AN INVESTIGATION OF ACCIDENT PREVENTION PRACTICES IN THE ZAMBIAN CONSTRUCTION INDUSTRY: A CASE STUDY FOR LUSAKA

BY

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A DISSERTATION SUBMITTED TO THE UNIVERSITY OF ZAMBIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE AWARD OF THE DEGREE OF MASTER OF ENGINEERING IN CONSTRUCTION MANAGEMENT

THE UNIVERSITY OF ZAMBIA

2021

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DECLARATION

I, Charity Kamwale declare that this work is my own, and that to the best of my knowledge, it has never been produced or submitted before in this university or any other institution for academic purposes, and that all sources of information have been duly acknowledged.

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CERTIFICATE OF APPROVAL

This dissertation by Charity Kamwale entitled "An Investigation of Accident Prevention Practices in the Zambian Construction Industry" is approved as partially fulfilling the requirements for the award of degree of master of Engineering in Construction Management of the University of Zambia.

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ABSTRACT

The construction industry plays a vital role in the development of the Zambian economy. With the growth of the construction industry is a corresponding need for the maintenance and securing of health and safety in a bid to minimize and reduce accidents in the construction industry. Zambia's overriding policy goals through the Ministry of labor and social security, Occupational Safety and Health Services Department, is to promote and enforce occupational health and safety standards at place of work to ensure a healthy and safe working environment. Despite the policy in place, the construction sector is still considered to be one of the most hazardous sectors. The aim of this study is to develop a framework that ensures the effective application of accident prevention practices in the Zambian construction industry. The study also targets to identify the accident prevention practices and mechanisms employed in Zambian construction industry and to establish the extent to which they are applied. The study adopted the mixed method approach in which both semi-structured interviews and survey questionnaire were adopted for primary data collection. Interviewees and respondents to the questionnaires were construction company stakeholders who included project engineers, site engineers, clerk of works, safety officers, project managers, artisans and general workers. The sample size for the questionnaire was 109 computed at 95% confidence level with a 5% confidence interval. The qualitative data was analyzed using thematic analysis while the analysis of quantitative data included use of descriptive statistics and One-Sample t-test. The key result of the study was the identification of accident preventive practices which included safety training and induction, provision and proper use of PPE, provision of safe and healthy working environments, safety inspections and enforcement. The study found that the accident prevention practices employed in the construction industry are to some extent adequately effective but there is need for improvement if the industry is to be deemed less hazardous. Finally, a model framework was developed to ensure the effective application of accident prevention.

Keywords: Accidents, Construction industry, Health, Safety, Zambia

ACKNOWLEDGEMENT

I wish to firstly thank The Lord God Almighty for having made it possible for me to undertake this study in good health.

My heartfelt gratitude goes to my project supervisor Dr. Erastus M Mwanaumo and Mr. Moffat Tembo for their valuable assistance in this research. Their support and guidance during the research.is fully appreciated.

Much appreciation goes to my husband, parents, siblings and friends for their encouragement, support and love.

Many thanks go to all my research participants for taking time off their busy schedules to participate in the interviews and questionnaire survey. I am grateful for their input, knowledge and cooperation.

DEDICATION

I dedicate this research work to my wonderful husband (Kankomba Chama Lungu).

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LIST OF ABBREVIATIONS

ILO- International Labor Organization

MLSS- Ministry of Labor and Social Security

NCC- National Council for Construction

OHSMS- Occupational Health and Safety Management Systems

OSH- Occupational Safety and Health

PPE- Personal Protective Equipment

PtD- Prevention through Design

CHAPTER ONE: INTRODUCTION

The value of good-quality infrastructure development to all developing countries facilitates not only industrialization, but also structural transformation and economic development (Economic Commission of Africa, 2017). To aid the development of an economy is economic infrastructure which comprises a range of basic services such as physical structures, systems, institutions, services, and facilities that are the foundational tool for developing the economy of a country, region, or city. In the context of the construction industry, the stock of physical infrastructure or physical assets is one of the bedrocks of industrial activity. It broadly determines the efficiency with which producers and consumers operate and interact in clearing markets, significantly shaping the fortunes of an economy (Cheelo and Liebenthal, 2020).

There are immense benefits that the economy, and the country in general can reap from the construction industry. Cheelo and Liebenthal (2020) register some of these benefits in the form of capital installations of physical infrastructure occasioned through the construction industry. That include:

i. transportation systems such as roads, bridges, walkways, rail, airports, and ports;
ii. electric energy production and distribution systems such as electric grids;
iii. water and sanitation systems that provide a supply of clean water, allow for water resource management, and support sanitation through waste disposal subsystems;
iv. housing infrastructure, including accommodation or buildings for residential and commercial purposes, office buildings, and extractive industry and manufacturing infrastructure or factories, which are specialized types of housing infrastructure; and
v. telecommunication installations like phone, television, or internet network installations, and satellites among others

1.1 Background

The construction industry plays a vital role in the development of the Zambian economy and was recorded as the second highest contributor of the Gross Domestic Product (GDP) in the informal sector with a contribution of 27.4 percent (Central Statistics Office, 2014). Activities in the sector are mainly driven by public and private projects including roads, hospital, schools, residential and commercial property. The industry has continued to show growth in the past decade at a steady annual rate of 17.5 percent, a growth that may have been directly attributed to by increased private and public sector investment on infrastructure development (Ministry of National Development Planning, 2017).

Public infrastructure development ambitions in Zambia can be seen in the Seventh National Development Plan 2017–2021 (Ministry of National Development Planning, 2017). The Seventh National Development Plan has ten Strategic Development Outcomes, including one on 'Improved Transport Systems and Infrastructure', which focuses on construction and rehabilitation of railways; development of aviation infrastructure and operations; construction and rehabilitation of the road network; and construction and rehabilitation of maritime and inland waterways among other infrastructure related objectives.

Deliberate government objectives and policy have promoted and necessitated the growth of the construction industry. With the growth of the construction industry is a corresponding need for the maintenance and securing of health and safety in a bid to minimize and reduce accidents in the construction industry. This culminates in the increase in the need for occupational health and safety. Tente et al., (2016) observe and state that the construction industry is considered one of the most hazardous industries. Further to the observation, Sakala (2019) reported that the Workers Compensation Fund Control Board noticed and bemoaned the increasing number of accidents in 2019 in the road and construction industries in Zambia stating that labour is going to waste because of the accidents. The Board also observed that the accidents in the construction industry are increasing because Zambia is literally a

construction site now, and there are construction works almost everywhere and the accidents continue to happen.

Studies have shown that accidents are common to the human experience and can happen anywhere. Heinrich (1931) defines an accident as an unplanned and uncontrolled event in which the action or reaction of an object, substance, person or radiation results in personal injury or the probability thereof. Accidents can result in injuries that range from minor to major, result in permanent disabilities and fatalities. In many instances, accidents also result in damage to or loss of property (Anderson, 2013). Furthermore, studies have concluded that human errors and operation sources such as equipment and facilities in work processes on construction sites are the major causes of accidents (Thompson, 2014; Sabet et al., 2013; National Research Council, 2011; Robertson et al., 2016).

The construction industry experiences accidents in different levels of severity with some accidents causing injuries that may be minor or major, while others may result in fatalities. Studies have shown that thousands of people are either badly injured and left disabled or killed during construction industry accidents every year (Sabet et al., 2013).

1.2 Statement of the Problem

Zambia's overriding policy goals through the Ministry of labor and social security, Occupational Safety and Health Services Department, is to promote and enforce occupational safety and health standards at place of work to ensure a healthy and safe working environment. Despite the policy in place, the construction sector is still considered to be one of the most hazardous sectors (Mwanaumo, 2014;Tente and Muya, 2014). Lusaka Times (2018) reports that National Association for Small and Medium Scale Contractors observed that the construction sector had seen a lot of accidents in 2018 and prior. The accidents in the construction sector in 2018 were second from mine accidents. Many of the small and medium enterprises in the sector are victims to these accidents and there is need to come up with serious measures that will reduce these accidents. It's been observed that accidents in the construction

industry have caused construction delays due to increased down time, conflict with workers, loss of productivity of project, reduced morale in the workers, loss of human lives, cost overruns and sometimes ruin the reputation of the organization (Kadiri et al., 2014). Studies reports the majority of the accident victims are in higher poverty levels making them more vulnerable when they are laid off or retired on medical grounds as they can no longer perform as expected (Namumba, 2018; Burgard and Katherine, 2013). Most of the victims are breadwinners of their respective families and thus the change of status largely affects the family's socio-economic positioning in society (ILO, 2012). In respect of this, the research intends to investigate the accident prevention practices employed to protect the work force in the Zambian construction industry.

1.3 Aim of the Study

The aim of the study is to develop a framework that ensures the effective application of accident prevention practices in the Zambian construction industry.

1.4 Objectives of the Study

1. To identify the accident prevention practices employed in Zambian construction industry.
2. To establish the extent to which accident prevention practices are being applied in the Zambian construction industry.
3. To design a framework that ensures effective application of accident prevention practices in the Zambian construction industry.

1.5 Research Questions

1. What provisions of accident prevention practices are being employed in the Zambian construction industry?
2. What is the extent to which accident prevention practices are being applied in the Zambian construction industry?
3. How can accident prevention practices be effectively applied in the Zambian Construction Industry?

1.6 Scope of the study

This study primarily focused on the accident preventive practices employed in the Zambian construction industry. According to the Mukosiku (2012) the building construction industry reported 58 fatalities between 2003 and 2007. This high number of fatalities ranked third behind the mining and chemical sectors. Therefore, the study limited the population of the construction industry to that of the building sector in Lusaka as the research was cost and time bound. The study confined itself to settings, groups, and/ or individuals based on specific characteristics because their inclusion provided the researcher with compelling insight about the phenomenon of interest. The study was limited to building constructions and contractors registered in Grade 1-2, category B or C as classified by the National Council for Construction (NCC) in Zambia.

1.7 Significance of the Study

This study was significant as it sought to reduce the accident causality and improve prevention practices employed in the Zambian construction industry given the continued occurrence and increase in the number of accidents over the years. Therefore, the findings of this of this study are important to employers and employees in the construction industry. Additionally, the findings when applied can improve accident prevention practices in the industry. Lastly, the study contributed to the body of knowledge in the field of occupation health and safety (OSH) in Zambia.

1.8 Ethical Considerations

Ethical clearance was obtained from the University of Zambia Ethics Committee. Participants were treated with respect and consent was obtained from participants before they could participate in the study. No respondent were at any point harmed, threatened or forced into participation as participation was voluntary, and no penalty or ramification of any nature was suffered by those that did not participate.

1.9 Structure of the dissertation

This dissertation is divided into seven chapters as follows:

Chapter one: This comprises the background to the study and statement of the problem. It highlights the aim, key objectives that this study desires to address and guiding questions that will be investigated. It also communicates the significance of the study and the methodology.

Chapter 2: This chapter comprises the review of relevant literature on the subject matter from journal papers and conference papers. Various examples have been cited and lessons explored on what has been done by other researchers pertaining to accident prevention practices employed in the construction industry.

Chapter 3: This chapter comprises the methodology of the study which provides details on how the study was conducted. It highlights the tools and methods used for data collection, data analysis, population and sampling design and the interpretation of results.

Chapter 4: This chapter presents the data collected, its analysis and findings. The findings are presented as statistical measures in literature and tables.

Chapter 5: This chapter consists of discussions on the results obtained from the research.

Chapter 6: This chapter comprises the designed framework that ensures effective application of accident prevention practices in the Zambian construction industry

Chapter 7: The last chapter comprises of the conclusion and recommendations

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature related to accident preventive practices in the construction industry both locally and globally. The chapter further describes the causes, types and preventive practices of accidents in the construction industry. Lastly, concluding remarks to this whole chapter provided.

2.2 Accidents in the construction industry

Many studies have provided definitions of what an accident is among which are Robertson (2015) who defines it as undesirable incidence and unplanned event that could have been prevented had circumstances leading up to the accident been recognized, and acted upon prior to its occurrence. While Dodo (2014) asserts that, an accident is an unplanned event that has the capacity to cause injury or damage and is attributed to either unsafe acts or unsafe conditions.

It has been recognized by different authors through different studies that the construction industry is increasingly booming day by day and has becomes one of the major economic forces globally. Nevertheless, accidents in construction sites are of major concern as they often lead to huge loss of properties, damage to plant or product, increased cost, injury to persons, few of which may prove fatal or even lead to death, bad image of company and sometimes project failure (Dodo, 2014; Shekh et al, 2013).

According to ILO (2019) 1,000 people globally are estimated to die daily from occupational accidents and a further 6,500 from work-related diseases. Additionally, it reports that there has been an overall increase in the number of deaths attributed to occupational accidents and work related diseases from 2.33 million deaths in 2014 to 2.78 million deaths in 2017.

There is therefore a need to predict and prevent the occurrence of accidents on construction sites if the workplace is to be considered safe. Understanding the causes

and types of accidents involved in the construction industry accident is key to preventing future occurrence.

2.3 Causes of accidents in construction

Studies suggest that the construction industry is a high hazard industry as it poses a high danger of accident occurrence. Accidents are one of the major challenges faced on many construction sites due to the nature of work involved and it has shown no sign of ending (Oni, 2019). Ahmed (2019) in his survey carried out in Bangladesh attributed the top five causes of accidents in the construction industry to being unaware of safety-related issues, lack of personal protective equipment, lack of safety hazards eliminating design, unfit equipment, and lack of knowledge and training on equipment respectively.

A study conducted in Zambia revealed that the main causes of accidents on construction sites are as a result of poor attitude to safety, inadequate safety equipment, poor enforcement of safety and health regulations, lack of safety training, and inclement weather (Tente, 2016). According Carrillo-Castrillo et al (2013) the causes of accidents on construction sites can be classified as either active causes such as unsafe acts and unsafe conditions or as contributing causes such as safety management performance and the mental and physical conditions of the workers.

In Taiwan, Cheng and Wu (2013) identified a number of causes of accidents in their research with the most critical causes being careless acts about the implementation of safety measures on construction sites. While the less critical causes are by insufficient safety training for novice employees, lack of competent health and safety officers, inadequate attention from the authorities concerning safety issues and the lack of safety awareness.

Ademola et al, (2016) identified the following as major causes of accidents in the Nigerian construction industry:

i. Slips and Falls: These are mainly as a result of uneven terrain, hazards that may cause one to trip, working at heights and conditions that require use of ladders and scaffolding.
ii. Machinery Accidents: There are a lot of moving parts on a construction project site including machinery, vehicles, and large plant on and around the jobsite. Due to the numerous activities on a worksite, workers are more vulnerable to being hit by moving vehicles or machinery.
iii. Falling Objects: Construction hazardous environments include working at a close proximity to falling materials. Normally workers working at a height do not usually pay attention to what is going on down below. This could result in injuries or even fatalities caused by falling objects and debris.
iv. Exhaustion: Construction work usually covers hours of manual labour. This can quickly cause exhaustion or stress which may leave workers tired or strained and ultimately affecting their capacity to cope with hazards.

Additionally, Uduakobonge et al. (2016) identified the major causes of construction accident in Nigeria to include the lack of safety measures while handling materials/objects, operating damaged equipment and caving in of excavations.

2.4 Types of accidents

The construction site has an incredibly high amount of action taking place with everyone focused on the task at hand. In such an environment, accidents are prone to take place, some of the most common types of construction accidents include;

2.4.1 Construction Site Falls

Accidents resulting from falls include roof related falls, crane falls, scaffolding falls, elevator shaft falls, falls resulting from holes in flooring and falling object. Proper protection equipment such as safety belts, retaining belts, safety harness, and safety ropes are necessary to protect the lives of workers and to secure them against falling from heights (Kemei and Nyerere, 2016).

Scaffolds and ladders are a leading cause of fall accidents and have one of the highest injury rates (Jahangiri et al., 2019). Enshassi and Shakalaih, (2015) in their study found that there are six main factors that cause scaffolding accidents and these are related to the erection, staff, loads, personal safety, workers competencies and workers behaviors. (Enshassi and Shakalaih, 2015).

2.4.2 Crane Accidents

The use of cranes is increasingly becoming common in the construction industry worldwide. While cranes have shown improvement along with technology over the years, crane accidents on construction sites still occur and result in injury or death (Lee et al., 2022). Crane accidents deaths can arise from a number of factors including; human behavior, inducting lightning, high winds, poor safety management, defective cranes, falls, electrocution and other hazards associated with working environments resulting in unsafe work procedures at heights (Zaini et al., 2020; Gharaie et al., 2015).

2.4.3 Electrical Accidents on Construction Site

Electrical related accidents common to the construction industry include electric shock, electrocutions, power line contact and steam accidents. The risks of these hazards are heightened to workers who come in contact with exposed wiring, unfinished electrical systems and power lines while performing their job on scaffolding or cranes near overhead power line (Bhole, 2016).

2.4.4 Other types of Construction site accidents

In addition to the aforementioned types of construction site accidents, Hughes and Ferrett (2007) exemplify the following as accidents that occur in the construction industry:

i. Coming in contact with moving machinery or material,
ii. Being struck by moving, flying or falling object;
iii. Being hit by a moving vehicle;
iv. Striking against something fixed or stationary;
v. Being injured while handling, carrying or lifting objects;

vi. Slipping, tripping and falling on the same level and/or from a height;
vii. Being trapped by something collapsing;
viii. Drowning or asphyxiating;
ix. Being exposed or in contact with a harmful substance;
x. Being exposed to fire or an explosion;
xi. Getting in contact with electricity or an electrical discharge among other accidents.

2.5 Accident preventive measures and mechanisms

The construction industry to date remains one of the most hazardous occupations in the world (Thompson, 2014). In Zambia, Mutwale-Ziko et al., (2017) opine the most effective way of preventing accidents on construction sites is through induction. Induction provides critical information about the site, proper work methods, proper use of plant and equipment, employer/employee responsibility, emergency procedures, environmental issues, reporting of accidents and near misses, personal protective equipment (PPE), and providing awareness on regulations relating to safety and health to parties exposed to construction works such as workers or visitors to the site (Australian Government, 2007).

Additionally, Tente et al., (2016) identified a number of the accident preventive measures that include improved attitude to safety and health, enforcement of the Factories Act, addition of safety and health as an item in all Bills of Quantities and the introduction of Occupational Safety and Health subjects in curricula of universities and colleges for students pursuing construction related qualifications.

Several studies have outlined that there are a number of benefits associated with occupational health and safety management systems among which include the benefit of accident prevention (Bijelic et al., 2015; Mambwe et al., 2021; Correll, 2020). Bottomley (1999) defines occupational health and safety management systems (OHSMS) as planned, documented and verifiable methods of managing hazards and associated risks. These management systems provide special attention to incident preventions, risk reduction and the overall welfare of the employees.

Occupational health and safety management systems are used to help organizations when it comes to dealing with operational risks and improvements of occupational health and safety performances hence reducing the costs associated with accidents and incidents. Having a proper occupational health and safety management system in place provides the employees with a clear and precise protocol to follow on how to deal with hazards, report accidents/ incidents and generally how to work through a problem (Work Safe, 2020).

Studies conducted in Korea and Canada suggest that buildings under construction face the greatest risk from fires as they do not contain permanent fire protection systems but only rely on fire extinguishers (Garis, 2015; Khan, 2020). According to Ali (2010), in order to prevent fires from occurring on construction sites the following measures should be applied:

i. Use less flammable materials
ii. Minimize the quantity of flammables on site
iii. Store flammable materials away from oxygen cylinders or oxidizing materials.
iv. Make sure that rubbish is removed regularly
v. Smoking should only be allowed in designated areas

Construction site workers are liable to face electrocution or shock as a result of coming in contact with exposed wiring, unfinished electrical systems and power lines while work is in progress. Bhole (2016) suggests the following measures should be implemented in order to prevent accidents of this kind.

i. Use personal protective equipment (PPE)
ii. Inspect Tools and Cords
iii. Use skilled and trained personnel in electrical safety for the task to be performed
iv. Ensure all machinery and power tools are properly grounded or double insulated

v. Thoroughly inspect all extension and power cords for wear and tear before use
vi. Ensure the plugs on any power tools or machinery are disconnected before inspecting or repairing

2.6 Accident prevention practices

Accident prevention practices refer to policies and procedures put in place to limit and control exposure to risks so that accidents are prevented. These practices take into account the relationship between the workforce, tasks and workplace (Alli, 2008; Wachter and Yorio, 2014). Studies have shown the specifics of accident prevention practices differ in accordance with the nature of the business. In the building construction industry accident prevention practices are so numerous and include some of the following:

2.6.1 Safety policies and procedures

Construction safety management is fundamental for organizations looking to prevent accidents in the work place. This allows for safety planning which provides the details on all safety policies and procedures appropriate for recording any accidents, alerting management to possible risks and how to complete safety related tasks (Priyadarshani et al., 2013). Additionally, this document also helps the employees understand what the expectations of management consequently preventing any miscommunication and legal issues in the event of accidents (Bijelic et al., 2015; Mambwe et al., 2020).

It should be understood that the construction industry is dynamic and constantly growing, hence organizations are advised to review their safety policies and procedures at least once per year (Priyadarshani et al., 2013). When and if any changes are made to the policies and procedures, it is imperative that the changes be communicated to the employees immediately.

2.6.2 Pre and post-employment physicals for specific positions

Some organizations tend to require employees who desire to occupy specific roles to undergo physical and mental screening before taking the job. This is done in order to ensure the mental and physical capabilities of the employees to perform the duties as the position demands. For instance, machine operators and truck drivers are required to undergo health screenings annually to in order to continue working (Zhao, 2019)

2.6.3 Regular training

Safety training is largely concerned about teaching employees the safe methods of carrying out their jobs and focusing on the occupational hazards. This helps the employees understand the risks associated with their jobs and how they can minimize the chances of accident occurrence (Hallowell, 2012; Demirkesen and Arditi, 2015). Safety training may include the following:

(i) Proper lifting techniques

(ii) Importance and correct use of personal protective equipment

(iii) Procedures for handling hazardous material

(iv) Accident reporting

(v) Locations of emergency equipment like fire extinguishers

2.6.4 Hire a safety officer

Construction companies are encouraged to get in the practice of hiring safety officers as their main focus is on safety and prevention of accidents. They are responsible for determining organizational risks, developing safety and wellness plans, implementing safety procedures and enforcement of the safety policies (Widajati et al., 2017). Safety officers concern themselves with identifying potential hazards by inspecting the workplace and reviewing accidents reports from previous years. Furthermore, safety officers ensure the organization complies with all the safety and health regulations of the state and industry.

2.6.5 Provide protective gear

Employers are required to provide the necessary safety gear and require the employees to use it appropriately. The personal protective equipment (PPE) provided depends on the nature of the work and the environment. PPE include but are not limited to reflective vests, helmets, googles, gloves, waist belts, harnesses and foot protection (Ammad et al., 2020).

Studies state that the employer should not just end at providing the protective gear but they should extend this practice to include training the employees on the right ways to use the equipment. Additionally, employers can conduct an unannounced inspection to make sure the employees are using their protective equipment appropriately (Ulang et al., 2014)

2.6.6 Housekeeping

Housekeeping which refers to the day to day cleaning of the construction site is an essential accident prevention practice in the construction industry. Poor housekeeping can result in the creation of hazards and employees are very likely to slip on floors or trip over objects (Aboagye-Nimo and Emuze, 2017).

2.7 Models of accident prevention practices

Despite extensive research on safety in the construction industry, accidents and incidents are still one of the major problems of the industry. With regard to these concerns, some researchers have focused on proactive and preventive approaches such as Prevention through Design (PtD) and safety climate, which can prevent accident occurrences of about 40% (Behm, 2005; Moaveni et al., 2019). Additionally, Manuele, (2008) highlighted the benefits of PtD as “improved productivity, decreased operating costs, significant risk reduction, and avoidance of expensive retrofitting”.

Safety climate serves as a frame of reference for employees to make sense of safety measures in the workplace and adapt their behaviors. In a bid to improve the safety climate at the individual level, Shen et al., (2014) developed a model that suggests

how management can create the desired psychological safety climate in a workplace by efforts from structural, perceptual, interactive, and cultural perspectives.

In Norway, Lund and Aaro (2004) presented a model of how two categories of risk factor and two process factors are influenced by the modification of three accident preventive measures. The two risk factors considered in their study included behavior, and physical and organizational environment. While the two process factors included attitudes and beliefs, and social culture and norms. The three accident preventive measures were identified to be:

i. Attitude modification: refers to changing ones attitudes through information and persuasion.
ii. Behaviour modification: refers to procedures for changing behaviour directly without trying to influence attitudes. Involves the use of techniques such as skills training and providing rewards.
iii. Structural modification: refers to changes in the physical environment, organization and social context through regulation, legislation, organization and economy.

The nature of the construction industry and the processes applied in executing the works have continued to grow in complexity leading to an increase in the potential for serious accidents. Presently, many new safety and accident prevention models have been developed, improved and implemented (Asan and Akasah, 2014). However, Li and Poon, (2010) projected that future accident causation and prevention models will become more complex to keep in tandem with the increasing changes such as the usage of high technology tools on site.

2.8 Literature reviewed on safety in the construction industry

The summary of the literature reviewed is tabulated in table 2

Table 2.1: Summary of technical papers reviewed on safety in the construction industry

No	Author	Title of Study	Findings/Conclusions	Comments, Critique (If Any)
1.	Muizz, *et al*., (2020)	Causes of Scaffold Accidents in Construction Industry	The paper concluded that the top three causes of scaffold accidents include: insufficient bracing/anchorage, scaffolding erected by incompetent professionals and "missing/faulty guardrails	The Study was limited to causes of scaffold accidents in Saudi Arabia
2	Kadiri, *et al*., (2014)	Causes and Effects of Accidents on Construction Sites (A Case Study of Some Selected Construction Firms in Abuja F.C.T Nigeria)	The study found that labourers are not only the major victims but are the main class of workers that are mostly responsible for accidents on construction sites. The study concluded that negligence was the major cause of accidents on construction sites. In order to ensure an accident free construction site management must implement some or all of the following measures which include regular supervision and inspection by safety officials and leaders on site, regular training on the use of tools and equipment, correct use of safety items and attire and provision of safety signs and notices on construction sites.	

No	Author	Title of Study	Findings/Conclusions	Comments, Critique (If Any)
3	Mohammadfam, *et al*., (2015)	Factors affecting occupational accidents in the construction industry	The study revealed that the occurrence and severity of accidents in construction were due to the combination of failures in accident contributing factors such as demographical and organizational factors, factors related to work conditions and equipment, unsafe acts and conditions, accident type, safety training and control measures. Consequently, to prevent and reduce the rate of such accidents, management should critically consider all these factors.	The study focused on identifying factors related to occupational injuries and the severity of their consequences on large construction sites in Iran.
4	Winge and Albrechtsen, (2018)	Accident types and barrier failures in the construction industry	The paper identified frequent accident types in the construction industry which include: fall from roof, floor or platform; contact with falling objects; fall from scaffold; and contact with moving parts of a machine. The study also showed that the distribution of accident types varied regarding severity and different construction types. This was explained by differences in work type, hazard, and energy type and energy amount.	The research was limited to frequent accident types in the Norwegian construction industry

No	Author	Title of Study	Findings/Conclusions	Comments, Critique (If Any)
5	)Mitropoulos, *et al*., (2005)	Accident Prevention Strategies: Causation Model and Research Directions	This paper presented an accident causation model that identifies the production system factors affecting the accident process. Additionally the paper proposed three accident prevention strategies: i. The reduction of task unpredictability to reduce the frequency of hazards. ii. Improving the work conditions to enable productive behaviours among the workforce without increasing the safety risk. iii. Develop error management strategies to prevent and mitigate the consequences of errors.	
6	Ajayeoba, *et al*., (2019)	Modelling Safety beyond Accident Prevention in Construction Industry	This study revealed that accidents can be prevented at different applications of safety strategies and not only when all safety interventions are applied. It also provided various strategies for saving cost which in turn showed that safety could be seen as a profitable service system other than only for accident prevention.	

No	Author	Title of Study	Findings/Conclusions	Comments, Critique (If Any)
7	Trinh and Feng (2018)	Improving Construction Safety Performance through Error Management: A Literature Review	The results of the review showed that error management is an effective way to improve organisational outcomes such as safety performance and innovativeness.	Most Organizations often focus on error prevention as a single strategy for dealing with errors. However, the authors successfully highlighted that error prevention needs to be supplemented by error management.
8	Kamardeen, (2010)	8D BIM modelling tool for accident prevention through design	The study revealed that Accident Prevention-through-Design (PtD) is one of the most effective ways of dealing with hazards. The PtD concept depends on designers to conduct a thorough risk assessment of each design component of the facility they design.	Studies suggest designers are not equipped to implement PtD due to their limited knowledge about safety during construction.

No	Author	Title of Study	Findings/Conclusions	Comments, Critique (If Any)
9	Su, *et al*,. (2019)	Developing A Case-Based Reasoning Model for Safety Accident Pre-Control and Decision Making in the Construction Industry	The study focused on the mechanism of safety accidents and developed a pre-decision-making framework by applying the Case- Based Reasoning (CBR) method. The developed framework is expected to provide construction practitioners with a platform to understand the hazards of safety accidents systematically and to provide them with valuable information for safety management.	There are limited studies that endeavour to introduce the CBR theory into construction safety management and risk management.
10	Zaira and Hadikusumo, (2017)	Structural equation model of integrated safety intervention practices affecting the safety behaviour of workers in the construction industry	The study developed a multilevel safety intervention structural equation modelling and the results showed that technical intervention has a positive influence by management and human intervention. Additionally, the study indicated that in order to achieve an improvement in the workers safety behaviour, focus should be on the technical intervention with five essential safety practices: safety permits, workplace safety inspections, safe work practices, personal protective equipment (PPE) programmes, and safety equipment availability and maintenance.	

No	Author	Title of Study	Findings/Conclusions	Comments, Critique (If Any)
11	Shin, *et al.*, (2014)	A system dynamics approach for modelling construction workers' safety attitudes and behaviours	The study developed a system dynamics (SD)-based model which was applied to examine the effectiveness of the following safety improvement policies: incentives for safe behaviours, increased levels of communication and self-immersion in accidents. Application of the model verified its strong potential to provide a better understanding of how to eliminate unsafe acts, and how to assess the effectiveness of safety programs before their implementation.	The developed model showed its potential to provide a better understanding of the perception of construction workers' toward safe behaviour
12	Al-Bayati, A.J., (2021)	Impact of Construction Safety Culture and Construction Safety Climate on Safety Behavior and Safety Motivation	The study suggests that the construction safety culture initiates and maintains the construction safety climate. Likewise, the construction safety culture, which is represented by the actions of upper management and safety personnel, significantly contributes to higher levels of safety behaviour and safety motivation, while the construction safety climate does not.	The study highlighted the importance and influence of construction safety culture on overall workplace culture.

2.9 Conceptual Framework

This study aims at developing a framework that ensures the effective application of accident prevention practices in the Zambian construction industry. Furthermore, the study identifies the accident prevention practices and mechanisms employed in the Zambian construction industry and also establish the extent to which the accident prevention practices are being applied. The conceptual framework in figure 2.1 suggests safety audits and inspections, shared expectations and accident control measures can ensure effectiveness of accident prevention method during project operation.

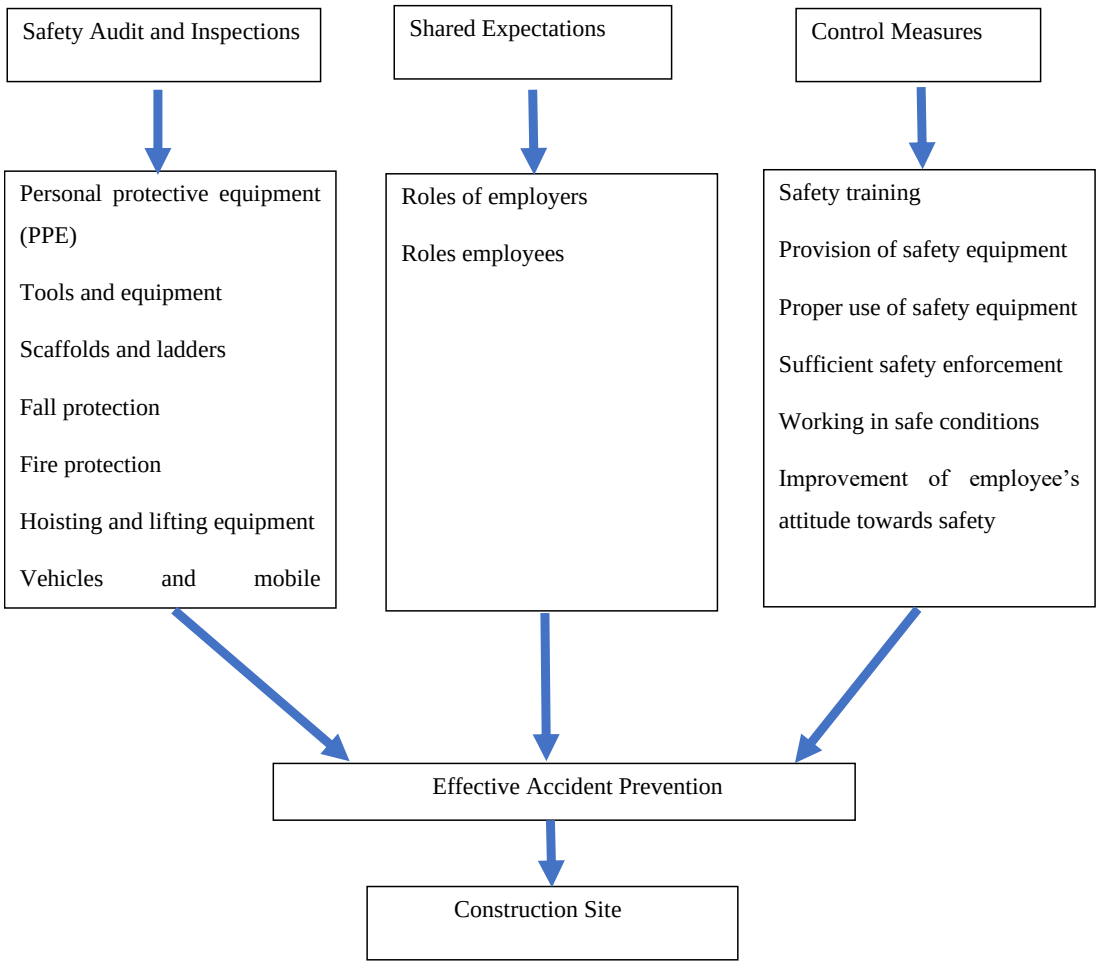

Figure 2.1: Conceptual framework

Issues of safety have gained vital importance in the construction industry and as such all individuals involved in construction projects should be concerned with the safety of the workforce performing the actual construction on site (Wu et al., 2010). Bhole (2016) suggests that establishing shared expectations about the safety roles of employees and employers can help prevent the occurrence of some accidents and ultimately improve the overall level of safety on construction sites.

Goh et al., (2016) suggested the use of safety audits and inspections at construction sites to ensure the effectiveness of accident prevention methods during project operations. Safety audits are used to examine and determine whether or not the daily

activities and processes of a company conform to their planned health and safety arrangements as well as safety laws prescribed by the government. It is important to note that safety audits are mainly conducted to check the effectiveness of the various programs and they do not take the place of regular site inspections (Nkeleme, et al., 2021). Safety audits are carried out by qualified occupational safety and health professionals from external third-party agencies of internally by safety officers (Sivaprakash, et al., 2013).

Several studies have outlined various accident control measures with the following being the commonly suggested ones; proper safety training, sufficient enforcement of safety, provision of safety equipment and its proper use, improvement of employee attitude towards safety and lastly avoiding working in unsafe site conditions.

Research shows that health and safety training programs significantly improve compliance by the employees to health and safety requirements in the construction industry (Wilkins, 2011; Albert and Hallowel, 2013). To effectively enforce safety on construction sites, studies suggest the need for safety professionals or site supervisors to know the safety standards for the tasks being performed and to monitor the work frequently (Idowu and Iyabo, 2017). Some construction accidents result, in part, because the necessary safety equipment to perform the job safely is not present when needed. With the bid to improving safety on construction sites employers are required to provide protective equipment to their employees whose requirement is to use them. However for various reasons, employees tend not to use the protective equipment provided to them making themselves susceptible to accidents (Tente and Muya, 2014; Wu et al., 2010). Studies further suggest that sharing experiences relating to safety in construction sites can essentially promote a positive safety culture and improve safety related behavior in the workforce (Lau and Rowlinson, 2009). Tente and Muya, 2014 opine employee participation in the development of safety measures can strengthen their commitment to improving safety as it gives them a sense of belonging which in turn could change their attitude

to safety and health. As is true for lack of training, lack of proper equipment, poor attitude to safety, conducting work under improper site conditions increases the chances of accident occurrence and this can be mitigated by ensuring safe working conditions (Toole, 2002; Work Safe , 2020).

2.10 Summary

This chapter has defined in detail what accidents are and highlighted the effects of accidents to include injuries, death, costs, bad image of the company and delayed project schedules. It has been established that accidents are attributed to unsafe acts such as bad safety attitudes and unsafe or hazardous conditions. The common causes of accidents identified by many researchers in internationally and those in Zambia include slips and falls, machinery accidents, poor attitude to safety, lack of personal protective equipment and lack of safety training. The chapter revealed that accident preventive strategies and measures include practices such as use of personal protective equipment, provision of safety training on the use of tools and equipment and improved attitude to safety and health. Although many studies have been conducted on accident preventive strategies globally, not many studies have been done regarding accident prevention modelling.

The following chapter discusses the methods used to achieve the research objectives.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter presents the methodology used to carry out the research presented in this dissertation in order to address the defined study aim and objectives. The chapter further explains the following parameters; research design, research population, sample size, data collection, and data analysis techniques.

3.2 Research methodology

Research methodology is the plan of action the researcher uses to conduct the research project (Leedy and Ormrod, 2001). It defines the activity of research including the choice and use of particular methods or techniques, how to proceed, how to measure progress, and what constitutes success in systematically solving the research problem to the desired outcomes (Kothari, 2004).

3.3 Research Design

Creswell (2008) defines research design as a plan and procedure for research that spans the decisions from broad assumptions to detailed methods of data collection and analysis. The research design is used to outline how the researcher intends to generate answers to a particular research problem (Orodho, 2003). In order to achieve the set objectives, this study adopted the use of the research design matrix as a method of planning as shown in table 3.1.

Table 3.1: Research design matrix

Research Question	Research Objectives	Sample Population	Data Collection	Data Analysis
1. What provisions of accident prevention practices and mechanisms are being employed in the Zambian construction industry?	1. To identify the accident prevention practices and mechanisms employed in Zambian construction industry	1. Senior Officials in Construction companies (Expert Purposive Sampling)	1. Interviews	1 Content Analysis
2. What is the extent to which accident prevention practices are being applied in the Zambian construction industry?	2. To establish the extent to which accident prevention practices are being applied in the Zambian construction industry	2 Construction workers (Simple Random Sampling)	2. Questionnaires and observation	2. Statistical Analysis
3 How can accident prevention practices be effectively applied in the Zambian Construction Industry?	3. To develop a framework that ensures effective application of accident prevention practices in the Zambian construction industry.	3. Senior Officials in Construction companies (Expert Purposive Sampling)	3. Interviews	3. Content Analysis

3.4 Study Population and Sample Size

In this study the sample population was composed of NCC registered local contractors in grades 1 and 2. With the focus being on both the employers (contractors) and employees (workers) working on construction projects in Lusaka, Zambia.

The study population was undertaken in Lusaka, because most construction activities are heavily concentrated in the city. This is where a sample of respondents were drawn from NCC registered local contractors in grades 1 and 2. According to the NCC annual report of 2018 the population size was 151 and the study sample size was estimated using the following formula for calculating sample size with a finite population.

$$n = \frac{\frac{Z^2 * p(1-p)}{e^2}}{1 + \left(\frac{Z^2 * p(1-p)}{e^2 N}\right)}$$

Where p is the prevalence or proportion of population of interest for the study, e is the Precision (or margin of error). For this research e is 5% of p and $Z = Z\alpha/2$ is normal deviate for two-tailed alternative hypothesis at a level of significance; such that, for 5% level of significance, Zα/2 is 1.96. p may be estimated at 50% to reflect the assumption that an impact is expected in 50% of the population. Note that assuming p of 50% in this research is also a conservative estimate such that the sample size with a finite population of 151 was calculated as follow as;

$$n = \frac{\frac{1.96^2 * 0.5(1-0.5)}{e^2}}{1 + \left(\frac{1.96^2 * 0.5(1-0.5)}{0.05^2 * 151}\right)} = 108.4$$

Hence, sample size of 109 with margin error of 5% and confidence level of 95% was required to conduct a survey to achieve the objectives of this research. Additionally, the sample size for the qualitative analysis can be limited to 12 participants (Onwuegbuzie and Collins, 2007).

Therefore, the sample size constituted a total of 121 participants where 12 key informants were subjected to interview guides as managers of workers in the construction industry and 109 questionnaires were administered to individuals that are workers of contractors registered with NCC in grades 1 and 2.

3.5 Sampling Method

In order to acquire the sample population for this study, this research made use of random sampling methods for probability sampling and a purposive sampling method for non-probability sampling.

3.5.1 Random sampling

The study adopted the use of the simple random sampling technique. This is where every member of a population has the same chance of being selected (West, 2016).

3.5.2 Purposive sampling

A purposive sample is defined as a non-probability sample that is selected based on characteristics of a population and the objective of the study (Crossman, 2020). Guarte and Barrios (2006) describe purposive sampling as a random selection of sampling units within a population with the most information on the characteristic of interest.

Purposive sampling was used in this research in order to select people that are believed to be reliable, valuable and would provide as much insight as possible into the conduct of workers and employers with regard to institution of accident protection practices as the phenomenon under investigation. Therefore, the sample comprised those individuals that have undertaken work or management in the construction industry in Zambia.

3.6 Data Collection

The primary data of this study was collected through the semi - structured interviews limited to 12 construction site senior personnel from NCC registered local contractors in grades 1 and 2 operational in Lusaka. These personnel included site engineers, project managers, project engineers and safety officers. Interviews were conducted prior to the preparation and administration of the questionnaires so that the preliminary data obtained could be used to enhance the questionnaire survey limited to 109 artisans as the target participants.

The study also made use of secondary sources of data such as books, journal articles, dissertations and thesis, reputable newspapers, conference proceedings and other authoritative and acceptable sources for data collection.

3.7 Data Analysis Technique

In this research quantitative data was analyzed using a computer software known as Statistical Package for Social Sciences (SPSS). Descriptive statistics was used to present the results from the survey using tables. The data coding method for quantification was introduced in individual data analysis sections in connection with the statements or questions analyzed. The data analysis process and corresponding findings were organized in accordance with the assessed program components that consist of a number of variables.

Furthermore, qualitative data was analyzed using content analysis as it allows rich, detailed and complex description of the data that was collected through examination and interpretation of patterns and themes in textual data.

3.8 Summary

The Chapter has presented the methodology, research design and a description of the data collection and data analysis tools that was used in order to achieve the objectives of the study. The primary data was collected from interviews and questionnaires while the secondary data was collected from books, journal articles,

dissertations and thesis, reputable newspapers, conference proceedings and other authoritative and acceptable sources for data. The sampling methods that were employed in the study are simple random and purposive sampling while the collected data was analyzed using excel and SPSS.

CHAPTER FOUR: DATA ANALYSIS AND RESULTS

4.1 Introduction

The chapter presents the data analysis and research findings of the survey conducted. The results will be presented in themes in line with the three objectives of this research which are as follows:

- To identify the accident prevention practices and mechanisms employed in Zambian construction industry.
- To establish the extent to which accident prevention practices are being applied in the Zambian construction industry.
- To develop a framework that ensures effective application of accident prevention practices in the Zambian construction industry.

4.2 Interviews results

The interviews were conducted with 12 key professionals from eight (8) NCC registered local construction companies in grades 1 and 2 operational in Lusaka. The numbers of interviewees are tabulated in table 4.1.

Table 4.1: Number of respondents

S/N	Registered Grade of Contractor	Number of interviewees
1	Grade 1	8
2	Grade 2	4

4.2.1 The profile of interviewees

Interviewees were carefully selected to represent the key professional players concerning occupational safety and health in construction companies. The interviewees included four safety officers, four site engineers, two project engineers, one clerk of works and one Project Manager.

Interviewees were asked how long they have worked in the construction industry and not particularly in the organization they currently work for. It was evident that the majority of the interviewees had over 6 years work experience and were therefore expected to have better knowledge on health and safety in the

construction industry, and thus provide reliable information. The findings are tabulated in table 4.2

Table 4. 2: Demographic profile of the interviewees

No	Position	Education level	Experience (years)
1	Project Engineer	MSc	20
2	Project Manager	MSc	16
3	Site Engineer	Degree	11
4	Site Engineer	Degree	10
5	Safety Officer	Diploma	10
6	Project Engineer	MSc	8
7	Site Engineer	MSc	7
8	Clerk of works	Degree	6
9	Safety Officer	Certificate	6
10	Safety Officer	Degree	4
11	Site Engineer	Degree	3
12	Safety officer	Certificate	2

4.2.2 Interviewee involvement in issues of OSH

This part of the interview was meant to establish how the respondents were involved with issues pertaining OSH in their organizations. The results showed that generally all the respondents were highly involved in issues of safety as it hinged on productivity. Respondents echoed how productivity was directly linked to safety hence they all played a role in enforcing safety at the work site. Their involvement included regular safety sensitization talks, inspections and monitoring, enforcing compliance and the distribution of PPE.

4.2.3 Accidents recorded

When asked if accidents are recorded after they occur on sites, interviewees did not have a unanimous response as some said yes and others were not sure about it at all.

> *"I have worked on this project for over a year and no accidents have been recorded on this current project. However we recorded six near misses*

with one notable example being after excavating for foundation, the poorly reinforced excavated walls caved-in immediately after an artisan had moved away from the edge of the excavation."

"We record accidents as they occur; records are kept at the site clinic as well as with the safety officer. On this current project we recorded 6 minor accidents as a result of negligence by the workers. One example was when a worker was hammering nails while not using gloves that were provided and consequently hammered a nail in one of his fingers."

"Since I joined the organization as a site engineer two years ago we have not had any major accidents and I am not sure if the minor accidents and near misses we encountered were recorded as I have not seen any such records."

It was gathered that the largest recorded number of accidents in a period of one year was 8-10. These included various non-fatal accidents resulting in minor injuries and bruises. These accidents included slips and falls, cuts due to non-usage or wrong usage of PPE such as gloves. It was also gathered that a number of near misses had occurred on these construction sites.

4.2.4 Safety audits and inspections

This part of the interviews was meant to establish if the construction companies conduct safety audits and inspections. The interviewees were asked to state if their companies conduct safety audits and inspections and how often. The study found that all the companies in question conduct safety inspections on the job sites while safety audits are conducted in only four companies.

"Having worked on several projects in my 16 year career in the construction industry in various parts of the country, it is apparent to me that safety audits are taken a lot more seriously on the Copperbelt and in particular on the mines as compared to the building sector."

"Site inspections are conducted regularly on our site, daily by the contractors' safety officer and weekly by the contractors' safety officer in

the company of the consultants' safety officer. However safety audits are something we are yet to start implementing in our organization."

"Both safety audits and inspections are conducted in our organization. Safety inspections are done on a regular basis while safety audits have in the past been conducted after the occurrence of accidents by internal auditors."

The site inspections are regularly conducted and in some instances they are impromptu by safety officers and others directly involved with issues of safety. While safety audits were said to be conducted by internal safety auditors.

The interviewees further highlighted the following as the key items in the safety audits:

(i) Personal protective equipment (PPE)
(ii) Tools and equipment
(iii) Scaffolds and ladders
(iv) Fall protection
(v) Fire protection
(vi) Hoisting and lifting equipment

4.2.5 Shared expectations in construction companies

In this part of the interviews, the interviewees were asked if their companies express the shared expectations among the employer, management and general workers in relation to OSH.

"All players in our organization are aware of what is expected of them with regards to safety for example management provides a safe work environment and PPE while the workers are expected to use the provided PPE."

"Various functional departments among which is the safety department meet weekly and have review sessions where each department presents a

summary of their operations. This allows for an open seating where shared expectations are expressed and later channeled down to the rest of the work force in each department."

The interviews showed that generally all the companies in question express their shared expectations and they understand their roles well enough and thus ultimately have good work systems.

4.2.6 Accident control measures

This part of the interviews was meant to establish the accident control measures applied in the construction industry. The interviewees suggested the following as the common accident control measures in the construction industry:

(i) Safety training and induction
(ii) Provision of PPE
(iii) Proper use of PPE
(iv) Safety inspections
(v) Sufficient safety enforcement
(vi) Providing safe working conditions and environment

4.2.7 Accident prevention practices

Site observations and interviews established that the accident control measures highlighted in the preceding section are the accident prevention practices commonly implemented in Zambian construction industry.

4.2.8 Views on the effectiveness of accident prevention practices

The study found that the accident prevention practices employed in the construction industry are to some extent adequately effective. From the site visited it was observed that most of the workers endeavor to adhere to safety regulations as they were seen using their PPE and carefully performing their tasks without putting each other in harms way. Additionally, from the interviews the study found that all the interviewees shared the same sentiment about the effectiveness of the accident prevention practices. They indicated that the accident prevention practices are to some extent adequately effective because despite measures being put in place they had few accidents and near misses

recorded on their construction sites therefore indicating there was need to improve on accident prevention practices.

4.2.9 Improvements on accident prevention practices

The interviewees suggested the following recommendations on how to make improvements on accident prevention measures in the construction industry**:**

(i) Employers should not compromise on the quality of PPE they provide to their workers.
(ii) Engage qualified OSH personnel on every project
(iii) Regulators such as NCC should conduct safety audits on construction projects
(iv) Use of breathalyzers should be a must on every project
(v) Employees with no or incorrect PPE should not be allowed to access the site
(vi) Employers should introduce a reward system for example awarding a safety champion as a way of motivating the workforce to uphold safety.
(vii) Issues of OSH should be added to the curriculum in higher learning institutions

4.2.10 Emerging patterns from interviews

With the interviewees' permission, the interviews were audio-recorded to help in the collection of information and later replayed to record key points raised during the interview. Common words, phrases and perceptions were identified and coded as shown in table 4.3

Table 4.3: Emerging patterns from interviews

Themes	Patterns	Interview Quotes	Relevance
Accident Records	Near misses and incidents	*"I have worked on this project for over a year and no accidents have been recorded on this current project. However we recorded six near misses with one notable example being after excavating for foundation, the poorly reinforced excavated walls caved-in immediately after an artisan had moved away from the edge of the excavation."*	Need to address the issue of near misses and incidents
Audits and Inspections	Safety audits	*"Having worked on several projects in my 16 year career in the construction industry in various parts of the country, it is apparent to me that safety audits are taken a lot more seriously on the Copperbelt and in particular on the mines as compared to the building sector."* *"Site inspections are conducted regularly on our site, daily by the contractors' safety officer and weekly by the contractors' safety officer in the company of the consultants' safety officer. However safety audits are something we are yet to start implementing in our organization."*	Need for construction companies to incorporate safety audits in their policies

Shared expectations	PPE Safety training	*"All players in our organization are aware of what is expected of them with regards to safety for example management provides a safe work environment and PPE while the workers are expected to use the provided PPE."* *"Safety talks are given on a weekly basis as a way of educating the workers on safety measures which is mostly the only training provided."*	Need for companies to express shared expectations beyond the provision and usage of PPE regarding safety
Accident prevention practices	PPE Inspections and enforcement of safety	*"Defective PPE is not replaced immediately, it is only replaced as and when it is scheduled for replacement. As a result it is a common sight to spot one or two workers using defective PPE as they await new ones."* *"As a site engineer enforcing safety without a safety officer is a challenge, safety is not my primary concern as I am more concerned with achieving the set deliverables hence the weak safety enforcement."*	Enhance the enforcement of accident prevention practices

Views on effectiveness of accident prevention practices	Adequacy Quality of PPE	*"Despite accident measures being put in place, we still record accidents, near misses or incidents on our construction sites, this entails there is more that can be done to improve on accident prevention practices."* *"Management should not compromise on the quality of PPE they provide, for example they should pay attention to expiry dates on hard hats as they purchase them"* *"Government through the Ministry of labor and social security*	Need to improve on accident prevention practices

Improvements on accident prevention practices	Government Reward and penalties Academia	*, Occupational Safety and Health Services department should provide external safety audits to the construction companies. This act should also be extended to regulating bodies such as NCC."* *"Construction companies should make an effort to award persons or departments that are adhere to safety. They should also in the same vein penalize individuals who do not adhere to the safety guidelines. Doing so will encourage workers to take safety seriously."* *"Issues of OSH should be added to the curriculum in all learning institutions so that workers should not only be introduced to safety once they are employed."*	More has to be to prevent the occurrence of accidents

4.3 Questionnaire survey

One hundred and nine (109) questionnaires were prepared and administered to the site workers of eight (8) construction companies registered in grades 1 and 2 by NCC with an objective of establishing the extent to which accident prevention practices are being applied in the Zambian construction industry. However, eight (8) questionnaires were not returned therefore the results and findings presented in this chapter are based on one hundred and one (101) questionnaires.

The questionnaire was segmented into three sections. Section one aimed at collecting background information of the respondents while section two aimed at establishing the extent to which accident prevention practices are applied based on the following three dimensions; Accident control measures; Safety audits and inspections; and Shared expectations. The final section aimed at establishing how accident prevention can be made effective in the Zambian construction industry. The results and findings obtained from the questionnaires are shown and discussed in the section below:

4.3.1 Background Information

The following were the background information of respondents and consisted of their gender, age, level of education, and years of experience in the construction industry. Table 4.4 shows the gender of the respondents.

Table 4.4: Gender of respondents

Gender	Frequency	Percent	Cumulative Percent
Male	87	86.1	86.1
Female	14	13.9	100.0
Total	101	100.0	

The majority of the respondents were male representing 86% and the minority being the female respondents accounting for 14% respectively. It is therefore evident that

there is a large gender disparity in the construction industry which continues to be male dominated. Table 4.5 shows the age groups of the respondents.

Table 4.5: Age groups of the respondents

Age Group	Frequency	Percent	Cumulative Percent
Under 26	7	6.9	6.9
26-30	45	44.6	51.5
31-35	34	33.7	85.1
36-40	15	14.9	100.0
Total	101	100.0	

Majority of the respondents were in the age bracket of 26-30 years, which accounts for 44.6% of the total. Those under 26 years were the fewest and represented by 6.9%. While those between 31-35 years and 36-40 years of age represented 33.7% and 14.9% of the total**.** Table 4.6 shows the level of education attained by the respondents.

Table 4.6: Level of education of respondents

Level of Education	Frequency	Percent	Cumulative Percent
Not completed high school	8	7.9	7.9
High School	23	22.8	30.7
Certificate	37	36.6	67.3
Diploma	14	13.9	81.2
Bachelors	19	18.8	100.0
Total	101	100.0	

It is evident that majority of the respondents were certificate holders (36.6%) followed by those who only completed high school (22.8%) and degree holders (18.8%). While those with a diploma represent (13.9%) and those who did not complete high school (7.9%) of the total. From this data, we can deduce that the

majority of the respondents had obtained tertiary level of education. Therefore it was expected that they have better knowledge on health and safety in the work place, and are able to provide reliable information. Table 4.7 shows the years of experience the respondents have worked in the construction industry.

Table 4.7: Years of experience in the construction industry

Years of Experience	Frequency	Percent	Cumulative Percent
0-4 years	35	34.7	34.7
5-10 years	52	51.5	86.2
11-15 years	7	6.9	93.1
16-20 years	7	6.9	100.0
Total	101	100.0	

The majority of the respondents (66) were found to have more than 5 years working experience in the construction industry, while (35) of the respondents had less than 5 years working experience in the industry. This implied that both those who had fewer years of experience and those with a longer service length were represented. The data showed that the frequency of the respondents was skewed towards those who had 5-10 years working experience.

4.3.2 The extent to which accident prevention practices are applied in the Zambian Construction industry.

A five point Likert scale was used to collect data which was assigned an ordinal measurement. The questionnaire had a number of statements that were generated from literature and condensed to identify themes that apply to the study. It had seven statements regarding Accident control measures, thirteen statements regarding Safety Audits and Inspections, and lastly eleven statements regarding Shared expectations of which respondents were assigned numerical values to the ordinal scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Unsure, 4 = Agree, 5 = Strongly Agree as shown in Appendix 2.

The range and interval lengths of the scale values were calculated in Microsoft excel and were found to be as shown in the table 4.8.

Table 4. 8: Range and interval lengths of the scale values

Level	**Scale**	**Interval length**	**Lower Limit**	**Upper Limit**
Strongly Disagree	1	0.80	1	1.80
Disagree	2	0.80	1.81	2.60
Neither agree or disagree	3	0.80	2.61	3.40
Agree	4	0.80	3.41	4.20
Strongly agree	5	0.80	4.21	5.00

According to Pimentel (2010), the five-point Likert scale is considered an interval scale and the mean is very significant. Table 4.8 indicates that scale interval from 1 to 1.8 means strongly disagree. From 1.81 to 2.60, it means disagree. From 2.61 to 3.40, it means neutral; from 3.41 to 4.20, it means agree; from 4.21 to 5.00, it means strongly agree.

Based on Oxford and Burry-Stock (1995) mean scores range from low, medium to high. Where low range is between 1.0 and 2.4, medium range is between 2.5 and 3.4, and high range is between 3.5 and 5.0. However, the mean score values of the three variables, that is, Accident control measures, Safety Audits and Inspections, and Shared expectations were also each calculated using weighted data entries for each statement in Microsoft excel and are shown in table 4.9.

Table 4.9: Mean score values

Variable	**Mean score**	**≥ mean score**
Accident control measures	3.82	Good
Safety Audits and Inspections	3.75	Good
Shared expectations	3.89	Good

a) Accident Control Measures

Accident control measures are measures put in place to prevent the occurrence of accidents in the construction industry. In order to establish the extents at which these accident control measures are applied, respondents' were asked to score the common accident control measures highlighted in table 4.10.

Table 4.10: Accident control measures (field survey,2021)

No	Statement	Strongly Disagree (%)	Disagree (%)	Unsure (%)	Agree (%)	Strongly Agree (%)	Total (%)
1	Safety training is provided to recognize and avoid job hazards	4.0	6.9	5.9	51.5	31.7	100
2	Site supervisors enforce safety standards at all times	7.9	12.9	2.0	48.5	28.7	100
3	Safety equipment is provided by employers	4.0	9.9	5.9	45.5	34.7	100
4	Workers use the safety equipment provided at all times	7.9	15.8	6.9	42.6	27.6	100
5	Defective tools or equipment are replaced immediately	7.9	20.8	13.9	44.6	12.9	100
6	All works are conducted using safe methods or sequencing	0	14.9	5.9	46.5	32.7	100
7	There is proper housekeeping to ensure safe site conditions	0	7.9	5.9	59.4	26.7	100

(i) Safety training is provided to recognize and avoid job hazards

Table 4.10 shows that 51.5% of respondents agreed to the statement, 'safety training is provided to recognize and avoid job hazards'. While 31.7% of respondents strongly agreed, 6.9% disagreed, 4% strongly disagreed and 5.9% were neutral. We can therefore deduce that the majority of the respondents representing 83.2% of the total respondents agreed that safety training is provided on the construction sites.

(ii) Site supervisors enforce safety standards at all times

Table 4.10 shows that 48.5% of respondents agreed to the statement, 'site supervisors enforce safety standards at all times'. While 28.7% of respondents strongly agreed, 12.9% disagreed, 7.9% strongly disagreed and 2% were neutral. This indicates that the majority of the respondents representing 77.2% of the total respondents acknowledged that site supervisors enforce safety standards at all times.

(iii) Safety equipment is provided by employers

Table 4.10 indicates that 45.5% of respondents agreed to the statement, 'safety equipment is provided by employers'. While 34.7% of respondents strongly agreed, 9.9% disagreed, 4% strongly disagreed and 5.9% were neutral. This data implies that the majority of the respondents representing 80.2% of the total respondents said the employers provide safety equipment. However, it is important to note that nearly 20% of the contractors do not consider providing PPE on worksites as their top most priority

(iv) Workers use the safety equipment provided at all times

Table 4.10 shows that 42.6% of respondents agreed to the statement, 'workers use the safety equipment provided at all times'. While 27.6% of respondents strongly agreed, 15.8% disagreed, 7.9% strongly disagreed and 6.9% were neutral. This indicates that 70.2% of the total respondents representing the majority acknowledged that workers use the safety equipment provided to them at all times.

(v) Defective tools or equipment are replaced immediately

The data in table 4.10 indicates that 44.6% of respondents agreed to the statement, 'defective tools or equipment are replaced immediately'. While 12.9% of

respondents strongly agreed, 20.8% disagreed, 7.9% strongly disagreed and 13.9% were neutral. This indicates that 57.5% of the total respondents acknowledged that defective tools or equipment are replaced immediately. While this a positive finding it is important to note that almost 40% of the respondents feel that replacing defective tools and equipment is not considered a priority by their employers.

(vi) All works are conducted using safe methods or sequencing

Table 4.10 shows that 46.5% of respondents agreed to the statement, 'all works are conducted using safe methods or sequencing'. While 32.7% of respondents strongly agreed, 14.9% disagreed, and 5.9% were neutral.

(vii) There is proper housekeeping to ensure safe site conditions

Table 4.10 shows that 59.4% of respondents agreed to the statement, 'there is proper housekeeping to ensure safe site conditions'. While 26.7% of respondents strongly agreed, 7.9% disagreed, 5.9% were neutral. It can be deduced that 86.1% of the total respondents felt that there is proper housekeeping to ensure safe site conditions in their workplaces.

(viii) Descriptive Statistics for accident control measures

The seven statements on accident control measures were further analyzed in order to determine those that were significant. This was done by using the mean score which was calculated using weighted data entries for each statement in Microsoft excel and the minimum cut off point for accident control measures was set at 3.82 as shown in table 4.11. Out of the seven (7) statements, four (4) were found to have a mean score greater than 3.82.

Table 4.11: Descriptive statistics of Accident control measures

Statement	N	Min	Maxi	Mean	Std. Dev	Variance	Mean score >3.82
(i) Safety training is provided to recognize and avoid job hazards	101	1	5	4.00	1.010	1.020	Yes
(ii) Site supervisors enforce safety standards at all times	101	1	5	3.77	1.224	1.489	No
(iii) Safety equipment is provided by employers	101	1	5	3.97	1.081	1.169	Yes
(iv) Workers use the safety equipment provided at all times	101	1	5	3.64	1.254	1.572	No
(v) Defective tools or equipment are replaced immediately	101	1	5	3.34	1.177	1.386	No
(vi) All works are conducted using safe methods or sequencing	101	2	5	3.97	0.995	0.989	Yes
(vii) There is proper housekeeping to ensure safe site conditions	101	2	5	4.05	0.805	0.648	Yes

The four statements whose mean scores were greater than 3.82 were further tested for significance using the One-Sample t-test. The One-Sample t-test was run in order to assess if the sample mean differs statistically in comparison to the population mean set at 3.82. It was established that the first three statements were statistically not significant at $p>0.05$ while the last statement was statistically significant at $p<0.05$ as shown in table 4.12. Statements that were statistically insignificant were dropped off immediately as they do not adequately represent the population while those that were significant were later used in the development of the proposed framework in chapter six.

Table 4.12: One –Sample t-test for Accident control measures

Statement	Test Value = 3.82					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
(i) Safety training is provided to recognize and avoid job hazards	1.791	100	0.076	0.180	-0.02	0.38
(iii) Safety equipment is provided by employers	1.397	100	0.166	0.150	-0.06	0.36
(vi) All works are conducted using safe methods or sequencing	1.519	100	0.132	0.150	-0.05	0.35
(vii) There is proper housekeeping to ensure safe site conditions	2.866	100	0.005	0.230	0.07	0.39

b) Safety audits and inspections

Safety audits and inspections are used to examine and determine whether the daily activities and processes of a company conform to their planned health and safety arrangements as well as safety laws prescribed by the government. In order to establish the extent at which safety audits and inspections are applied, respondents' were asked to score the common activities that occur on their construction sites with regards to audits and inspections as shown in table 4.13.

Table 4.13: Safety audits and inspections (field survey, 2021)

No	Statement	Strongly Disagree (%)	Disagree (%)	Unsure (%)	Agree (%)	Strongly Agree (%)	Total (%)
1	Safety inspections are carried out regularly	6.9	17.9	4.0	47.5	33.7	100
2	Workers are provided with the necessary PPE and equipment for the works being conducted	0	7.9	0	60.4	31.7	100

No	Statement	Strongly Disagree (%)	Disagree (%)	Unsure (%)	Agree (%)	Strongly Agree (%)	Total (%)
3	Defective PPE is replaced immediately	5.0	17.8	15.8	34.7	26.7	100
4	Defective tools and equipment are replaced immediately	5.0	16.6	17.8	38.6	21.8	100
5	Smoking on site is only done in designated areas	12.9	25.7	9.9	25.7	25.7	100
6	Fire extinguishers are available on site	18.9	28.9	5.0	23.5	23.8	100
7	All workers are familiar with the use of the fire extinguishers available	16.8	9.9	27.7	39.6	5.9	100
8	All workers on site know the safety procedures to follow when a fire breaks out	5.0	10.9	29.7	31.7	22.8	100
9	Workers using full body harness are trained to use and properly wear it	6.9	6.9	12.9	46.5	26.7	100
10	Workers have been trained and instructed how to lift safely	4.0	12.9	17.8	38.6	26.7	100
11	All excavations are protected with clearly marked and fixed covers to prevent falls	0	5.9	8.9	50.5	34.7	100
12	Edge protection is provided to prevent people or materials falling from heights	0	11.9	4.0	55.4	28.7	100
13	Scaffolds are erected and dismantled by competent people	0	5.9	4.0	59.4	30.7	100

(i) Safety inspections are carried out regularly

A total of 81.2% of respondents were agreeable that safety inspections are carried out regularly. Table 4.13 shows that among the respondents 47.5% of them agreed while 33.7% strongly agreed respectively. 14.8 % of the respondents felt that safety inspections are not carried out regularly, these represented the 7.9% who disagreed with the statement and the 6.9% that strongly disagreed, while 4% of the respondents were neutral. This implies that the majority of the construction workers acknowledge that safety inspections are carried out regularly.

(ii) Workers are provided with the necessary PPE and equipment for the works being conducted

A total of 92.1% of respondents were agreeable that workers are provided with the necessary PPE and equipment for the works being conducted. Table 4.13 shows that among the respondents 60.4% agreed while 31.7% of respondents strongly agreed. Among the respondents 7.9% disagreed to the statement. This implies that the majority (92.1%) of the construction workers acknowledge that they are provided with the necessary PPE and equipment for the works being conducted.

(iii) Defective PPE is replaced immediately

Among the respondents 34.7% agreed to that defective PPE is replaced immediately while 26.7% of respondents strongly agreed. Among those that did not agree were 17.8% that disagreed, and 5% that strongly disagreed leaving 15.8 % of the respondents neutral. This implies that the majority (61.4%) of the respondents felt that defective PPE is replaced immediately while (38.6%) of the respondents included those that disagreed and those that neither agreed nor disagreed.

(iv) Defective tools and equipment are replaced immediately

A total of 60.4% of the total respondents agreed that defective tools and equipment are replaced immediately. These were represented by the 38.6% that agreed and the 21.8% of respondents that strongly agreed. Among the respondents 21.8% did not agree with the statement and were represented by the 16.8% that disagreed, and the 5% that strongly disagreed respectively while 17.8% of the respondents neither

agreed nor disagreed. This implies that the majority of the respondents feel that defective tools and equipment are replaced immediately by their employers.

(v) Smoking on site is only done in designated areas

About 51.4% of the total respondents said that smoking on sites is only done in designated areas and these were represented by 25.7% that agreed to the statement and 25.7% of respondents that strongly agreed. Among the respondents that did not agree to the statement 25.7% disagreed, and 12.9% strongly disagreed while 9.9% were neutral. It is evident that only about half of the total respondents (51.4%) agreed that smoking is only done in designated areas.

(vi) Fire extinguishers are available on site

About 23.5% of respondents agreed to that fire extinguishers are available on site while 23.8% of respondents strongly agreed. Among those that did not agree, 28.9% disagreed and another 18.9% nine percent strongly disagreed while 5% were neutral. The data shows that almost half of the respondents (47.3%) said that fire extinguishers are available on sites while the (52.7%) representing the majority of respondents did not agree that fire extinguishers are available.

(vii) All workers are familiar with the use of the fire extinguishers available

About 39.6% of respondents said that all workers are familiar with the use of the fire extinguishers available while 5.9% of respondents strongly agreed with the statement. The data shows that 9.9% disagreed, and 16.8% strongly disagreed while 27.7% were neutral. It is evident that the majority of the respondents (54.4%) did not agree with the statement that all workers are familiar with the use of the fire extinguishers available.

(viii) All workers on site know the safety procedures to follow when a fire breaks out

About 31.7% of respondents agreed to the statement all workers on site know the safety procedures to follow when a fire breaks out. 22.8% of respondents strongly

agreed, 10.9% disagreed, and 5% strongly disagreed while 29.7% were neutral. It is evident that nearly half of the respondents (45.5%) did not agree with the statement that all workers on site know the safety procedures to follow when a fire breaks out while 54.5% of the respondents agreed.

(ix) Workers using full body harness are trained to use and properly wear it

The data shows that 46.5% of respondents agreed to the statement,' Workers using full body harness are trained to use and properly wear it'. Furthermore, 26.7% of respondents strongly agreed, 6.9% seven percent disagreed, and another 6.9% strongly disagreed while 12.9% were neutral. This implies that the majority of the respondents representing 73.2% acknowledged that workers using full body harnesses are trained to use and wear them appropriately.

(x) Workers have been trained and instructed how to lift safely

Table 4.13 shows that 38.6% of respondents agreed to the statement,' Workers have been trained and instructed how to lift safely'. 26.7% of respondents strongly agreed, 12.9% disagreed, and 4% strongly disagreed while 17.8% were neutral. This implies that the majority of the respondents acknowledged that workers are trained and instructed on how to lift items safely.

(xi) All excavations are protected with clearly marked and fixed covers to prevent falls

Table 4.13 shows that 50.5% of respondents agreed to the statement, 'All excavations are protected with clearly marked and fixed covers to prevent falls'. 34.7% of respondents strongly agreed, 5.9% disagreed, and 8.9% were neutral. This data indicates that the majority of the respondents representing 85.2% of the total respondents said that all excavations are protected with clearly marked or with fixed cover to prevent falls.

(xii) Edge protection is provided to prevent people or materials falling from heights

Table 4.13 shows that 55.4% of respondents agreed to the statement,' Edge protection is provided to prevent people or materials falling from heights'. 28.7% of respondents strongly agreed, 11.9% disagreed, and 4% were neutral. This indicates

that the majority of the respondents representing 84.1% of the total respondents felt that edge protection is provided to prevent people or materials falling from heights.

(xiii) Scaffolds are erected and dismantled by competent people

Table 4.13 shows that 59.4% of respondents agreed to the statement,' Scaffolds are erected and dismantled by competent people'. While 30.7% of the respondents strongly agreed, 5.9% disagreed, and 4% were neutral. This indicates that the majority of the respondents representing 90.1% of the total respondents acknowledged that scaffolds are erected and dismantled by competent people to prevent accidents.

(xiv) Descriptive statistics for safety audits and inspections

The thirteen statements regarding safety audits and inspections were further analyzed in order to determine those that were significant. This was done by using the mean score which was calculated using weighted data entries for each statement in Microsoft excel and the minimum cut off point was set at set at 3.75 as shown in table 4.14. Out of the thirteen (13) statements, six (6) were found to have a mean score greater than 3.75.

Table 4.14: Descriptive statistics for safety audits and inspections

	Safety Audits and Inspections	N	Min	Max	Mean	Std. Dev	Variance	Mean score> 3.75
1	Safety inspections are carried out regularly	101	1	5	3.93	1.151	1.325	Yes
2	Workers are provided with the necessary PPE and equipment for the works being conducted	101	2	5	4.16	0.784	0.615	Yes
3	Defective PPE is replaced immediately	101	1	5	3.60	1.201	1.442	No
4	Defective tools and equipment are replaced immediately	101	1	5	3.55	1.153	1.330	No
5	Smoking on site is only done in designated areas	101	1	5	3.26	1.419	2.013	No
6	Fire extinguishers are available on site	101	1	5	3.74	1.180	1.393	No
7	All workers are familiar with the use of the fire extinguishers available	101	1	5	3.08	1.189	1.414	No
8	All workers on site know the safety procedures to follow when a fire breaks out	101	1	5	3.56	1.108	1.228	No
9	Workers using full body harness are trained to use and properly wear it	101	1	5	3.79	1.125	1.266	Yes
10	Workers have been trained and instructed how to lift safely	101	1	5	3.71	1.117	1.247	No
11	All excavations are protected with clearly marked and fixed covers to prevent falls	101	2	5	4.14	0.813	0.661	Yes
12	Edge protection is provided to prevent people or materials falling from heights	101	2	5	4.01	0.900	0.810	Yes
13	Scaffolds are erected and dismantled by competent people	101	2	5	4.15	0.753	0.568	Yes

The six statements whose mean scores were greater than 3.75 were further tested for significance using the One-Sample t-test. The One-Sample t-test was run in order to assess if the sample mean differs statistically in comparison to the population mean set at 3.75. It was established that the two statements were statistically not significant at $p>0.05$ while four statements were statistically significant at $p< 0.05$ as shown in table 4.15. Statements that were statistically insignificant were dropped off immediately as they do not adequately represent the population while those that were significant were later used in the development of the proposed framework in chapter six.

Table 4. 15: One-Sample T-test for safety audits and inspections

Statement	Test Value=3.75					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
(i) Safety inspections are carried out regularly	1.578	100	0.118	0.181	-0.05	0.41
(ii) Workers are provided with the necessary PPE and equipment for the works being conducted	5.235	100	0.000	0.408	0.25	0.56
(ix) Workers using full body harness are trained to use and properly wear it	0.376	100	0.708	0.042	-0.18	0.26
(xi) All excavations are protected with clearly marked and fixed covers to prevent falls	4.805	100	0.000	0.389	0.23	0.55
(xii) Edge protection is provided to prevent people or materials falling from heights	2.902	100	0.005	0.260	0.08	0.44
(xiii) Scaffolds are erected and dismantled by competent people	5.315	100	0.000	0.399	0.25	0.55

c) Shared expectations

Shared expectations refer to the common understanding that is common between the employers and employees with regards to their safety roles. In order to establish if shared expectations are expressed in their companies, respondents' were asked to score the shared expectations as they relate to their construction company as shown in table 4.16.

Table 4.16: Shared expectations in construction companies (field survey, 2021)

No	Statement	Strongly Disagree (%)	Disagree (%)	Unsure (%)	Agree (%)	Strongly Agree (%)	Total (%)
1	Employers provide a safe and healthy working environment to his employees.	0	5.9	6.9	57.4	29.7	100
2	Employers provide adequate and appropriate information, instruction, training and supervision to his employees.	3.0	14.9	4.0	47.5	30.7	100
3	Employers set out safety and health standards and procedures.	0	5.9	5.9	62.4	25.7	100
4	Employers appoint responsible personnel to ensure that the safety and health standards, instructions and procedures are strictly observed and followed.	5.0	9.9	3.0	57.4	24.8	100
5	Employers provide adequate and proper personal protective equipment for his employees.	2.0	19.8	0	61.4	16.8	100
6	Workers are conversant and co-operate with the employer in administering the safety and health standards, instructions and procedures, which are related to their work to avoid accident.	4.0	9.9	16.8	50.5	18.8	100

No	Statement	Strongly Disagree (%)	Disagree (%)	Unsure (%)	Agree (%)	Strongly Agree (%)	Total (%)
7	Workers work safely and take good care of themselves and others who may be affected by them at all times.	0	14.9	5.9	59.4	19.8	100
8	Workers avoid to take dangerous shortcuts, avoid to improvise dangerous tools, and always seek assistance and advice if in doubt.	0	14.9	5.9	52.5	26.7	100
9	workers use the PPE as required and take reasonable care of them when they are not used	0	13.9	14.9	52.5	18.8	100
10	Workers take immediate action to rectify or report any unsafe tools, equipment and plant to their supervisors or the responsible person in control of the workplace.	4.0	19.8	3.0	54.5	18.8	100
11	Workers report all accidents to the supervisors immediately after their occurrences	2.0	2.0	3.0	56.4	36.6	100

(i) Employers provide a safe and healthy working environment to his employees

Table 4.16 shows that 57.4% percent of respondents agreed to the statement, ’Employers provide a safe and healthy working environment to his employees’. While 29.7% of respondents strongly agreed, 5.9% disagreed, and 6.9% were neutral. This indicates that the majority of the respondents (87.1%) acknowledged that employers provide safe and healthy working environments to their employees.

(ii) Employers provide adequate and appropriate information, instruction, training and supervision to his employees.

The data in table 4.16 shows that 47.5% of the respondents agreed to the statement,' Employers provide adequate and appropriate information, instruction, training and supervision to his employees.' While 30.7% of respondents strongly agreed, 14.9% disagreed, 3% strongly disagreed and 4% were neutral. This implies that the majority of the respondents representing 78.2% of the total respondents felt that employers provide adequate and appropriate information, instruction, training and supervision to their employees.

(iii) Employers set out safety and health standards and procedures

The data in table 4.16 shows that 62.4% of respondents agreed to the statement,' Employers set out safety and health standards and procedures'. While 25.7% of respondents strongly agreed, 5.9% disagreed, and 5.9% were neutral. This implies that the majority of the respondents representing 88.1% of the total respondents said employers set out safety and health standards and procedures.

(iv) Employers appoint responsible personnel to ensure that the safety and health standards, instructions and procedures are strictly observed and followed

Table 4.16 shows that 57.4% of respondents agreed to the statement,' Employers appoint responsible personnel to ensure that the safety and health standards, instructions and procedures are strictly observed and followed'. While 24.8% of respondents strongly agreed, 9.9% disagreed, 5% strongly disagreed and 3% were neutral. This indicates that 82.2% of the total respondents acknowledge that their employers have appointed responsible personnel to ensure that the safety and health standards, instructions and procedures are strictly observed and followed.

(v) Employers provide adequate and proper personal protective equipment for his employees.

Table 4.16 indicates that 61.4% of respondents agreed to the statement,' Employers provide adequate and proper personal protective equipment for his employees'. While 16.8% of respondents strongly agreed, 19.8% disagreed, and 2% strongly disagreed. This indicates that the 72.8% of the total respondents acknowledge that their employers provide adequate and proper PPE for their use.

(vi) Workers are conversant and co-operate with the employer in administering the safety and health standards, instructions and procedures, which are related to their work to avoid accident.

A total of 69.8% of the total respondents acknowledged that workers are conversant and co-operate with the employer in administering the safety and health standards, instructions and procedures, which are related to their work to avoid accidents. These represented the 50.5% of respondents that agreed to the statement and the 18.8% that strongly agreed respectively. While 9.9% disagreed, 4% strongly disagreed and 16.8% were neutral representing the minority of the respondents respectively.

(vii) Workers work safely and take good care of themselves and others who may be affected by them at all times.

Table 4.16 shows that 59.4% of respondents agreed to the statement,' Workers work safely and take good care of themselves and others who may be affected by them at all times'. While 19.8% of respondents strongly agreed, 14.9% disagreed, and 5.9% were neutral. This indicates that the majority of the respondents representing 79.2% of the total respondents acknowledged that workers work safely and take good care of themselves and others who may be affected by them at all times.

(viii) Workers avoid taking dangerous shortcuts, avoid improvising dangerous tools, and always seeking assistance and advice if in doubt.

Table 4.16 shows that 52.5% of respondents agreed to the statement,' Workers avoid to take dangerous shortcuts, avoid improvising dangerous tools, and always seeking assistance and advice if in doubt'. While 26.7% of respondents strongly agreed, 14.9% disagreed, and 5.9% were neutral. This shows that 79.2% of the total

respondents acknowledge that workers avoid to take dangerous shortcuts, avoid improvising dangerous tools, and always seeking assistance and advice if in doubt

(ix) workers use the PPE as required and take reasonable care of them when they are not used

Table 4.16 shows that 52.5% of respondents agreed to the statement,' workers use the PPE as required and take reasonable care of them when they are not used'. While 18.8% of respondents strongly agreed, 13.9% disagreed, and 14.9% were neutral. This indicates that the majority of respondents (71%) feel that workers use the PPE as required and take reasonable care of them when they are not used.

(x) Workers take immediate action to rectify or report any unsafe tools, equipment and plant to their supervisors or the responsible person in control of the workplace.

Table 4.16 shows that 54.5% of respondents agreed to the statement,' workers take immediate action to rectify or report any unsafe tools, equipment and plant to their supervisors or the responsible person in control of the workplace'. While 18.8% of respondents strongly agreed, 19.8% disagreed, 4% strongly disagreed and 3% were neutral. This indicates that the majority of respondents (73.3%) acknowledge that workers take immediate action to rectify or report any unsafe tools, equipment and plant to their supervisors or the responsible person in control of the workplace.

(xi) Workers report all accidents to the supervisors immediately after their occurrences

Table 4.16 shows that 56.4% of respondents agreed to the statement,' workers report all accidents to the supervisors immediately after their occurrences'. While 36.6% of respondents strongly agreed, 2% disagreed, another 2% strongly disagreed and 3% were neutral. This indicates that the majority of the respondents (93%) said that workers report all accidents to the supervisors immediately after their occurrences.

(xii) Descriptive statistics for shared expectations in the construction companies

The eleven statements were further analyzed in order to determine those which were significant. This was done by using the mean score which was calculated using weighted data entries for each statement in Microsoft excel and the minimum cut off point was set at set at 3.75 as shown in table 4.17. Out of the eleven (11) statements, four (4) were found to have a mean score greater than 3.89.

Table 4.17: Descriptive statistics for shared expectations among employees and employers

	Statement	**N**	**Min**	**Max**	**Mean**	**Std. Deviation**	**Variance**	**Mean score >3.89**
1	Employers provide a safe and healthy working environment to his employees	101	2	5	4.11	0.773	0.598	Yes
2	Employers provide adequate and appropriate information, instruction, training and supervision to his employees	101	1	5	3.88	1.098	1.206	No
3	Employers set out safety and health standards and procedures	101	2	5	4.08	0.744	0.554	Yes
4	Employers appoint responsible personnel to ensure that the safety and health standards, instructions and procedures are strictly observed and	101	1	5	3.87	1.055	1.113	No
5	Employers provide adequate and proper personal protective equipment for his employees	101	1	5	3.71	1.033	1.067	No
6	(vi) Workers are conversant and co-operate with the employer in administering the safety and health standards, instructions and procedures, which are related to their work to avoid accident.	101	1	5	3.7	1.015	1.031	No
7	Workers work safely and take good care of themselves and others who may be affected by them at all times.	101	2	5	3.84	0.914	0.835	No
8	Workers avoid taking dangerous shortcuts, avoid improvising dangerous tools, and always seeking assistance and advice if in doubt.	101	2	5	3.91	0.96	0.922	Yes
9	Workers use the PPE as required and take reasonable care of them when they are not used	101	2	5	3.76	0.918	0.843	No
10	Workers take immediate action to rectify or report any unsafe tools, equipment and plant to their supervisors or the responsible person in control of the workplace	101	1	5	3.64	1.119	1.252	No
11	Workers report all accidents to the supervisors immediately after their occurrences	101	1	5	4.24	0.777	0.603	Yes

The four statements whose mean scores were greater than 3.89 were further tested for significance using the One-Sample t-test. The One-Sample t-test was run in order to assess if the sample mean differs statistically in comparison to the population mean set at 3.89. It was established that the one statement was statistically not significant at $p>0.05$ while three statements were statistically significant at $p< 0.05$ as shown in table 4.18. Statements that were statistically insignificant were dropped off immediately as they do not adequately represent the population while the statistically significant statements were later used in the development of the proposed framework in chapter six.

Table 4. 18: One –Sample t-test for Shared expectations

	Test Value = 3.89					
Statement	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
(i) Employers provide a safe and healthy working environment to his employees	2.845	100	0.005	0.219	0.07	0.37
(iii) Employers set out safety and health standards and procedures	2.556	100	0.012	0.189	0.04	0.34
(viii) Workers avoid taking dangerous shortcuts, avoid improvising dangerous tools, and always seeking assistance and advice if in doubt.	0.219	100	0.827	0.021	-0.17	0.21
(xi) Workers report all accidents to the supervisors immediately after their occurrences	4.499	100	0.000	0.348	0.19	0.50

4.3.2 Views on accident prevention in the Zambian construction industry

Respondents suggested the following on how accident prevention can be made effective in the construction industry**.**

(a) Employers should provide PPE and encourage its usage at all times

(b) Construction companies should ensure they employ qualified safety officers instead of leaving issues of safety to site engineers whose main focus is meeting targets
(c) Government should come up with strict laws that guide employers on how to properly train employees
(d) Construction companies should develop safety slogans for employees to recite on a daily basis thus fostering a mentality of safety
(e) Employees should follow all site rules and regulations
(f) Safety officers should be proactive and be able to detect potential hazards early enough
(g) All construction sites should encourage random breathalyzers tests to discourage the workers from consuming alcohol during work hours.

4.3.3 Summary

This chapter presented the findings from the collected data on accident prevention practices in the construction industry from the semi-structured interviews and questionnaire survey. The analysis revealed that the accident prevention practices employed in the construction industry are not sufficiently effective as there were accidents and near misses recorded on various construction sites in the industry. To this effect research participants submitted various ideas that can be useful in the improvement OSH in the industry. The next chapter presents a discussion on the results.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter presents the discussion of the research findings of the study and how they relate to findings of other researchers. The discussion centers around two objectives which was to identify the accident prevention practices and mechanisms employed in Zambian construction industry, and to establish the extent to which accident prevention practices are being applied in the Zambian construction industry.

The results of the interviews and questionnaires were summarized as follows:

(i) Accidents recorded
(ii) Accident preventive practices and the extent to which they are applied
(iii) Views on the effectiveness of accident prevention practices
(iv) Improvements on accident prevention practices

5.2 Accidents recorded

The study found that people are aware of accidents that occur on construction sites and this is important because it helps us to know what prevention practices need to be implemented for particular accidents. From construction companies sampled during the study, it was gathered that the largest recorded number of accidents in a period of one year was approximately 8-10 accidents. These included various non-fatal accidents resulting in minor injuries and bruises. These accidents included slips and falls, cuts due to non-usage or wrong usage of PPE such as gloves. The study also gathered that a number of near misses and incidences had occurred on these construction sites. A case study by Namonje, (2017) categorized the accidents common on Zambian construction sites into falls, cuts, burns, exertion, electrical, struck by, poisoning and classified them into minor, major and fatal.

Additionally, the study identified inadequacies in reporting of accidents and near misses on construction sites. This finding on this study conform with the findings of

Mutwale-Ziko et al., (2017) who established that despite most construction sites having formal systems of reporting, recording and investigating accidents as guided by organizational OSH policies, they have low levels of adherence to reporting of accidents, injuries, near misses and illnesses on site. The study findings also agree with Tente, (2016) who asserts that "there were no accident reports in many interviewees sites" in the study she conducted.

5.3 Accident preventive practices and the extent to which they are applied

The study established the common accident preventive practices in the Zambian construction industry and the extent to which they are applied. The accident preventive practices were categorized into 3 main groups namely; accident control measures, safety audits and inspections and shared expectations in the construction companies.

5.3.1 Accident control measures

Accident control measures are those actions that are taken to reduce the likelihood of accidents being realized. Among the many accident control measures, the common ones that were sited in this study included; safety training, the provision of PPE and its proper use, safety inspections, sufficient safety enforcement and the provision of safe working conditions and environments.

(i) Safety training

The study deduced that the majority of the research participants accounting for 83.2% of the total respondents agreed that safety training is provided on the construction sites. It was also established that safety training is mostly provided for in the form of safety talks that are given on a regular basis as a way of educating the workers on safety measures. During these safety talks, workers are taught about the safe methods of carrying out their jobs and focusing on the occupational hazards. This helps the employees understand the risks associated with their jobs and how they can minimize the chances of accident occurrence. The study found that safety training included proper lifting techniques, the importance and correct use of

personal protective equipment, procedures for handling hazardous material and procedures for accident reporting.

The findings align with Eggerth et al., (2018) whose study focused on safety talks also refered to as toolbox talks. Tool box talks are extensively used in the United States and internationally. These talks are normally brief lasting 10-15minutes and focus on specific safety topics relevant to the worksite. However, the findings of this study are contrary to the findings of Mutwale-Ziko et al., (2017) whose study indicated that most contractors did not provide continued health and safety training to their casual workers. This is indicative of an improvement in the area of safety training on the construction sites.

(ii) Provision of PPE and its usage

The study found that most employers provide their employees with PPE at the onset of the project as this is normally something the client and consultants are on the watch for. However, it was found that employers are reluctant to replace defective PPE immediately, it is only replaced as and when it is scheduled for replacement in the procurement plans. It is therefore a common sight to spot one, two or more workers on construction sites using defective PPE as they await new ones. This poses a huge risk to employees in the event of accident occurrence. This aligns with Farooqui et al., (2009) whose study highlighted that PPE can be a significant determining factor between safety and an accident on worksites. Their study also highlighted the need for improvement in both organizational and worker commitment towards PPE compliance.

The professional interviews conducted in this study highlighted that employers should not just end at providing the protective gear but they should extend this practice to include training the employees on the right ways to use the equipment. Additionally employers can conduct unannounced inspections to make sure the employees are using their protective equipment appropriately. A study by Zin, and Ismail, (2012) conducted to assess the employers' behavioural safety compliance factors toward occupational, safety and health improvement in the construction

industry highlighted that the employer is required to supervise the employees from time to time to ensure they always follow the rules on how to wear and use safety tools so as to keep their safety a priority at all times.

(iii) Safety inspections

According to this study, the majority of the construction workers accounting for 81.2% of the total respondents acknowledged that safety inspections are carried out regularly. Additionally, the interviewees cited that site inspections are carried out regularly on their sites, daily by the contractors' safety officer and weekly by the contractors' safety officer in the company of the consultants' safety officer. The interviews further revealed that during the safety inspections the inspectors walk around the construction site and inspect the works done, the working environment and the use of PPE by the workers. Failure to satisfying the requirements of the inspectors the safety officers have the authority to suspend the works or remove the workers found wanting from the sites. This indicates that construction managers take the proactive approach of ensuring workers comply with issues of safety and as a result, this helps to foster compliance of safety by the workers. According to Keng and Razak, (2014), site safety inspections are the most important practice that needs to be conducted regularly. This was revealed in the case studies on the safety management at construction site.

The study also established that government regulators do not take time to inspect the construction sites unless after accidents occur and there is media influence. Literature emphasizes on the importance of safety inspections by construction managers and by regulators. According to Saurin, (2015), safety inspections carried out by regulators should not only be based on monitoring compliance with prescriptive regulations but should be a broader evaluation of how effective the organizations risk management systems are.

(iv) Sufficient safety enforcement

The study found that 77.2% of the respondents representing the majority of the research participants acknowledged that site supervisors enforce safety standards at all times. This was mostly attributed to sites that had safety officers. The interviews revealed that construction sites without safety officer's and have site engineers managing issues of safety lack sufficient safety enforcement as they are more concerned about meeting targets and deliverables at minimal time and cost. This aligns with Priyadarshani et al., (2013) who found that safety on construction sites is a secondary concern in a market driven society. On such sites safety issues are normally left for the foreman who has to decide whether to enforce safety standards at the expense of being disliked by team members or intentionally ignore employees who do not adhere to the safety standards.

Construction companies are therefore encouraged to get in the practice of hiring safety officers as their main focus is on safety and prevention of accidents. They are responsible for determining organizational risks, developing safety and wellness plans, implementing safety procedures and enforcement of the safety policies (Widajati et al., 2017). Studies have revealed that human behavior is a main contributor of construction accidents. According to Zin and Ismail, (2012) much can be improved provided employers, managers and workers make strong efforts to comply with safety and its enforcement.

(v) Provision of safe working conditions and environments

The study through the interviews found that most employers provide their employees with safe working conditiions and environments. This was also echoed by the majority of the respondents who accounted for 87.1% of the total participants of the questionnaire survey. The results obtained show that workers are provided with productive work environments which reduce workplace stress as a result workers are motivated to work hence less absenteeism.

Shazwan et al., 2017 commented that in order to ensure a safe working environment it is crucial to have a good housekeeping program. Additionally, proper housekeeping contibutes to the timely completion of projects due to lesser

distractions being created on the worksites by what would otherwise be a chaotic scenario. Poor housekeeping on the other hand can result in the creation of hazards and employees are very likely to slip on floors or trip over objects (Aboagye-Nimo and Emuze, 2017).

5.3.2 Safety audits and inspections

Safety audits are organizational assessment activities used to identify, assess and evaluate the efficiency, effectiveness and reliability of the total safety management system so that recommendations for improvement can be made (Prasad and Reghunath, 2011). The study through the interviews established that some construction companies conduct safety inspections only and do not conduct safety audits. This aligns with the study by Keng and Razak, (2014) titled case studies on the safety management at construction sites where they highlighted that safety inspections have been the main tool for maintaining safe conditions and monitoring unsafe practices at workplace. The subsequent discussion is based on the responses from the questionnaire survey concerning areas of interest in safety audits and inspections.

(i) Fire protection

Construction sites utilize various materials and tools susceptible to fire hazards if not stored or used properly, or instance certain activities such as welding and or the use of a cutting torch can generate heat and sparks. These sparks and heat are considerably enough to ignite any flammable vapor or substances near them. The study found that about 51.4% of the workers do not use the safe smoking zones provided for them while in other cases some construction companies do not provide any smoking zones at all therefore increasing the risk of fires. The study also established from 52.7% of the respondents that some construction companies do not provide fire extinguishers on the construction sites nor do they provide their workers with sufficient training on safety procedures to follow when a fire breaks out. Additionally, on the construction sites that provide fire extinguishers, it was established that most workers are not familiar with the use of the said fire

extinguishers with only 54.5 % of the respondents saying they know how to use the fire extinguishers. These results reveal that employers should endeavor to provide more training and awareness on fire safety to their workers.

Yeung and Chan, (2019) in their study conducted in Hong Kong highlighted that industrial practitioners often pay less attention to the prevention of fires at construction sites and they recommended the implementation of risk assessments for evaluating potential fire hazards and risks in order to improve the awareness of fire risk on construction sites. The findings of this study align with those of Barrow et al., (2021) in their study on occupational health and safety risks and hazards among workers in the Gambian building construction sites.

(ii) Fall protection

Falls from heights are one of the most major safety issues in the construction industry, due to the increasing number of high-rise buildings under construction. Accidents resulting from falls include roof related falls, crane falls, scaffolding falls, elevator shaft falls, falls resulting from holes in flooring and falling object (Kemei and Nyerere, 2016).

The study established that the majority of the respondents were of the following views all excavations are protected with clearly marked or with fixed covers to prevent falls; edge protection is provided to prevent people or materials falling from heights; and lastly that scaffolds are erected and dismantled by competent people to prevent fall accidents. These respondents represented 85.2%, 84.1% and 90.1% of the total respondents respectively, thereby reflective of adequate fall protection measures.

5.3.3 Shared expectations in the construction companies.

Shared expectations in this context refer to the understanding that is common between the employers and employees with regards to their safety roles. The study established that the common expressed shared expectations among the stakeholders in construction companies mainly circle around the following aspects of safety:

(i) Safe and healthy working environments

The study established from 81.7% of the respondents that most of the employers adequately provide safe and healthy working environments to their employees. However, having safe working environments is two-fold as the employees also have their own roles to play to ensure safe working environments are achieved. The study established that 73.3% of the workers take immediate action to rectify or report any unsafe tools, equipment and plant to their supervisors or the responsible person in control of the workplace. In addition to that, the study found that 79.2% of workers work safely and take good care of themselves and others who may be affected by them at all times. Lastly, 79.2% of the workers avoid taking dangerous shortcuts, avoid improvising dangerous tools, and always seek assistance and advise if in doubt

The importance of safe and healthy working environments cannot be overemphasized. Employers have the responsibility to provide safe and healthy working environments to their employees in order to prevent accidents in the workplace (Mwanaumo et al., 2014). According to Shamsuddin et al., (2015), this aligns with the Occupational Safety and Health Act of 1970 whose aim was to protect employees by stating that employers have a legal obligation to provide their employees with a safe working environment.

(ii) Provision of adequate and appropriate information, instruction, training and supervision.

Studies have highlighted the importance of communication in construction sites as it enhances job safety (Dai et al., 2021; Alsamadani et al., 2013). The study found that the majority of the workers representing 78.2% of the respondents feel that employers provide adequate and appropriate information, instruction, training and supervision to their employees. By providing the workforce with adequate information and keeping all channels of communication open for job safety related issues, the study also established that one outcome of this is that workers avoid to take dangerous shortcuts, avoid improvising dangerous tools, and always seeking assistance and advice if in doubt.

(iii) Safety and health standards and procedures

The study established through the questionnaire survey that the majority of the employees accounting for 88.1% acknowledge that employers set out clear safety and health standards and procedures, which are very fundamental for organizations looking to prevent accidents in the work place. This study finding aligns with various studies that have indicated that having clearly set out safety and health standards and procedures in the workplace provides the employees with a clear and precise protocol to follow on how to deal with hazards, report accidents/ incidents and generally how to work through a problem (Mwanaumo et al., 2018;Work Safe, 2020; Lloyd's Register, 2019).

Additionally the study found that about 82.2% of the workers acknowledge that their employers have appointed responsible personnel to ensure that the safety and health standards, instructions and procedures are strictly observed. By doing so, workers are conversant and co-operate with the employer in administering the safety and health standards, instructions and procedures, which relate to their work to avoid accidents. Along with the set out standards and procedures, the study established that employers provide their employees with the necessary PPE while the employees have the responsibility of taking reasonable care for the PPE while in use and when not in use.

5.4 Views on the effectiveness of accident prevention practices

According to Tente et al., (2016) the effectiveness of accident prevention depends on the participation of the two main stakeholders of construction companies, thus the workers and company management. The study found that the accident prevention practices employed by construction companies registered in grades 1 and 2 are to some extent adequately effective because of the improved safety attitudes shown by the workers and the company management in ensuring safe working environments.

However, it should suffice to say that this does not imply the absence of accidents, near misses and incidences on construction sites. The interviews established that

despite the necessary accident preventive measures and practices in place in the various construction companies, accidents and near misses were recorded on their construction sites hence there was need to improve on accident prevention practices.

The study focused on large construction companies and thus indicating a bias to safety in relation to company size. However, studies by Rodrigues et al., (2015) and Guo et al., (2017) highlighted that company size does not matter hence the level of safety climate is not dependent on it. Meanwhile, Ozmec et al., (2014) highlighted in their study that small construction companies have high rates of work related injuries and prevalent challenges in preventing them.

5.5 Improvements on accident prevention practices

The study established that improvements on accident prevention practices were required**.** Research participants echoed the need for issues of OHS to be part of the curriculum in higher learning institutions as opposed to the prevailing norm where the majority of the members of the construction industry learn about issues of OSH when they get employment. Additionally, regulators such as NCC should conduct safety audits and inspections on construction projects to encourage the construction community to take issues of safety seriously and those found wanting should be fined or penalized. To ensure adequate safety enforcement, all construction sites should have a qualified safety officer as opposed to leaving matters of safety in the hands of the site engineers whose top priority is to productivity. The study suggested that employers should make improvements on the quality of PPE provided to their employees. While the employees should always use the provided PPE and take reasonable care of them.

5.6 Summary

This chapter presented a discussion of the key findings of the study. The discussion of the findings were in relation to what other scholars have established on the subject of accidents in the construction industry.

CHAPTER SIX: DEVELOPMENT OF THE FRAMEWORK

6.1 Introduction

This chapter presents the development of the model frame for accident prevention in the Zambian construction industry in an effort to abate the identified challenges.

6.2 Description of the framework

The study identified various areas of improvements through the literature review and the qualitative study. These areas of improvements are matched with drivers of change to help remedy or improve them. It is expected that with proper management of these drivers of change they should yield the expected improvements that will allow for the effective implementation of accident prevention practices in the construction industry.

The first column in the framework shown in figure 6.1 represents the two major institutions identified in the qualitative study that have a big role to play in curbing the issue of occupational accidents. The second column represents the areas that require improvements by the institutions of identified (column 1). The third column establishes the drivers of change that are supposed to yield the expected improvements in the fourth column. The expected improvements in the fourth column if managed well are expected to reduce the prevalence of occupational accidents in the construction industry.

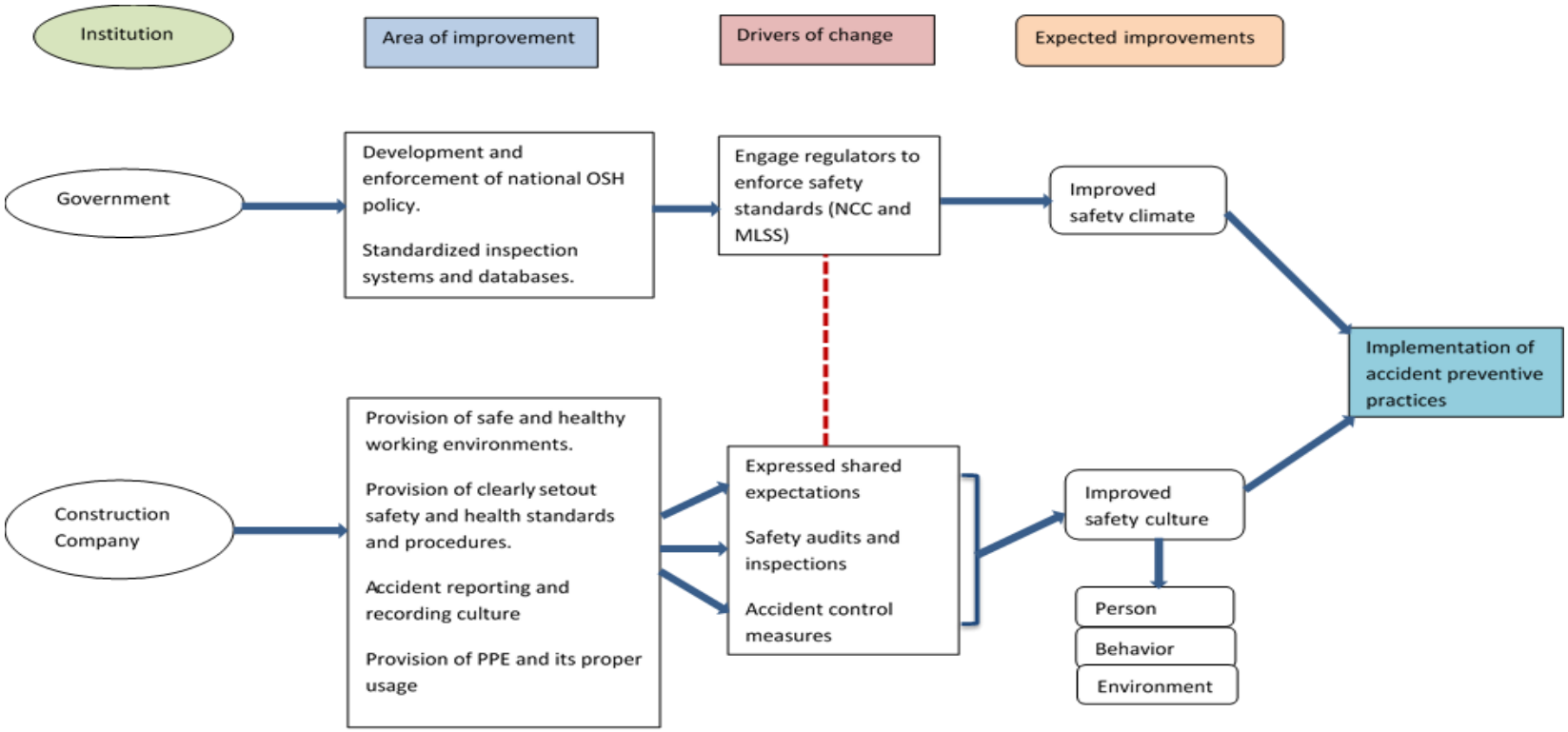

Figure 6.1: Proposed framework for accident prevention in the construction industry

6.3 Roles of stakeholders in the framework

(i) Government

The government of the republic of Zambia has a huge role to play in fostering and the enforcement of Health and Safety in the construction industry. Zambia's overriding policy goals through the Ministry of labor and social security, Occupational Safety and Health Services Department, is to promote and enforce occupational health and safety standards at place of work to ensure a healthy and safe working environment. Furthermore, the prevention and control of workplace risks is governed by the Factories Act - Chapter 441 and partially Occupational Safety and Health Act 36 of 2010 (Phiri, 2017). It is the role of the government to provide policies regarding occupational health and safety. However these policies and guidelines have not been taken with the utmost seriousness by the construction industry therefore the research proposes regular safety inspections and compliance through MLSS and regulators such as NCC to registered construction companies and those found wanting should be penalized.

The study agrees with (Mwanaumo and Thwala, 2011; Awwad et al., (2016) whose studies highlighted the need for development of policies, national construction safety standards, inspection systems, and databases where all stakeholder commitments and collaborations are of utmost importance to achieve the desired safety climates on construction sites.

(ii) Construction companies

The qualitative study established that there is more to be done in construction companies to effectively do away with accidents on sites. The research participants echoed that construction companies should ensure that they employ qualified safety officers instead of leaving issues of safety to site engineers whose main focus is meeting targets as opposed to putting safety as a priority. Additionally, construction companies should develop safety slogans for employees to recite on a daily basis thus fostering a mentality of safety.

Construction companies consist of three main key players namely; employers, management and the field staff. Employers are the owners of the construction company while members of management directly involved in construction works include but are not limited to the following professionals; project managers, project estimators and safety managers. Lastly, the field staff include site engineers, safety officers, artisans and general workers. The different categories of players in the construction company have various roles to play to ensure safety in the worksites for instance; employers should provide PPE and encourage its usage at all times; employees should follow all site rules and regulations; and safety officers should be proactive and be able to detect potential hazards early enough.

6.4 Identified areas of improvement

The literature review and the qualitative study revealed the need for the government to develop and enforce the National OSH Policy, as it does not currently have one. Consequently, there is no National OSH Management Systems that have been developed by OSH authorities for use in workplaces in Zambia (Mukosiku, 2012). According to Namumba, (2018) the absence of a national policy makes it difficult for the government and other relevant stakeholders to have standardized inspection systems and data bases that support inspections and routine evaluation of safety performance in the various industries.

The quantitative study identified six major inadequacies in the implementation of accident prevention practices in the Zambian construction industry. These six inadequacies refer to the statements that were found to be statistically insignificant in the One-Sample t-tests (table 4.12, table 4.15 and table 4.18 at $p>0.05$).

The study identified housekeeping as the first inadequacy in the construction industry and a second inadequacy similar to it of employer not adequately providing their employees with safe and healthy working conditions and environments. Construction site housekeeping is one of top main concerns of site management because adequate housekeeping entails good site management and ensures safe site conditions to working personnel (Shazwan et al,. 2017). Aboagye-Nimo and Emuze

(2017) found similar indequacies in their study to explore why housekeeping is a continuing challenge in Lesotho construction. It was highlighted in their study that due to the rapid and complex nature of projects the construction industry faces challenges in maintaining good housekeeping practices on-site. Several studies have shown that housekeeping related accidents such as slipping and tripping occur repeatedly despite the awareness on the importance of site's cleanliness and tidiness and to avert this, studies suggest influencing a behavioral change in the site operatives through safety talks and frequent inspections (Aboagye-Nimo and Emuze, 2017 ; Bates, 2015; Tan and Razak,2014; Tente,2016).

The study established the third inadequacy as the lack of clearly set out safety and health standards and procedures by employers. Safety standards and procedures are provided in the safety policies of the organization. These documents help the employees understand what the expectations of management are and consequently helps to prevent any miscommunication and legal issues in the event of accidents (Bijelic et al., 2015). The study through the interviews conducted identified a gap in the area of communicating the safety policies to the workforce. Most of the safety talks conducted on sites focus on the hazards relating to the worksite and do not delve in the broader construction safety standards and procedures as laid out in the company policies. To improve this, it is imperative that the construction company owners and management effectively educate and communicate the safety policies to the employees.

The fourth inadequacy identified was the provision of workers with the necessary PPE and its usage. According to Farooqui et al., (2009) PPE can be considered as a significant determining factor between an accident and safety on construction sites. While incorrectly used PPE can further compromise safety of the workers. Therefore, improving this matter requires training and technical guidance to the workers on the appropriate use of PPE (Colares et al., 2019).

The fifth inadequacy identified was that of accident reporting. This aligns with Siziya et al., (2010) who highlighted that data on accidents directly related to

construction work is not readily available in Zambia due to the extensive underreporting culture of the industry. Additionally, Tente et al., (2016) in their study also found that most sites did not have accident reports. There is therefore great need for the Zambian construction industry to develop and improve on the culture of accident reporting and recording.

The last identified inadequacy was that of fall protection. Studies have revealed that the rate of fall accidents is one of the most serious problems in construction industries. Kang, (2018) stated that in the US construction industry the lack of fall protection has been the most frequently cited Occupational Safety and Health Administration (OSHA) standard. Scaffolds and ladders are a leading cause of fall accidents and have one of the highest injury rates (Jahangiri et al., 2019). Studies have suggested the need for physical barriers to be in place during the construction stage in order to prevent falls from heights.

6.5 Drivers of change and expected improvements

The framework developed focuses on obtaining a positive safety climate and safety culture which essentially results in effective accident preventive practices. Safety climate is the measurement that can be used to proactively evaluate the overall strength of an organization's safety culture (Schwatka et al., 2016). Chen et al., (2018) highlighted in their study that safety climate has the potential to affect construction safety performance. The government can influence a good safety climate in the construction industry by engaging regulators such as NCC to actively work alongside the MLSS in enforcing the national OSH policy in the construction industry.

The Confederation of British Industry (1990) defined safety culture as "the ideas and beliefs that all members of the organization share about risk, accidents, and ill health." According to Ulang et al., (2014) factors affecting safety culture on construction site circle around the relationship between person, environment and behavior. In order to attain a desirable safety culture studies suggest the

implementation of expressed shared expectations, safety audits and inspections and setting up accident control measures.

Bhole (2016) suggests that establishing shared expectations about the safety roles of employees and employers can help prevent the occurrence of some accidents and ultimately improve the overall level of safety on construction sites. Expressed shared expectations help to shape the persons knowledge, motives, attitudes, skills, abilities and personality (Mwanaumo and Mambwe, 2019). While Goh et al., (2016) suggested the use of safety audits and inspections at construction sites to ensure the effectiveness of accident prevention methods during project operations. These essentially focus on the environmental aspect of the construction sites including elements such as housekeeping, equipment, tools and management systems. Lastly, various studies opine that having accident control measures in place can help prevent the occurrence of some accidents and thus improve safety on construction sites (Mutwale-Ziko et al., 2017; Ajayeoba et al., 2019; Mohammadfam et al., 2015). Accident control measures influence the behavior of the workforce as they focus on activities like putting on PPE, cleaning spills,following procedures and many more.

6.6 Summary

In this chapter, the proposed framework was developed so that it can be used to enhance the current accident prevention practices employed in the Zambian construction industry.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This chapter presents the summary of the salient points raised in the study and recommendations based on the research objectives.

7.2 Summary of findings

The aim of the study was to develop a framework that ensures the effective application of accident prevention practices in the Zambian construction industry. Additionally, the specific objectives of the study were categorized as:

i. To identify the accident prevention practices and mechanisms employed in Zambian construction industry.
ii. To establish the extent to which accident prevention practices are being applied in the Zambian construction industry.
iii. To develop a framework that ensures effective application of accident prevention practices in the Zambian construction industry.

7.2.1 Accident prevention practices employed in Zambian construction industry.

The study identified the accident prevention practices employed in the Zambian construction industry through the interviews to include: safety training and induction, provision of PPE and ensuring its proper usage, safety inspections, sufficient safety enforcement and proving safe working conditions and environments. The study found that the accident prevention practices employed in the construction industry are to some extent adequately effective. All the interviewees shared the same sentiment about the effectiveness of the accident prevention practices as they claimed that despite measures being implemented they still had few accidents and near misses recorded on their construction sites. To this effect, they echoed that there was need to improve on accident prevention practices.

7.2.2 The extent to which accident prevention practices are being applied in the Zambian construction industry.

The study identified the common accident preventive practices in the Zambian construction industry as highlighted in the preceding section. It was therefore imperative to establish the extent to which the accident prevention practices are applicable in the construction companies. The identified accident preventive practices were categorized into three main groups namely accident control measures, safety audits and inspections and shared expectations in the construction companies for simplicity purposes.

i. Accident control measures

The study identified a number of accident control measures with the common ones cited in the study being; safety training, the provision of PPE and its proper use, sufficient safety enforcement and the provision of safe working conditions and environments.

The study established that safety trainings provided are in the form of safety talks given on a regular basis as a way of educating the workers on safety measures. These safety talks are normally conducted on a daily to weekly basis. The study also found that most employers provide their employees with PPE at the onset of the project as this is normally something the client and consultants are on the watch for. Additionally, it was found that employers are reluctant to replace defective PPE immediately thereby posing a huge risk to employees in the event of accident occurrence. This study also established that construction sites without safety officer's and have site engineers managing issues of safety lack sufficient safety enforcement as they are more concerned about meeting targets and deliverables at minimal time and cost. Lastly, the study through the interviews found that most employers provide their employees with safe working conditions and environments, a sentiment also echoed by the majority of the respondents of the questionnaire survey.

ii. Safety audits and inspections

The study established that the majority of the construction workers acknowledged that safety inspections are carried out regularly. The interviewees cited that site inspections are carried out regularly on their sites, daily by the contractors' safety officer and weekly by the contractors' safety officer in the company of the consultants' safety officer. The study also established that government regulators do not take time to inspect the construction sites unless after accidents occur and there is media influence.

Concerning fire protection the study found that most of the employees do not use the safe smoking zones provided for them while in other cases some construction companies do not provide any smoking zones at all therefore increasing the risk of fires. The study also established that the majority of the construction companies do not provide fire extinguishers on the construction sites nor do they provide their workers with sufficient training on safety procedures to follow when a fire breaks out. Additionally, on the construction sites that provide fire extinguishers, it was established that most workers are not familiar with the use of the said fire extinguishers.

iii. Shared expectations in the construction companies

The study established that the common expressed shared expectations among the stakeholders in construction companies mainly circle around safe and healthy working environments, provision of adequate and appropriate information, instruction, training and supervision, and safety and health standards and procedures. The expressed shared expectations among the stakeholders in the construction company help all members to understand their roles and those of others with regards safety issues. This helps in preventing any miscommunication and legal issues in the event of accidents.

7.2.3 To develop a framework that ensures effective application of accident prevention practices in the Zambian construction industry.

The framework was developed to ensure effective application of accident prevention practices in the construction industry. The framework encourages the participation

of the government and the construction companies in fostering good safety climates and safety cultures. It identifies the areas of improvements for the stakeholders and suggests the necessary drivers of change for the expected improvements. The effective use of the developed framework could improve the status of safety and health in the construction industry in Zambia.

7.3 Recommendations

In view of the results of this dissertation, the following recommendations emerged from the study:

(i) Employers should provide PPE and encourage its usage at all times. Additionally, they should not compromise on the quality of PPE they provide to their workers.

(ii) Construction companies should ensure they employ qualified OSH personnel on every project instead of leaving issues of safety to site engineers whose focus is meeting deliverables.

(iii) Government should facilitate the quick development of the national OSH policy that shall allow for stiff punishment/penalties for employers who do not comply.

(iv) Employers should develop safety slogans for employees to recite on a daily basis thus fostering a mentality of safety. Additionally, they should also introduce a reward system by awarding safety champions (workers with good safety records) as a way of motivating the workforce to uphold safety.

(v) All construction sites should encourage random breathalyzer tests to discourage the workers from consuming alcohol during work hours.

Issues of OSH should be added to the curriculum in higher learning institutions.

7.4 Study limitation and additional area of research

The study was conducted during the COVID 19 pandemic and this posed difficulties in accessing the many construction sites of interest. As a result the study was limited

to 8 construction companies that granted the researcher access to their construction sites.

The research was limited to identifying and establishing the extent to which accident preventive practices are employed by construction companies registered in grades 1 and 2 which can broadly be identified as large companies. However, this is creates a research gap which can be addressed in future studies to establish whether issues of safety and health are influenced by the size of the company. Therefore, there is need for more studies to include the evaluation of accident preventive practices in the entire construction industry by encompassing contractors registered from grades 1 to 6.

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APPENDICES

Appendix 1: Interview Guide

1. What position do you hold in the company?
   .....
2. How are you involved with issues of occupational safety and health in your company?
   ……
3. Do you take record of the number of accidents that occur on your construction sites? (If yes). How many accidents do you record in a year?
   ……
4. Does your company conduct safety audits and inspections? (If yes). How often?
   ……
5. Does your company express the shared expectations among the employer, management and general workers in relation to safety?
   ……
6. What accident prevention practices or control measures does your company employ?
   ……
7. Do you think the accident prevention practices employed by your company are effective?
   ……
8. How can accident prevention practices be effectively applied in the Zambian construction industry?
   ……

APPENDIX 2: QUESTIONNAIRE SURVEY

Questionnaire Survey Cover Letter

The University of Zambia
School of Engineering
Dept of Civil & Environmental Engineering
P.O Box 32379, Lusaka.
Cell : 0977339574, E-mail: kamwalec@gmail.com

August, 2021

Dear Sir / Madam,

QUESTIONNAIRE SURVEY ON ACCIDENT PREVENTON PRACTICES IN THE ZAMBIAN CONSTRUCTION INDUSTRY.

I am a student at The University of Zambia, pursuing a Master of Engineering degree in Construction Management. The topic of my research is **"An Investigation of Accident Prevention Practices in the Zambian Construction Industry."**

The study seeks to assess accident prevention practices in the Zambian construction industry. The aim of this research is to develop a framework that ensures the effective application of accident prevention practices in the Zambian construction industry.

Attached herewith, is a questionnaire. Based on your experience in this sector, kindly answer all the questions. Please note that information that will be collected will only be used for research purposes and will be strictly confidential. For any queries, please contact the undersigned using the address provided above.

Thank you so much for your time and cooperation.

Yours Faithfully,

Charity Kamwale (Master of Engineering Student)

QUESTIONNAIRE

Please **WRITE** down your answer in the spaces provided and **TICK (√)** your answer where there are several choices.

SECTION 1. BACKGROUND INFORMATION

1.1 Gender: Male [ ] Female [ ]

1.2 Age: under 26 [ ] 26-30 [ ] 31-35 [ ] 36-40 [ ] 41-45 [ ] above 45 [ ]

1.3 Education: Not completed high school [ ] High school [ ] Certificate [ ] Diploma [ ] Bachelors [ ] Others [ ] specify…….

1.4 Years of experience in construction sector.

0- 4 years [ ]

5 – 10 years [ ]

11- 15 years [ ]

16- 20 years [ ]

Above 20 years [ ]

1.5 What is the name of your company?.....

SECTION 2: SAFETY IN THE CONSTRUCTION INDUSTRY

There are 29 statements in the survey to be scored in using five scales of judgement based on your opinion and belief. The degree of which you are agreeing or not to each statement is provided through a five levels scale: (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, and (5) strongly agree.

* The survey statements are based on the following dimensions including **ACCIDENT CONTROL MEASURES, SAFETY AUDITS AND INSPECTIONS and SHARED EXPECTATIONS** in respect to accident prevention practices and the extent to which they are applied in the Zambian construction industry.

* For each statement identified below, **TICK (√)** the column that best fits your judgment **strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree.**

2.1 Accident control measures are measures put in place to prevent the occurrence of accidents in the construction industry. Kindly score the accident control measures applied on your construction site.

	Accident control measures	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	Safety training is provided to recognize and avoid job hazards					
2	Site supervisors enforce safety standards at all times					
3	Safety equipment is provided by employers					
4	Workers use the safety equipment provided at all times					
5	Defective tools or equipment are replaced immediately					
6	All works are conducted using safe methods or sequencing					
7	There is proper housekeeping to ensure safe site conditions					

2.2. Safety audits and inspections used to examine and determine whether the daily activities and processes of a company conform to their planned health and safety arrangements as well as safety laws prescribed by the government. Kindly score the safety audits and inspections that occur on your construction site.

	Safety Audits and Inspections	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	Safety inspections are carried out regularly					
2	Workers are provided with the necessary PPE and equipment for the works being conducted					
3	Defective PPE is replaced immediately					
4	Defective tools and equipment are replaced immediately					
5	Smoking on site is only done in designated areas					
6	Fire extinguishers are available on site					
7	All workers are familiar with the use of the fire extinguishers available					
8	All workers on site know the safety procedures to follow when a fire breaks out					
9	Workers using full body harness					

	are trained to use and properly wear it					
10	Workers have been trained and instructed how to lift safely					
11	All excavations are protected with clearly marked and fixed covers to prevent falls					
12	Edge protection is provided to prevent people or materials falling from heights					
13	Scaffolds are erected and dismantled by competent people					

2.3 Shared expectations refer to the common understanding that is common between the employers and employees with regards to their safety roles. Kindly score the shared expectations as they relate to your construction company.

	Shared Expectations: Roles of employers, safety professionals and employees with regards to safety	**Strongly Disagree**	**Disagree**	**Neither Agree Nor Disagree**	**Agree**	**Strongly Agree**
1	Employers provide a safe and healthy working environment to his employees.					
2	Employers provide adequate and appropriate information, instruction, training and supervision to his employees.					
3	Employers set out safety and health standards and procedures.					
4	Employers appoint responsible personnel to ensure that the safety and health standards, instructions and procedures are strictly observed and followed.					
5	Employers provide adequate and proper personal protective equipment for his employees.					
6	Workers are conversant and co-operate with the employer in administering the safety and health standards, instructions and procedures, which are related to their work to avoid accident.					
7	Workers work safely and take					

	good care of themselves and others who may be affected by them at all times.					
8	Workers avoid to take dangerous shortcuts, avoid to improvise dangerous tools, and always seek assistance and advice if in doubt.					
9	workers use the PPE as required and take reasonable care of them when they are not used					
10	Workers take immediate action to rectify or report any unsafe tools, equipment and plant to their supervisors or the responsible person in control of the workplace.					
11	Workers report all accidents to the supervisors immediately after their occurrences					

SECTION 3: EFFECTIVE ACCIDENT PREVENTION

3.1 In your own words, how can accident prevention be made effective in the Zambian construction industry?

……
……
……
……

Thank you for your participation in the study.