safety team. As suggested by Stollard and Abrahams (1999), fire is one of the most common disasters, causing deaths more than any other type of disaster, but it may not be deadly if buildings had sophisticated early warning systems like smoke detectors as well as fire alarms and if everyone knew what to do in case of fire emergencies. This usually determines the level of preparedness of the fire safety team and from the study, it was revealed that various stakeholders were not satisfied about how the institution fire safety issues were managed. The fire safety personnel were not fulfilling their mandate of ensuring that building occupants were able to use the equipment (Subramaniam, 2004; Pires, 2005). So, a lot needs to be done

to ensure 100% compliance with the HF concept such that efficient and effective FSM in public learning institutional buildings can be attained, thereby, minimising the number of casualties and destruction of valuables from fire incidents.

9.8 SUMMARY

The research problem was that fire disasters occur in public learning institutional buildings despite the existence of advanced fire safety equipment installed. The lack of HF development, facilitating ignorance and awareness of fire safety by building occupants aggravates the damage and rate of fatality during fire events. It was noted that many basic HF principles, guidance, elements and techniques were not incorporated into safety the system design and management. The research proved this problem statement by achieving the research objectives and noted the challenges facing the integration of the HF approach in FSM at the University of Zimbabwe.

The major objective of the study was to assess the level of availability and the condition of existing fire safety systems in university buildings. The study established that various fire safety facilities were in existence in university buildings. Most of the respondents identified water or foam, carbon dioxide and dry chemical extinguishers as the common firefighting equipment in several buildings. However, halon extinguishers and wet chemical were non-existent in any of the buildings surveyed. There were functional hose reel system and well

labelled exit signs in nearly every building. Sprinklers and fire blankets were in very few buildings. Since not all respondents agreed on the existence of fire-fighting equipment, more needs to be done in this area to meet the required standards. Concerning the condition of the existing equipment, the research noted that dates for inspection and service of most of the facilities had already expired by about 2 years. The frequency of servicing of the fire fighting facilities determines their condition. The fire safety department was using haphazard approaches in servicing the facilities, meaning that very few were in good condition.

The study evaluated the level and degree of incorporation of the human factor approach in university's fire safety management as the second objective. The research noted that most of the respondents identified the HF approach as important in fire safety management as it ensures the reduction of loss of life and property damages as well as enhancement of quick responses to fire emergencies. Though the HF approach was regarded as a critical component, the study indicated that its incorporation in FSM was at the premature level. The major reason was that most of building occupants at the university were not able to operate the firefighting facilities. Thus, this is an area that requires more attention, especially through education to increase awareness of how to operate the facilities, hence ensuring an advanced level of HF fusion in FSM.

The third objective was to assess stakeholders' perceptions on the operations of the institutional fire safety team. Data analysis and interpretation reflected that most of the building occupants were not satisfied by the preparedness of the university fire safety team. This was because the department was undermining their safety from fire since most of the facilities were not in good condition; most buildings' emergency exit routes were locked and the keys were not in their boxes, so no one could able to use those exit points in case of fire and that the occupants were unable to operate the firefighting equipment. This revealed that the fire safety management of the institution was not complying with the provisions of fire safety rules and standards stated in the MBBL and Factories and Works Act Chapter 14:08.

The fourth objective was to identify and explain the challenges faced in adopting the human factor approach in fire safety systems at the institution. Findings from the study established many constraints (both internal and external) faced by the institutional fire safety team. The internal difficulties noted include lack of financial capacities to ensure high standards of fire safety; lack of skills and competences by the safety team as well as theft of equipment and negligence by building occupants, while external challenges were lack of legal enforcement and support from the government. It was noted from the study that no follow-ups were made by local authorities to ensure that the system was operating efficiently.

9.9 RECOMMENDATIONS

The study's last objective was to suggest possible alternatives that can be adopted to enhance the amalgamation of human factor approach and fire safety management. In relation to the findings of the study, the following recommendations are suggested for the consideration by various stakeholders in the property industry which include public learning institutions, regulators, property companies and professional bodies.

According to MBBL, all building occupants should be trained on fire safety preparedness and awareness and in the safe use of fire-fighting appliances. So, the university should undertake regular basic fire safety trainings, especially during the orientation period. It should also perform awareness campaigns regularly to establish a high level of fire safety preparedness. In addition to that, every occupier should establish and implement fire safety policy, outline the organisation and arrangements for carrying out the policy, and all occupants should be informed on the contents of the policy. Similarly, property companies should also educate the occupants on the use of fire safety equipment so that in case of emergency, there is none loss of life and minimal property damages.

Regulatory bodies such as councils and NSSA must play a significant role by coming up with policies and legal frameworks that promote safety of building occupants in public learning institutions. This must include standards that ensure adequate

installation of fire safety equipment in all buildings, inspection as well as servicing of the equipment. They must make enforcements through inspections on the buildings in question in order to ascertain the level of compliance and ensure that lives and valuables of occupants are safe. This must also be done in commercial and industrial properties to guarantee health and safety of occupants.

There is also need for the institution to have internal fire safety experts, rather than outsourcing the service. These experts' duties must be to educate occupants and at the same time make patrols in all buildings to ascertain that all fire emergency exits, gangway and exit staircases are free of obstruction and fire exit doors easily. They should also facilitate emergency exercises or drills in accordance with the requirements of MBBL, to be conducted at intervals not exceeding 12 months. Further, there is need for provision of more fire assembly points and occupants must be familiar with them so that during an emergency, they know where they must go.

9.10 CONCLUSION

The level at which the learning institution incorporated the HF concept in FSM has been thoroughly analysed. From the study, related literature on both FSM and the HF concept has been reviewed and the methods used by the researcher to gather data during the study have been explained. As discovered from the research findings, the institution has advanced fire safety

facilities. However, despite the existence of those facilities, it has been noted that the adoption of the HF approach is at its infancy stage since the occupants were unable to use the facilities. The HF approach will be fully incorporated if responsible stakeholders in the property industry (both commercial and non-commercial institutions) consider some of the suggested recommendations that can embrace the amalgamation of HF concept and FSM, hence ensuring the safety of occupants in learning institutions, residential and commercial buildings.