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INVESTIGATING THE CAUSES OF ACCIDENTS AT CONSTRUCTION SITES: A CASE STUDY OF MBUDZI INTERCHANGE SITE UNDER FOSSIL CONTRACTING.

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(ENVIRONMENTAL SCIENCE)

DECLARATION

To be complied by the student

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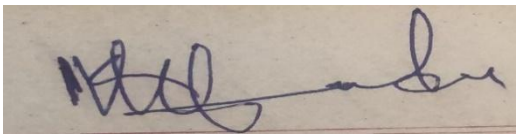
I, Kudzanai Ryan Mutanda, do hereby declare that this work is entirely the product of my own research and it was never used on any other academic work. All reference to previously published work has been clearly shown.

Student Signature  Date 14 June 2025

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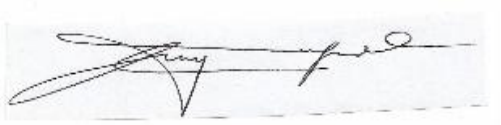 21 October 2025

DEDICATION

The research is dedicated to family and friends for their warm support, encouraging and love.

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The first thanks are being given to Jehovah the Almighty for giving me the life, strength to do my research even in difficult times. I carry on thanking my parents for giving me the opportunity to study and providing me with care support and encouragement. My utmost gratitude to my dissertation supervisor D r. Mabhungu who was patient for all his intellectual support and guidance.

ABSTRACT

The construction industry is a dynamic and complex sector, which often results in a high frequency of recorded accidents. The study aimed to investigate the types and causes of accidents at Mbudzi Interchange construction site in Zimbabwe, and to come up with a sustainable framework for managing accidents. A descriptive cross-sectional study was used for this research with self-administered questionnaires and interviews combining both closed-ended and open-ended questions. Questionnaires focused on collecting data on demographic information of study participants, most common types of accidents and their causes and components that must be included in a sustainable framework for managing accidents at the site. At the same time, interviews with department supervisors were utilised in addition to questionnaires to generate and produce data in more depth on the major types and causes of accidents occurring at Mbudzi Interchange as well as their take on the issue of sustainable construction. This approach aimed to gather unbiased and accurate information on the most common types of accidents and their causes within the organization and issue of sustainable construction on the workers perception. The SPSS version 23 (SPSS, Chicago, IL, USA) program was used to process and analyse the questionnaire data to produce descriptive statistics like percentages of the most common types of occupational accidents that occur at Mbudzi Interchange. Thematic analysis was used to analyse in-depth interview data. The research revealed that machinery and vehicle-related accidents were the most prominent types of accidents at the site machinery accidents first followed by vehicle related accidents .Slips, trips and falls and environmental related accidents were less common at the site. The research categorized the causes of accidents in the construction industry into four major groups' unsafe conditions, organizational factors, unsafe acts, and external factors. For each group, specific primary causes were identified. For instance, production pressure was noted under

organizational factors; failure to use Personal Protective Equipment (PPE) fell under unsafe acts; public interference was associated with external factors; and poor housekeeping was classified as an unsafe condition. Based on the results found on the types and causes of accidents found a sustainable management framework was developed to address the accidents, offering a practical solutions for enhancing safety to different construction sites.

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CHAPTER 1

1.1 BACKGROUND TO THE STUDY

The construction industry is dynamic and complex in nature, and as a result, workplace accidents are frequent (Rafindadi et al., 2025). These accidents often lead to permanent disability, property loss, and high fatality rates (Chan et al., 2011). Numerous studies have shown that the construction sector records higher accident rates than other industries, though this varies by region (Reese and Eidson, 2006). Construction accidents typically fall into two broad categories: worker-caused and organization-caused, each with more specific contributing factors (Wahab, 2017). Beyond their immediate impacts, construction accidents result in financial loss, productivity disruptions, and long-term medical issues for employers and employees (Leigh, 2011). Globally, construction sites account for one in six deadly workplace incidents, with about 60,000 fatalities recorded annually (Anteneh, 2024). These statistics highlight the importance of developing effective mitigation strategies to improve workplace safety.

Regionally, workplace safety remains a pressing issue. In Zimbabwe, occupational injuries rose dramatically from 5,231 in 2018 to 133,000 in 2019 (Mhlanga, 2020). According to ZIMSTATS (2019), 364 employees are injured daily, representing 5% of the national workforce of 2.9 million (Tetteh, 2018). Globally, access to workplace health and safety services remains limited (Mrema et al., 2015). Only 15% of workers in developed nations have access to Occupational Health and Safety (OHS) services (Mabika, 2018). In developing countries, Occupational Health and Safety (OHS) systems remain underdeveloped, with implementation challenges stemming from inadequate expertise and human capital (Moyo et al., 2023). As a result, workplace incidents continue to increase.

The Occupational Safety and Health Administration (OSHA) in 2018 classified construction as one of the most high-risk industries, with common incidents including falls, hazardous exposure, and equipment-related injuries (Abukhashabah et al., 2020; Kadiri et al., 2014). These accidents are often attributed to poor supervision, lack of training, human error, and ineffective site management (Enshassi and Mohammaden, 2012).

Several accident causation models have been proposed, including the Domino Theory, Human Error Theory, and Multiple Causation Model (Grant, 2018). Although none have gained universal

acceptance, they've contributed to proactive approaches to accident reduction. Research consistently shows that despite these theoretical frameworks, accident rates remain high—particularly in developing nations such as Zimbabwe (Mabika, 2018). Ridley (1986) estimated that most accidents result from unsafe conditions, unsafe acts, or both.

Efforts to improve occupational safety have led to the creation of international bodies like the International Labour Organization (ILO) and the International Commission on Occupational Health (INTEROSH). In Zimbabwe, legislation such as the Factories and Works Act (1976), the Labour Act, and policies under the National Social Security Authority (NSSA) seek to address safety concerns (Mugwagwa, 2021). However, construction accident rates remain high. In 2023, Zimbabwe recorded 4,334 serious work-related accidents and 60 fatalities. By 2024, that number had risen to 70 fatalities from 4,242 serious incidents (Muonwa, 2025).

The Mbudzi Interchange site, the first of its kind in Zimbabwe, is a large-scale project involving complex operations such as land clearing, utility relocation, earthworks, bridge and road construction, and asphalt paving. As activities expand, so too does the risk of workplace accidents. The project is led by a local company that has recently transitioned from small-scale operations to becoming one of the nation's largest construction firms. The complex, evolving nature of the industry continues to strain operational efficiency and safety standards.

As the first project of its scale in Zimbabwe, the Mbudzi Interchange has drawn considerable public attention, intensifying pressure on the executing firm. Despite existing safety policies, accidents persist—revealing gaps in risk management, especially for emerging firms in developing regions. This study aims to analyze factors contributing to workplace accidents at the site and propose a sustainable accident management framework. The findings will support safer practices, inform policy decisions, and guide similar infrastructure developments across Zimbabwe and other developing countries.

1.2 PROBLEM STATEMENT

Accidents at the Mbudzi Interchange site have become a perennial problem despite the implementation of OHS measures. The construction site has been active for about four years now, and during each of the monthly Safety, Health, Environmental and Quality (SHEQ) reports, it is noticed that the number of accidents is very high, recording a maximum of 5 to 10 incidents per

day, this translates to around 60 incidents weekly an exceptionally high and concerning figure. The nature of operations or activities being done at that site presents several dangers to the lives and health of the workers. Operations such as working at heights, concrete batching, transportation to and from of asphalt and other construction materials in the busy highway, maintaining and servicing plant equipment, erecting and dismantling of scaffolds, and erecting heavy concrete pillars are some of the activities with high accident records At the beginning of 2025, the Mbudzi Interchange construction recorded its first fatal accident, resulting in the loss of an employee. The incident occurred during the dismantling of a tower crane when a falling component struck the worker. In addition to the tragic loss of life, the organization also sustained financial setbacks due to the damage of an expensive piece of equipment, all of which require compensation. Furthermore, the workshop area frequently houses malfunctioning machinery, and with each accident, hospital bills continue to accumulate, adding to the project's operational challenges. The problem is now the organisation keep on incurring all these expenses, but there are Occupational, Health and Safety (OHS) measures and a department that monitors to make sure that operations are being conducted safely. Therefore, the research aims to investigate the causes of the high prevalence accident rate at Mbudzi Interchange.

1.3 AIM OF THE STUDY

To investigate and analyse workplace accidents at Mbudzi Interchange construction site, identify their root causes, and develop a sustainable framework for effective accident prevention and management.

1.4 RESEARCH OBJECTIVES

1. To determine the major types of accidents occurring at Mbudzi Interchange construction site.
2. To determine the underlying causes of workplace accidents at Mbudzi Interchange construction site.
3. To develop a sustainable framework to manage the causes of accidents at a construction workplace.

1.5 RESEARCH QUESTIONS

1. What are the most common types of accidents that occur at the Mbudzi Interchange construction site, and how can they be categorized?
2. What are the primary factors contributing to workplace accidents at the Mbudzi Interchange construction site?
3. What strategies can be implemented to develop a sustainable framework for managing accident causes in construction workplaces?

1.6 ASSUMPTIONS

1. The respondents will be able to produce relevant answers to the subject area.
2. All workplace accidents occurring at Mbudzi Interchange construction site are accurately reported and documented by responsible personnel.
3. Implementing a structured and sustainable framework will significantly reduce the occurrence of accidents in construction workplaces by addressing root causes and enhancing safety measures.

1.7 JUSTIFICATION OF THE STUDY

This research aims to identify and categorise workplace accidents at the Mbudzi Interchange so that the organisation may be able to detect recurring patterns of accidents and their root causes and come up with a sustainable framework for manging accidents at the site. By examining such patterns, OHS practitioners can pre-emptively deal with risks that are well established, reducing the number of accidents and curtailing their impact when they inevitably occur. In addition, the study will push forward preventive actions to counter existing determinants of accident risk, safer working conditions for the employees, and improved overall productivity with the help of the framework. The findings will also provide valuable insights into constructing the organisation's safety programmes more robustly, giving employees improved protection, decreasing accidents, and perhaps enhancing the company's public image with stakeholders and clients. Most of the studies on construction accidents in Zimbabwe have been more on housing construction and building construction and not on road construction accidents. By addressing this research gap, the findings will significantly contribute to improving safety on similar projects in Zimbabwe and

other developing nations. Given that Mbudzi Interchange is one of the largest infrastructure projects in Zimbabwe, other players in the industry have an opportunity to learn from observing how the occupational health and safety department of the project manages risk. This research will come in handy as a reference for building companies looking to raise their own safety level. Moreover, the results of the research will add to the general pool of knowledge on effective safety practices and encourage the achievement of zero workplace accidents.

1.8 DELIMINATIOS OF THE STUDY

This study focuses on merely examining the causes of workplace accidents within the Mbudzi Interchange construction site, and the most prominent types of accidents on Mbudzi Interchange. Responses from machine operators, drivers, foremen, engineers, safety officers, human resource personnel, and accident victims where available will be utilized to gather information. The research will sample a purposive population of 105 participants to gain targeted insight into the issues in question.

1.9 LIMITATIONS OF THE STUDY

Construction firm owners and the construction site foreman and supervisors usually do not consider and even understand the concept of OHS of employees. This then proves to be an obstacle during the process of collecting data as employees turn to answering off-topic or giving irrelevant responses. During data collection, also, the employees sometimes are not given time to sit down with the student due to race against targets, and as a result, time to fully gather data can be a limitation. Restriction to certain research material some of the current literature requires money to purchase, which could be a problem for the student in this challenging economy.

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

This section examined existing research on the types and causes of accidents within the construction industry from different countries around the world. It mainly focused on the types of accidents that are occurring on construction sites and how they have affected the industry. Also the models and causes of accidents at construction sites and variables on the sustainable framework of managing accidents at construction site.

2.1 TYPES OF ACCIDENTS AT WORKPLACE

Due to the frequent accidents that occur in building projects, numerous risks, uncertainties, and complications are involved in the industry (Sousa et al., 2014). Many authors and organizations have recognized the various kinds of workplace accidents and their causes over the years. According to the Health, Safety, and Environment (HSE) (2006), falls, mobile machinery, collapsing materials, electrical mishaps, and tripping incidents are the most common types of accidents in the construction sector of European countries. A study by Abukhashabah, Summan, and Balkhyour (2020) found that on construction sites in Jeddah City, the most frequent accident types include falls, electric shocks, falling equipment that injures the head, and material handling incidents. However, these are not the only accidents, as some are not reported or recorded. Williams (2018) identifies thirteen different types of construction site accidents, including falls, contact with objects, vehicles, or machinery; lifting and handling objects; explosions; collapses; welding accidents; drowning or asphyxiation accidents; animal behaviour accidents; slips and trips; accidents involving equipment or tools; and electrocution.

Hatitye, Cesar, and Kudzanayi (2018) conducted a research on accidents and work-related illnesses in the construction sector in Chinhoyi housing project Zimbabwe, validating trench collapses, falling materials, tripping over sharp objects, and falls from heights or scaffolding as the most common incidents. A similar research was conducted by Simutenda et al. (2022) in Lusaka, which identified frequent accidents involving cranes or hoists, slips and falls from heights, gas leaks, fires and explosions, forklifts, trench collapses, electrocutions, machinery, moving and falling objects, caught-between incidents, and exposure to toxic chemicals. International organizations focused on occupational health and safety, such as the International Organization for Standardization (ISO)

and the Health and Safety Executive (HSE), have outlined four primary accident categories, two of which are listed below.

2.1.2 EQUIPMENT/MACHINARY-RELATED ACCIDENTS

Compared to all other types of occupational accidents globally, equipment-related incidents are significantly more common (Bilim et al., 2018). From cranes to bulldozers, the construction sector is primarily dependent on machinery. Accidents resulting in crush injuries, amputations, and other serious consequences frequently occur due to misuse, neglect, or operator error (Cartwright, 2024). Physical contact with machinery and powered equipment can cause serious occupational injuries and fatalities if sufficient safeguards and controls are not in place (Marsh and Fosbroke, 2015). A thorough analysis of various occupational accident types and their predictors at building sites in Lusaka City was carried out by Simutenda et al. (2022), who concluded that cranes are among the machines with the highest accident records.

2.1.3 ELECTRICAL ACCIDENTS

Electrocution is a major hazard on construction sites, especially when safety is overlooked (Romclaw, 2024). When construction workers or their equipment make contact with high-voltage power lines, electrocution deaths and serious injuries are most common. In the United States, McCann, Hunting, Murawski, Chowdhury, and Welch (2003) investigated the reasons behind electrical-related fatalities and injuries among construction workers. Electrical worker fatalities and injuries were primarily caused by interaction with "live" electrical wiring, equipment, and light fixtures, with contact with overhead power lines coming in second among non-electrical workers. Overhead power line contact accounted for the majority of fatal incidents (McCann et al., 2003).

2.2 CAUSES OF ACCIDENTS AT WORKPLACE

Accidents are not random events; they are caused by specific factors (Hamid et al., 2008). The origins of workplace accidents are a topic of ongoing debate, with researchers reaching varying conclusions. According to Ridley (1986), 99% of accidents result from risky behavior, unsafe conditions, or a combination of both. In contrast, Nkurunungi (2005) identifies technical, physical, and environmental factors as primary contributors to accidents on construction sites. Abdul Rahim et al. (2008) argue that construction accidents are mainly caused by hazardous methods, equipment, job site conditions, industry-specific characteristics, and human error. These perspectives suggest that accidents are often the result of multiple factors, which can be

categorized into human causes, environmental and site conditions, organizational and management factors, and technical factors.

2.2.1 HUMAN FACTORS

In the United States of America, Abdelhamid and Everett (2000) conducted a thorough investigation and found that human actions play a significant role in accidents. They identified contributing factors such as horseplay, operating equipment without permission, and failing to wear personal protective equipment (PPE). According to Enshassi and Mohammaden (2012), most accidents and injuries in the Gaza construction sector are caused by a combination of factors, including ignorance, inadequate safety training, human error, unskilled labor, poor supervision, negligence, and ineffective management.

In Saudi Arabia, particularly in Jeddah City, the construction industry is rapidly growing and employs thousands of local and foreign workers on complex projects (Mosly, 2015). However, many of these workers lack training and experience, putting them at risk. A study by Simutenda et al. (2022) in Lusaka found that human error and site conditions were the primary causes of accidents at construction sites. While existing research provides insight into the role of human error in accidents, there is a need for more information on recently established businesses in developing countries that undertake large-scale projects.

2.2.2 TECHNICAL FACTORS

Technical issues play a significant role in workplace accidents in the construction sector. According to Hamid et al. (2008), unsafe equipment handling and equipment breakdowns are major contributors to accidents. The inadequate use of PPE further increases risks on construction sites, highlighting the importance of proper tool and machine maintenance. Additionally, hazardous operating procedures, such as poor planning and disregard for technical guidelines, have been identified as significant accident contributors. Inadequate site management and technical equipment handling are also major factors in high accident rates, particularly in developing countries (Udo et al., 2016). Furthermore, technical flaws such as lack of warning signs in hazardous areas and poor floor traction due to slippery, wet, or polished surfaces can compromise workplace safety, especially in developing countries like Nigeria, where they are a leading cause of fall accidents (Williams et al., 2019).

2.2.3 ENVIRONMENTAL AND SITE CONDITIONS

In the construction sector, site and environmental factors are major contributors to worker accidents. Unstable or slick surfaces that cause trips and falls, working at high heights without safety belts, and caving-in excavations are all examples of poor site conditions that raise the risk of accidents. According to a study by Simutenda et al. (2022) at various building sites in Lusaka, the majority of accidents were brought on by the site's unsafe conditions, and housekeeping problems were identified as the primary cause of fall accidents. Bad weather and other external environmental factors affect working conditions and create dangerous situations, which further jeopardize safety.

Furthermore, unanticipated natural occurrences, which are classified as acts of God, can cause disruptions and increase the probability of accidents, highlighting the significance of taking environmental risks into account while managing construction safety (Ahmed, 2019).

2.2.4 ORGANISATIONAL AND MANAGEMANT FACTORS

Organizational flaws that greatly increase the likelihood of building accidents are highlighted by the dearth of specialists and technical personnel, as well as by weak inspection procedures and training initiatives (Fatih, 2015). The implementation of efficient safety measures is hampered by senior managers' or project managers' lack of awareness and involvement. Additionally, dangers are increased when contractors and law enforcement organizations fail to implement regulations effectively. Strong organizational and management frameworks are essential to ensuring worker safety, and external obstacles like legislative obstacles also contribute to the erosion of safe building practices (Ahmed, 2019).

2.3 MODELS ON THE CAUSES OF ACCIDENTS

This overview looks at several theories on workplace accident causes. Two well-known accident causation theories that explore the complex elements causing accidents at construction sites are Human error theory and Domino theory. Human error theory concentrates on environmental influences and human limits. Domino Theory provides a thorough grasp of safety issues in high-risk workplaces by examining how diversions and a series of events lead to accidents.

2.3.1 DOMINO THEORY

Herbert William Heinrich developed the first accident causation model in 1931, known as the Domino Theory. According to this theory, accidents result from a chain of events, including ancestry and social environment, faults of a person, unsafe acts or conditions, and the accident itself (Heinrich, 1931). As cited in Khanzode et al. (2012), the domino hypothesis suggests that a series of events, including personal culpability, risky acts or conditions, accidents, and injuries, lead to accidents. The sequence begins with ancestry and social environment, which influence an individual's behavior and likelihood of committing unsafe acts.

Heinrich's theory proposes that removing one domino, typically the unsafe act or condition, can prevent the accident. Taylor et al. (2004) and Khanzode et al. (2012) support this theory, highlighting the importance of addressing the root causes of accidents to prevent reoccurring of them.

2.3.2 HUMAN ERROR THEORIES

This viewpoint identifies the employee as the primary cause of the mishap (Abdul, 2018). Humans tend to make mistakes in a variety of circumstances, with human incompetence bearing the majority of the responsibility, according to research conducted by Abdelhamid (2000). However, a number of circumstances and events, such as stress, inept staff, work overload, and horseplay, might result in people or employees getting into an accident. This perspective suggests that accidents are also attributed to factors like workplace design and activities that fail to account for human limitations, indicating that workers aren't the sole cause of accidents. (Abdelhamid and Everett, 2000. Human error theory aims to develop work environments, tasks, and tools that accommodate human limitations, enhancing safety and efficiency. (Abdul Rahim, 2018).

2.4 SUSTAINABLE CONSTRUCTION SAFETY; INTEGRATING PREVENTION THROUGH DESIGN AND RISK MANAGEMENT

As noted in the introduction, the construction industry is one of the trades which contributes heavily to the economic sector of a nation, be it a developed or developing nation; however, the industry is also characterised by a disproportionately high rate of accidents. Over the years, there have been traditional approaches that have been used to mitigate accidents in the construction industry and have primarily focused on reactive measures, such as accident investigations and

complying with prescriptive regulations (Zhang, 2023). While these approaches have played their part in improving safety on construction sites, the continued recording of severe accidents in the industry has highlighted the limitations of such approaches in achieving truly sustainable safety outcomes. Research shows construction accidents result from various factors, including organisational failures, poor safety culture, inadequate training, insufficient risk assessment, and lack of safety integration throughout projects (Betsis et al., 2019). Hassan (2025) goes on to say construction projects' complex and dynamic nature, with multiple stakeholders and ever-changing work environments, poses distinct challenges to preventing accidents effectively. As a result of this a sustainable framework for managing construction accidents can go a long way in reducing accidents and can be applied in different environments as the industry is dynamic.

Although sustainability is increasingly important in construction, developing frameworks that specifically address accident causes remains underexplored and warrants further investigation (Dewlaney and Hallowell, 2012). The concept of sustainable construction is usually defined by or encompasses environment and economic aspects its integration with safety management and workers' involvement is less defined in the existing researches (Hassan, 2025). This research therefore seeks to develop a sustainable framework that encompasses the safety management aspects.

Research that has already been done on workplace accidents in the construction sector especially in developed countries emphasizes how important management, environmental, and human variables are. Nonetheless, there are still gaps in knowledge on accident causation in rapidly expanding businesses in developing nations, especially when it comes to large-scale, first-of-its-kind ventures. Also the literature of cause's workplace accidents in Zimbabwe is mainly concentred in building or housing construction with less concentration on road construction. This study aims to address these gaps by analysing workplace accidents at the Mbudzi Interchange, offering insights to what causes accidents in construction industry especially in road construction as Zimbabwe currently contains many road construction projects

CHAPTER THREE: METHODOLOGY

3.1 STUDY AREA DESCRIPTION

This research was conducted at the Mbudzi Interchange construction site in Harare, Zimbabwe. The site is managed by Fossil Contracting and is located at the intersection of Simon Mazorodze, Chitungwiza, and High Glen roads, in the southern part of the city. Geographically, it lies at coordinates 17.8017° S and 31.0686° E. The site covers approximately nine kilometres and includes the primary roundabout and associated roads, which feature fifteen bridges—thirteen on the interchange and two on Amalinda Drive and Harare Drive. The interchange is surrounded by urban residential areas, including Highfield, Glen Norah, Southview Park, and Hopely, where the company employs most of its workforce. It serves as a major transport hub, connecting traffic from South Africa via Masvingo Road to the rest of Zimbabwe. The area is also a market for tobacco and goat farmers, making it highly populated. Mbudzi Interchange is one of Zimbabwe's largest ongoing infrastructure projects, involving activities such as bridge construction, blasting, excavation, road maintenance, and new road development. These activities occur while the road remains in use by the public, and external contractors are sometimes hired, contributing to high traffic and an increased risk of accidents. Fig. 3.1 below shows the map of Mbudzi Interchange.

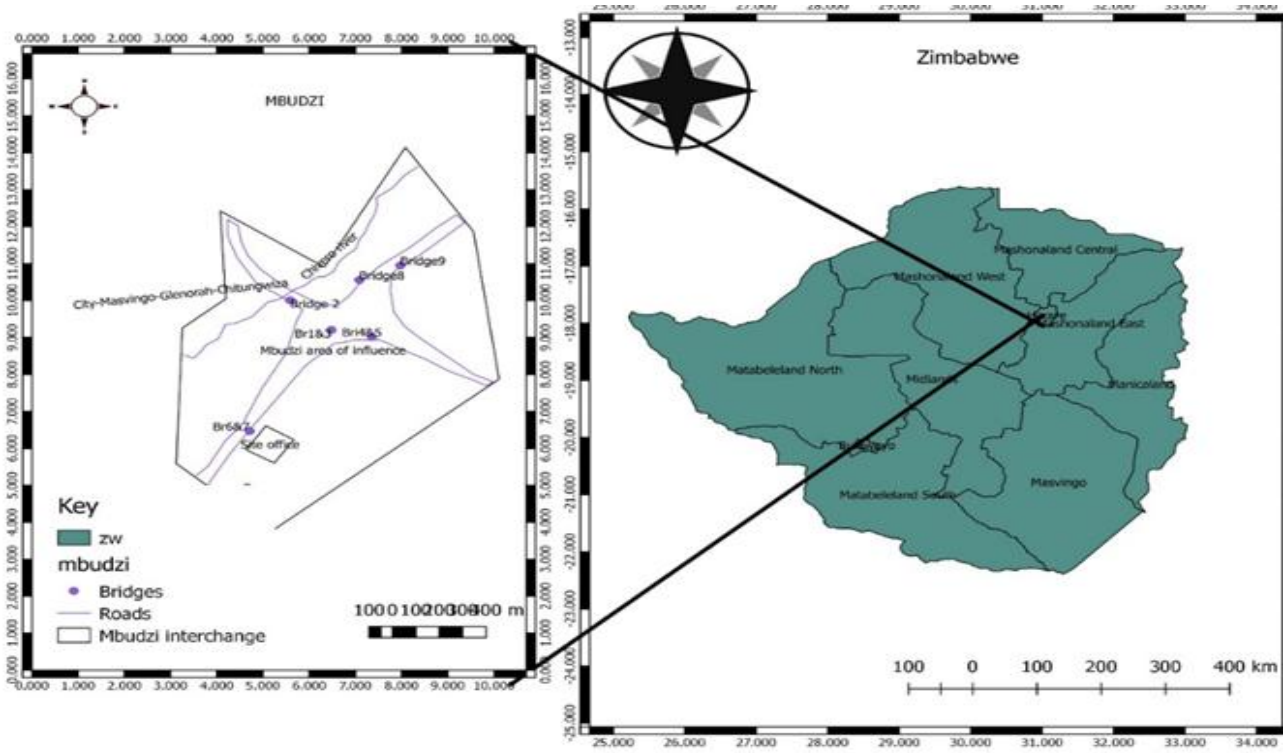

Fig.3.1 Map showing the location of Mbudzi Interchange

3.2 RESEARCH DESIGN

This study utilized a mixed-method design that incorporated both qualitative and quantitative approaches. As noted by George (2021, updated 2025), this design combines the strengths of qualitative and quantitative research, allowing for a more complete understanding than a single-method study. Quantitative information was gathered through both open-ended and closed-ended questionnaires, which examined the causes and frequencies of different types of accidents, as well as the elements that constitute an effective sustainable framework for accident management at the site. Qualitative information was obtained through interviews, facilitating a thorough investigation of workplace safety incidents and employees' awareness of sustainable management systems for accident control. These methods worked together to deliver a well-rounded perspective on accident patterns and guide the development of a sustainable safety framework for the construction site.

3.3 STUDY POPULATION

The study population consists of 350 construction workers employed by Fossil Contracting across the various departments listed in Table 3.1. The intended demographic was chosen as they have

significant expertise about the underlined research. Every employee has witnessed or even gotten involved in an accident at some point at the site.

Table 3.1: Illustration of Study Population

Department	Number of Employees
Engineers	25
Foremen	40
Safety Officers	16
Artisanal Workers	70
Operators	40
Drivers	50
General Workers	109
Total	350

3.4 SAMPLE AND SAMPLING PROCEDURE

Nwana (1992) and Saunders (1990) suggest that for populations in the low hundreds, a sample size of 30% to 40% can yield reliable and valid results in questionnaire-based researches. In this study, 30% of the study population was selected to form the sample. Table 3.2 presents the workforce distribution and the corresponding sample sizes of participants who received the questionnaires.

Table 3.2 Workforce Distribution and Sampling Data

Departments	**Number of Employees**	**Sample Size (30%)**
Engineers	25	8
Foremen	40	12
Safety Officers	16	5
Artisanal Workers	70	21
Operators	40	12
Drivers	50	15
General Workers	109	33
Total	350	106

Key informants such as the SHE officer, project manager, earthworks and concrete site agent, foreman, and engineers were selected for interviews using the purposive sampling technique. Each department on table 3.3 contains one lead supervisor to make them seven, all of them were chosen for the interview. They were chosen because they have the most pertinent information regarding occupational health and safety hazards at Mbudzi Interchange. Table 3.3 below details the rationale behind the selection of these key informants.

Table 3.3 Key informants interviewed and justification of their selection

Department/Role	Justification
Project Manager	Accountable for managing the entire venture, the project manager provides valuable insights into safety policies, risk management strategies, and how accidents impact project timelines and costs. Which is valuable information in developing a sustainable framework for managing accidents.
SHEQ Officer	Tasked with ensuring compliance with SHEQ standards, the SHEQ officer offers critical perspectives on existing safety measures and incident handling processes. Also they can shade light to the strategies of a good sustainable framework for managing accidents at the site.
Earthworks Site Agent	Manages earthworks operations and coordinates with foremen, making them well-positioned to discuss operational risks, safety challenges, and preventative measures specific to earthworks. Site agents are engineers that can shade light on engineering ways of improving the framework.
Concrete Works Site Agent	Oversees concrete-related tasks, providing specialized knowledge on accidents and safety concerns tied to material handling, formwork stability, and structural risks.
Earthworks Foremen	Works closely with workers on-site, giving practical insights into daily safety challenges, accident causes, and the effectiveness of existing safety protocols in earthworks activities.
Concrete Foremen	Engages directly with the workforce in concrete-related tasks, offering ground-level perspectives on hazards and risks encountered during operations.
Workshop Foremen	Supervises workshop operations, which often involve equipment maintenance and tool usage. Their input is vital for understanding accident risks in workshop settings and identifying areas for improvement.

3.5 DATA COLLECTION

Questionnaires and interviews were the instruments used to collect data for this research. Questionnaires were used to collect causes of accidents and types of accidents at the site and their frequencies. The questionnaires were also used to collect information on what the employees thought could be components of a good sustainable framework and ways of managing accidents. As for the interview they were used to collected in-depth data for the causes of accidents and also ways to mitigate the causes of accidents at the site and the knowledge of the supervisors on sustainable framework which is qualitative data. Questionnaires were administered to all Mbudzi Interchange construction workers from general workers to engineers who were chosen during sampling procedure. Interviews were administered to SHEQ officer, project manager, earthworks and concrete site agent, foreman, and engineers as they have expertise and first-hand information about the aim under study.

3.5.1 QUESTIONNAIRE

The questionnaire was chosen since it is a quick and effective method of gathering data. Both closed-ended and open-ended items were included in the questionnaire for this study. Respondents were able to submit answers more easily and quickly as a result, and they were also able to provide more detailed information about the causes and types of accidents at the site and also the knowledge of sustainable frameworks that can manage accidents. There were three sections to the questionnaire provided in the appendix 1. The respondents' demographic and occupational information is included in section A. Section B concentrates on determining the main categories of mishaps that take place at the construction site of Mbudzi Interchange.The questionnaire's section C examines the possible reasons and contributing elements of construction site accidents and also the possible components of a sustainable framework. To increase the return rate and provide clarification on questions that were written in English, which is not the local language, the researcher self-administered the surveys.

3.5.2 INTERVIEW

SHE officer, project manager, earthworks and concrete site agent, foreman, and engineers were interviewed to collect data on the causes of accidents, ways to reduce them and their knowledge

of the sustainable framework for managing accidents at construction sites. The interview guide contained semi-structured questions see Appendix 2 below and some questions were asked on the scene. Recordings of respondents' statements and notes were taken, especially on the most important topics. To guarantee convenience, all important informants were alerted and scheduled in advance, and interview questions were prepared well before the interview. The purpose and goals of the study served as a guide for the key interviewee

3.6 DATA ANALYSES AND PESENTATION

The questionnaires were organised, coded, and input into the Statistical Package for Social Sciences (SPSS), version 23.0 (SPSS, Chicago, IL, USA), where it was analysed utilising descriptive statistical methods, percentages, and graphical representations of the types and causes of accidents at the Mbudzi Interchange construction site, as well as the components of a sustainable framework for managing these accidents. Qualitative data from the interview underwent thematic analysis accompanied by direct quotes from participants' responses.

3.7 ETHICAL CONSIDERATIONS

John Rawls (1971) defined ethical issues as actions aligned with justice principles chosen by people in an original position of equality. In line with this definition, the researcher consulted both the school and the organisation about the research, and approval was granted. Respondents were well-versed about the study's objectives and benefits, assured of privacy, given informed consent, told participation was voluntary and unpaid, and told that the information gathered would be used solely for research purposes.

CHAPTER 4 RESULTS

4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS

The study's applicants were mostly men, making up about two-thirds of the respondents, while women accounted for around a third. The age range was diverse, with the majority falling between 26-35 years old, followed by those in their mid-to-late career (46-55 years old) and those in their mid-career (36-45 years old). In terms of tenure at the Mbudzi Interchange, most respondents had 2-5 years of experience under their belts. The educational background of participants varied, with many having completed advanced or ordinary level education, while some had primary level education. (Refer to table 4.1 below)

Table 4.1: Socio-demographic characteristics of respondents

CATEGORY		NUMBER	PERCENTAGE
Gender	Males	70	**66**
	Females	36	**34**
Age	16 – 25	10	**9.4**
	26-35 years old	30	**28.3**
	36-45 years old	20	**19**
	46- 55 years old	21	**20**
	56-65	15	**14.1**
	61+	10	**9.4**
Period of working at	Less than 1 year	25	**23.5**
Mbudzi Interchange	2-3 years	40	**37.7**
	4 - 5 years	41	**38.6**
Educational	Primary	25	**23.5**
qualifications	'O' Level	40	**37.7**
	'A 'Level	41	**38.6**

4.1.2 QUESTIONNAIRE RESPONSE RATE

A total of 106 questionnaires were distributed to the respondents and a total of 90 questionnaires were returned accounting to 85% as shown by table 4.2 below.

Table 4.2 showing response rate

QUESTIONNAIRES DISTRIBUTED	QUESTIONNAIRES RETURNED	RESPONSE RATE
106	90	85%

4.2 TYPES OF WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE CONSTRUCTION PROJECT

The types of accidents at Mbudzi Interchange are varied, but some patterns emerge from the data. According to the SHEQ Officer and Project Manager, machine-to-machine collisions are the most frequent type of accident, accounting for 25% of all incidents. These accidents have the potential to cause major injuries and significant destruction to assets, often due to the lack of regulated flow of movement on the site. Vehicle-related accidents are the second most common, making up 20% of all accidents, and often involve tippers, concrete mixers, and water bowsers, sometimes with public transport. Machine-human collisions account for 15% of accidents, while electrocution and environmental-related accidents each account for 10%, with artisans being most affected by electrocution and spillages being a major environmental hazard. Slips, trips, and falls account for 8% of accidents, highlighting the need for effective safety measures and warning signs. Other forms of accidents, including minor issues like tool deformations, eye irritation, and minor cuts, make up 7% of all incidents. (Refer fig 4.1 below)

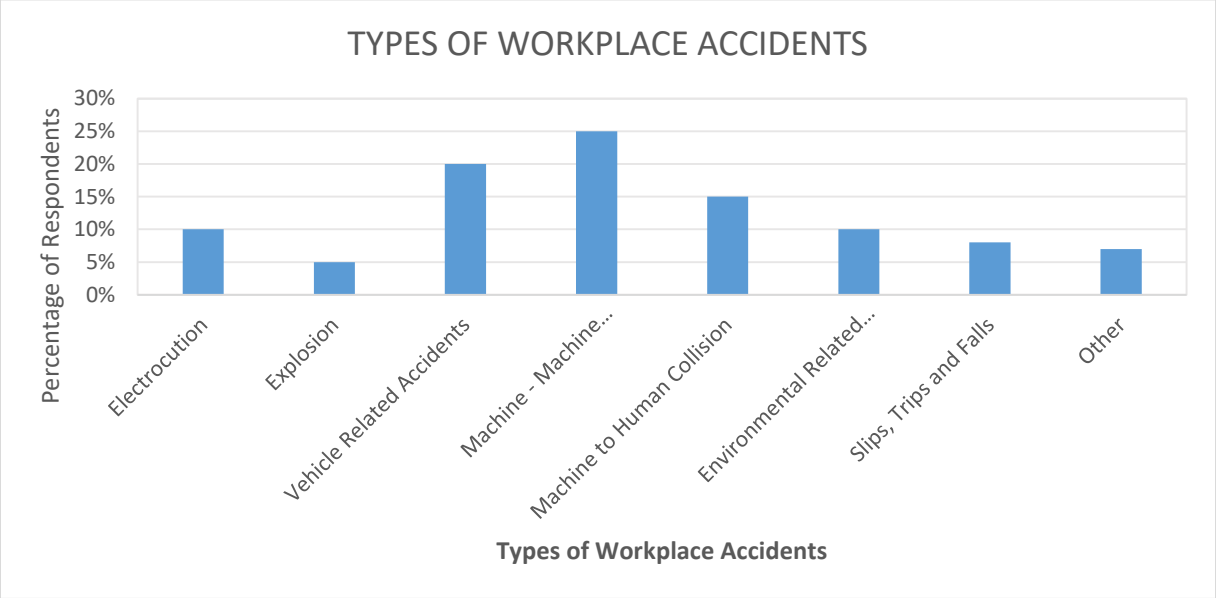

Figure 4.1: Types of Workplace Accidents at Mbudzi Interchange Project

4.3 THE CAUSES OF WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE PROJECT

The causes of accidents were grouped into four categories for easy identification and analysis that is unsafe acts, unsafe conditions, organisational/managerial factors and external factors.

4.3.1: UNSAFE ACTS WHICH CAUSES WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE PROJECT

Based on the research findings, there are several causes of accidents that can be categorised as unsafe acts. This implies that the occurrence of accidents at Mbudzi Interchange is highly influenced by the conduct and actions of the workers. The unsafe act with the highest percentage is failure to use provided personal protective equipment, with 25 % of responded accidents. This highlights the need for strict enforcement and increased awareness for the construction employees. Twenty percent of the respondents in this category said that neglecting safety protocols causes accidents; this violation of protocols can lead to mishaps at a workplace, most especially at a road interchange project. Another twenty per cent of the respondents outlined that improper use of equipment is another cause of workplace accidents at Mbudzi Interchange, indicating the need for appropriate equipment training before use, as most employees are general workers without training. Fifteen per percent of those surveyed indicated that lack of equipment is another factor contributing to workplace accidents at the site. Furthermore, ten percent of those surveyed pointed out that substance abuse contributes to workplace accidents, emphasising the necessity for stringent enforcement of breathalyser tests for employees and training programmes focused on the dangers of working while under the influence of alcohol. Taking unnecessary risks accounted for 10 % of the accidents taking place at Mbudzi Interchange, suggesting that improved signage and traffic control measures could reduce the accident rate.

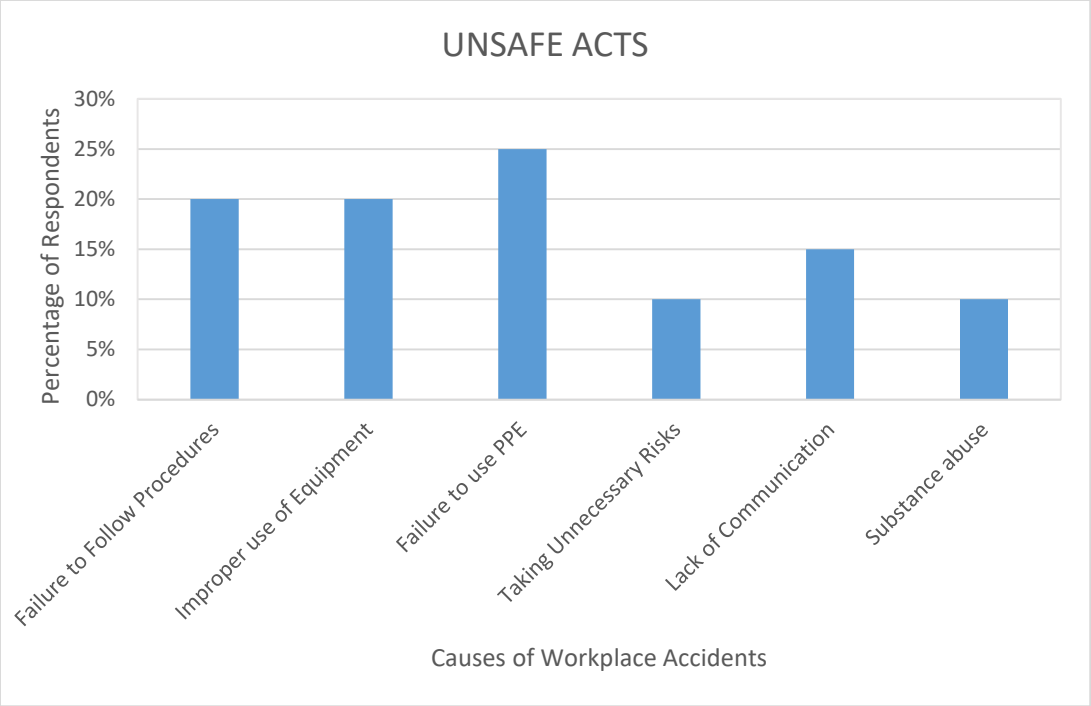

Figure 4.2: Unsafe Acts which causes workplace accidents at Mbudzi Interchange Project

4.3.2 UNSAFE CONDTIONS WHICH CAUSES WORKPLACE ACCIDENTS AT MBUDI INTERCHANGE PROJECT

Based on the research findings, some causes of accidents can also be classified as unsafe conditions. Twenty-five percent of the respondents noted that some of the major accidents at a construction project are due to poor housekeeping. To reduce the rate of accidents caused by poor housekeeping at the site the site must prioritize regular inspections and proper storage of materials. Twenty percent of respondents indicated that defective tools cause accidents, while another twenty percent noted that traffic hazards contribute to accidents at the Mbudzi Interchange project. Fifteen percent of the respondents mentioned that unstable excavations are also a cause of workplace accidents as there are high fills of excavated soil highlighting the need for signage and assessment of these high fills. The results from the data collected at Mbudzi Interchange catagorised under unsafe condition indicate that 10 % of accidents are being caused by for hazardous conditions and showing lower percentage for inadequate guarding and improper storage accounting 5 % of the accidents each. (Refer to Fig 4.3)

The earthworks site agent with 10 years of experience noted that housekeeping is not practiced daily due to high workload, resulting in hazards such as cement sacks, wires, and water puddles remaining on site unless someone trips. Housekeeping is only done on Fridays as workers prepare for the Sabbath day. The concrete site agent with 3 years of experience commented that the pressure to meet timelines often leads to safety being overlooked, resulting in accidents. According to the research findings, some causes of accidents can be classified as unsafe conditions.

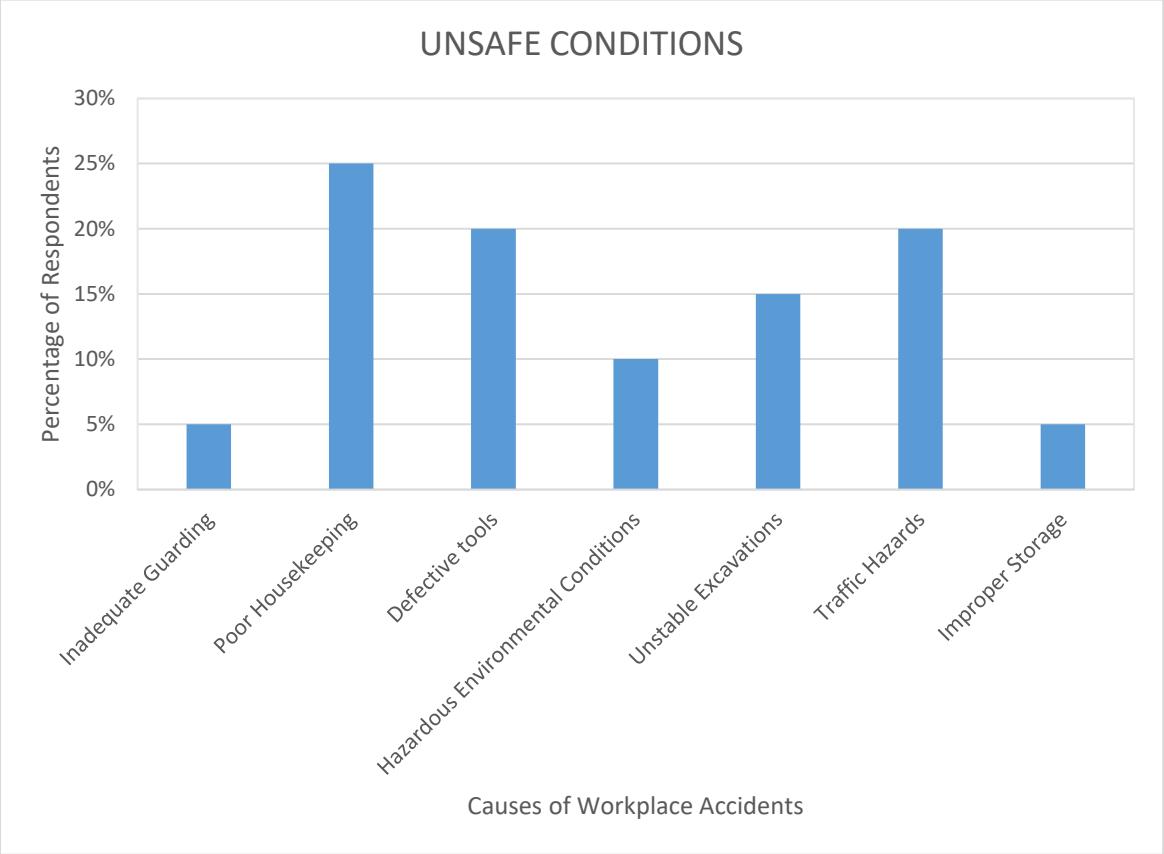

Figure 4.3 Unsafe Conditions which causes workplace accidents at Mbudzi Interchange project

4.3.3: ORGANISATIONAL/MANAGERIAL FACTORS WHICH CAUSES ACCIDENTS AT MBUDZI INTERCHANGE CONSTRUCTION PROJECT

From the data collected organizational or managerial factors also contribute to the rate of accidents that are occurring at the site with production pressure taking 30 % of the accidents at the site according to responses. This indicates the prioritizing of finishing the task and overlooking the safety of workers. Other notable incidents include inadequate safety training at 25% and accidents related to lack of supervision at 20%. Poor planning by managerial personnel accounted for 10 %

of accidents. The data also shows lower percentages for accidents involving lack of resources, subcontractor issues and inadequate communication between supervisors and workers. (Refer to Fig 4.4)

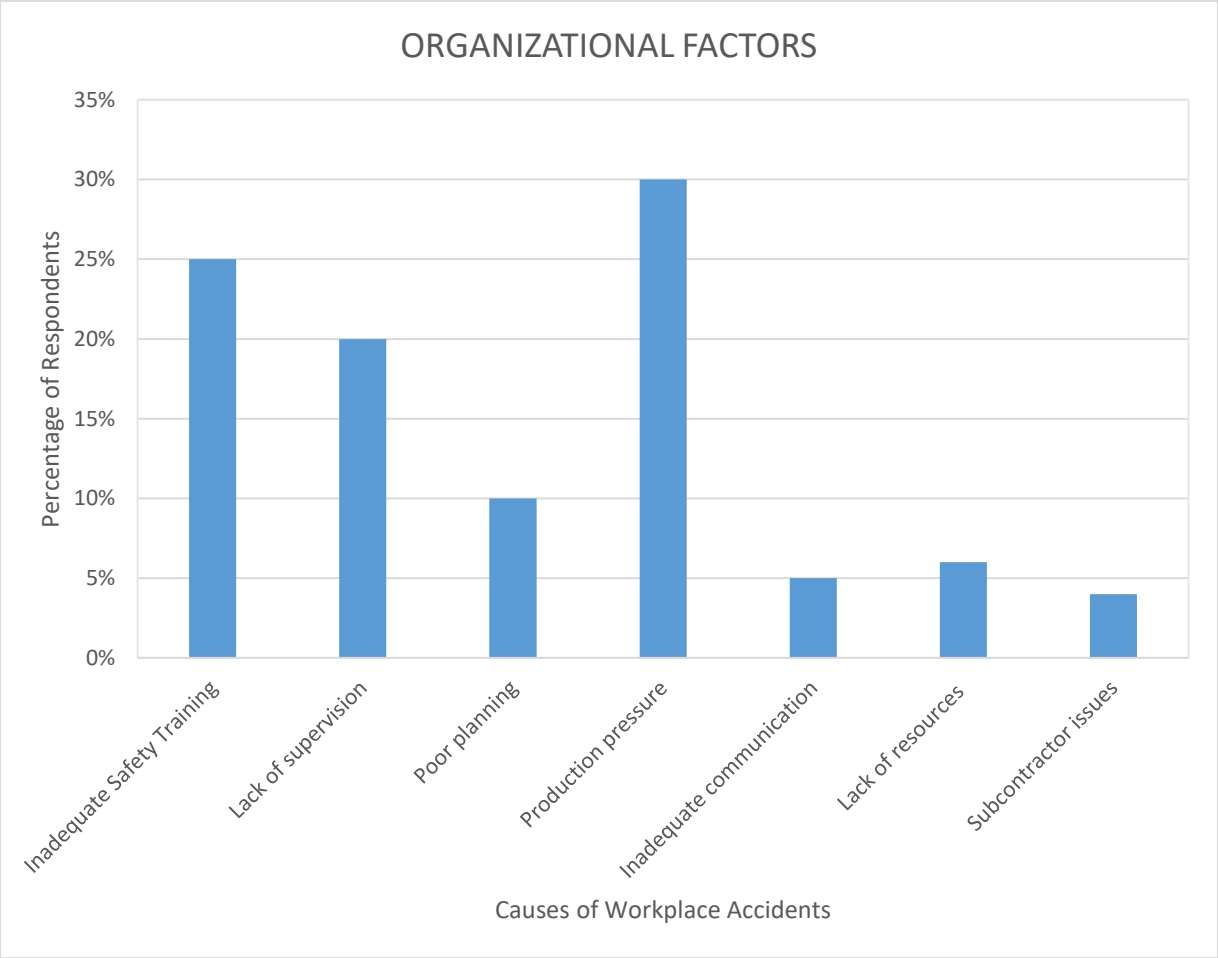

Figure 4.4: Organizational/Managerial factors which causes workplace accidents

4.3.4 EXTERNAL FACTORS WHICH CAUSES WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE PROJECT

The SHEQ officer with 15 years of experience in the construction industry highlighted that many workers at the site are casual labourers with minimal or no safety training, which contributes to accidents. Despite being provided with personal protective equipment (PPE), they often fail to understand the consequences of not using them, with some not wearing helmets or gloves due to discomfort or inconvenience. External factors also play a significant role in accidents at the site, with 30% of respondents attributing accidents to public interference, particularly since the

construction site shares roads with the general public. Weather conditions, such as rainy and windy seasons, also contribute to accidents, with 30% of respondents citing limited visibility and hazardous working conditions. Another 30% of respondents mentioned unexpected site conditions as a cause of accidents, emphasizing the need for proper workplace assessments before operations. Additionally, 15% of respondents identified other external factors that can cause accidents, highlighting the complexity of ensuring safety at construction sites. The SHEQ officer specifically noted that during rainy seasons, machinery can skid on compacted platforms, and temporary drainage may be insufficient, while during dry seasons, wind-blown sand can reduce visibility and cause eye irritation. (Refer to fig 4. 5 below)

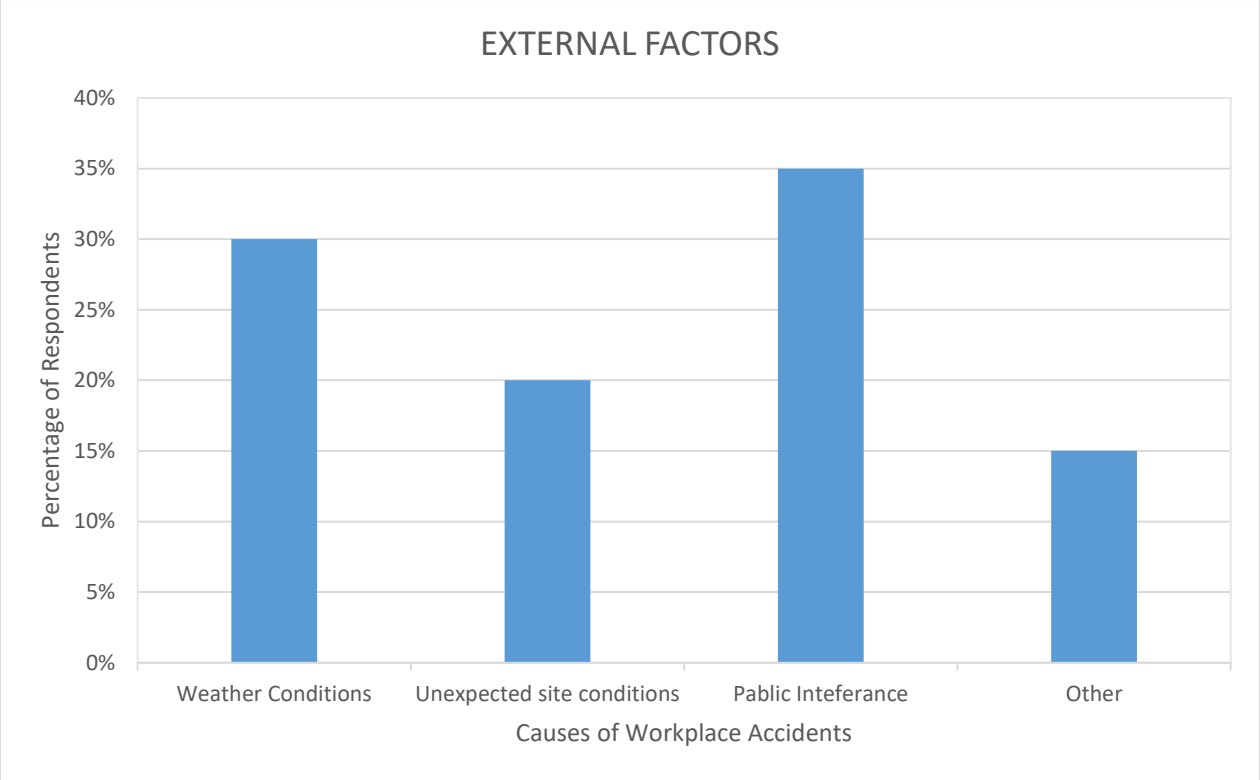

Figure 4.5: External Factors which causes workplace accidents at Mbudzi Interchange project

4.4.1 COMPONENTS OF A FRAMEWORK TO MANAGE THE CAUSES OF WORKPLACE ACCIDENTS AT A CONSTRUCTION SITE.

Based on the research findings, a framework for managing accidents at construction sites should contain different components, including risk assessment (20%), safety policies and procedures (15%), emergency preparedness (15%), training and education (10%), worker involvement (10%), technological integration (7%), communication (5%), monitoring and evaluation (5%), audits and inspections (5%), room for continuous improvement (5%), and safety culture (3%). (Refer to Fig 4.6) The concrete foreman noted that risk assessments are not done for every new task, and sometimes workers are left to do it alone without proper supervision. The foreman also emphasized the need for worker involvement in planning, saying that a proper safety framework should ask workers what's really happening on the ground and have room for change as site conditions are always changing. The SHEQ Officer focused on compliance, worker involvement, training, and culture, saying that top down rules don't work if workers aren't involved. The SHEQ Officer emphasized the need for worker-led safety committees, continuous safety education, and practical simulations of real risks.

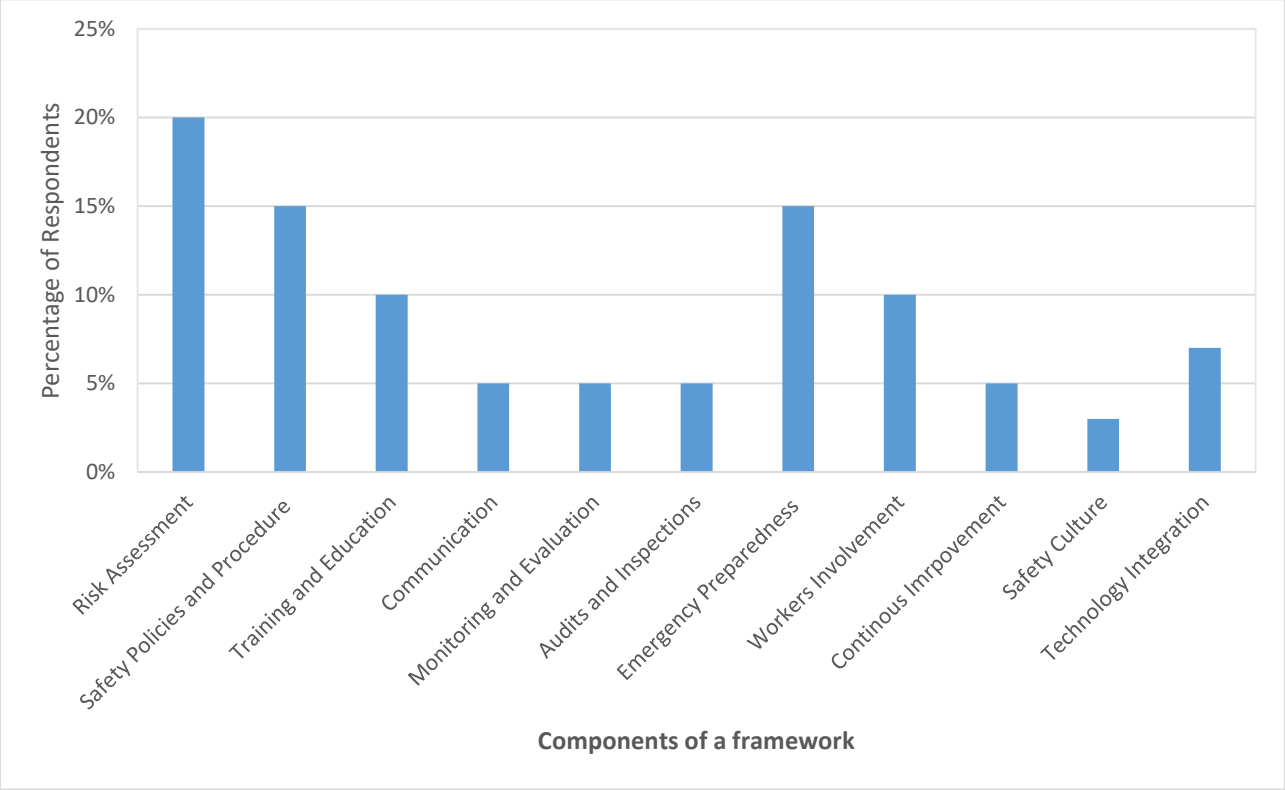

Figure 4.6: Components of a framework to manage the causes of workplace accidents at a construction site

4.4.2 DEVELOPED SUSTAINABLE MANAGEMENT FRAMEWORK FOR MBUDZI INTERCHANGE

The framework was developed using the results found on the causes of accidents at the Mbudzi Interchange construction site. From the results above, the causes of accidents are categorized into four groups: unsafe acts, unsafe conditions, external factors, and organizational factors.

The sustainable development framework developed (Fig 4.7) contains a section that examines the mitigation measures that can be taken to sustainably manage aaccidents. This section contains mitigation measures such as site planning and design, training and awareness, audits and inspections, risk assessment, emergency preparedness, worker involvement, and safety policies and procedures.

By implementing these mitigation measures, the sustainable part of construction is reflected in the results, such as timely completion of projects, accident reduction, and compliance.

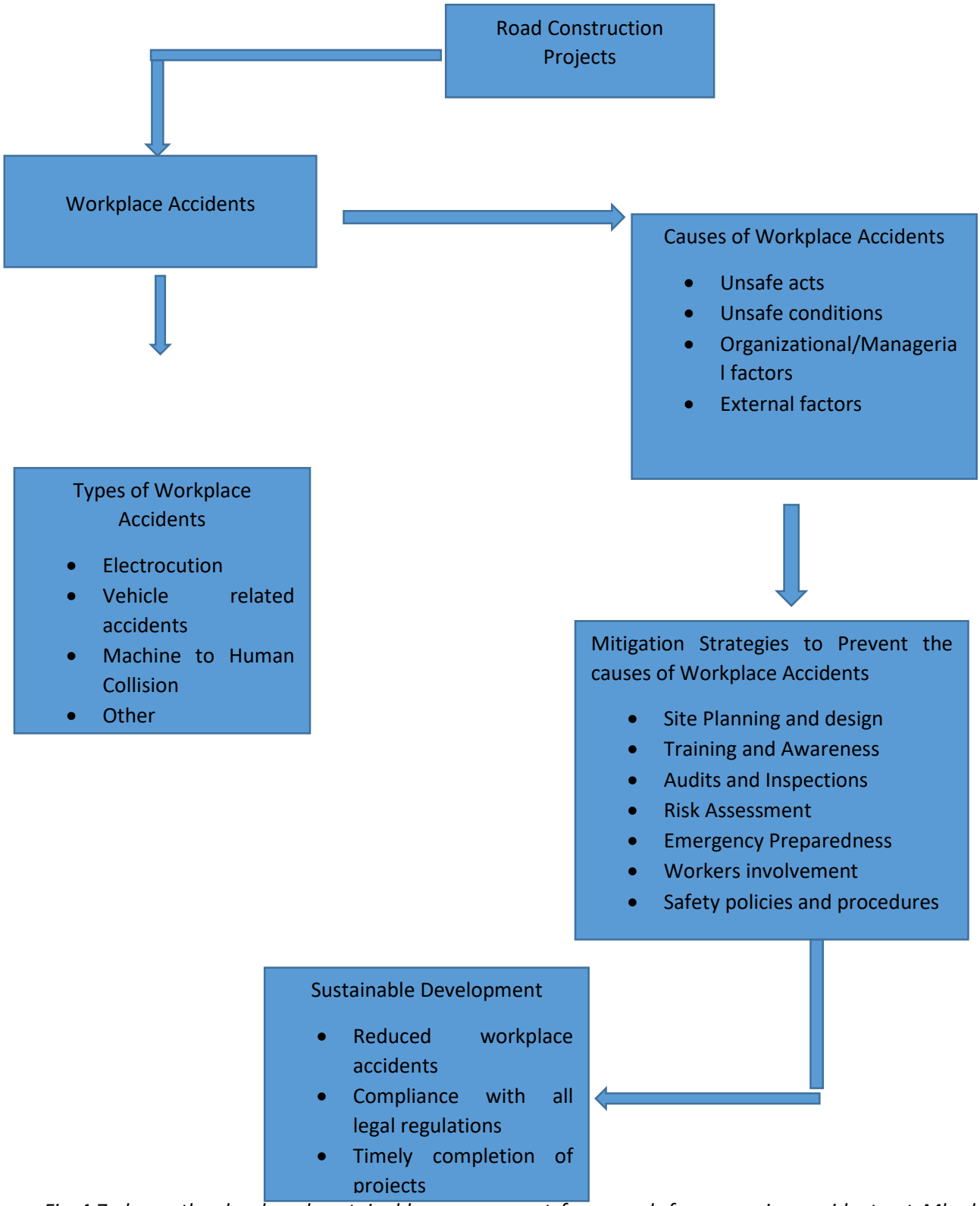

Fig 4.7 shows the developed sustainable management framework for managing accidents at Mbudzi Interchange

CHAPTRER 5 DISCUSSION

5.1 TYPES OF WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE CONSTRUCTION PROJECT

The Mbudzi Interchange results showed that machinery and vehicle accidents had the highest percentage. The results revealed that machine-to-machine collision (25%) and vehicle-related accidents (20 %) were the prevalent types of accidents at the Mbudzi Interchange construction site, proving to be the crucial forms of accidents at the site. During the interview the project manager highlighted that machine-to-machine collisions are more often because they are operating many activities using machines at close range. This finding is in line with the research that was done by Bilim et al. (2018), who reported that compared to other types of accidents that occur at construction sites globally, equipment-related accidents are notably more frequent, especially those involving earth-moving machinery. A more recent study in Lusaka City by Simutenda et al. (2022) found that of the recorded types of incidents at building premises, cranes and tippers have the highest accident records. The high records of machine-to-machine and vehicle-related accidents at the Mbudzi Interchange construction site may be attributed to the fact that there is much machinery, such as bulldozers, excavators, front-end loaders, cranes, tippers and water bowsers, working in a limited space. Also during the interview, the construction site supervisors highlighted the issue that they are using their access road with the public transport, and the road is always busy; as a result, accidents are bound to happen at some point.

In addition to machinery- and vehicle-related accidents being the key types of accidents occurring at Mbudzi Interchange, there is another significant type of accident at the site, which is electrocution. Electrocution can result from various hazards on construction sites, including contact with overhead power lines, faulty wiring, inadequate grounding, exposure to energised parts, wet conditions, lack of safety training, and overloaded circuits. The earthworks foreman highlighted that safety protocols or measures are sometimes overlooked; for example, instead of properly covering naked wires, shortcuts are used as long as the task is finished on time. A study by Romclaw (2024) shows that the potential for electrocution is one of the utmost shared hazards at construction sites when safety protocols are overlooked. The presence of slips, trips, and falls at 8% underscores the necessity for improved housekeeping and the implementation of warning signs, as poor site management can significantly increase accident rates (Gambatese et al., 2023).

5.2 THE CAUSES OF WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE PROJECT

The causes of accidents were grouped into four categories for easy identification and analysis that is unsafe acts unsafe conditions, organisational/managerial factors and external factors.

5.2.1 UNSAFE ACTS WHICH CAUSES WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE PROJECT

The discoveries of the current study also indicate that the most important cause of occupational accidents under unsafe acts is failure to use personal protective equipment followed by improper usage of machinery equipment. During the interviews the foreman highlighted workers do not have the knowledge of how to use some of the personal protective equipment and also do not know the importance of it. This finding is in line with the research that was conducted by Hamid et al. (2008) which states that Inadequate or improper usage of personal protective equipment and the state and upkeep of tools and machines are crucial to maintaining safety.

Failure to follow procedure 20% by workers on Mbudzi Interchange construction site occurred due to lack of communication 10% between the supervisors and their workers. Failure to follow procedure usually means employees are taking shortcuts for example during data collection supervisors indicated that most of the falls that occurs at the site employees will be jumping trenches instead of following the procedure. A study by Okoh and Haugen (2013) on maintenance-related major accidents, they discovered that miscommunication at any stage of operations can lead to accidents, as effective communication is crucial for ensuring safety and preventing errors.

5.2.2 UNSAFE CONDTIONS WHICH CAUSES WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE PROJECT

From the research carried on Mbudzi Interchange poor housekeeping under unsafe conditions at workplace contributed a high factor with 25 %. This was mainly caused by limited amount of time that was dedicated to housekeeping. During the interview the supervisors highlighted that housekeeping is done on Fridays only out of the six working days. Simutenda et al., (2022) conducted a study on the origins of accidents at building sites in Zambia and also concluded that majority of accidents were brought on by the site's unsafe conditions, and housekeeping problems were identified as the primary cause of fall accidents.

Following housekeeping on the major causes of accidents at Mbudzi Interchange is traffic hazards. This was caused due to high number of machinery working on one place and also traffic congestion in access roads that the site share with the public transport. This verdict is in line with study that was carried by Müngen and Gürcanli (2005) on the disastrous traffic accidents in the Turkish construction engineering and concluded that accidents occur when vehicles intrude construction site and they are caused by a number of factors such as inadequate traffic control, poor visibility and distracted drivers.

5.2.3 ORGANISATIONAL/MANAGERIAL FACTORS WHICH CAUSES ACCIDENTS AT MBUDZI INTERCHANGE CONSTRUCTION PROJECT

Organizational and managerial factors emerged as significant contributors to accidents at Mbudzi Interchange, with production pressure cited by 30% of respondents. The high percentage of production emphases the need for a strong workers' representative commit that is there to represent others when production is prioritized over the safety of workers as it continues to causes accidents. Usually the workers will be tied but out of fear do not complain. This finding underscores a serious matter in the construction sector, where the drive to meet deadlines often overshadows safety considerations. Zohar (2022) notes that prioritizing production over safety can lead to a culture where workers feel compelled to take risks, ultimately increasing accident rates.

Inadequate safety training (25%) and lack of supervision (20%) further exacerbate the issue. A shortage of supervisors leads to more employees working alone, increasing accident rates, especially among inexperienced workers. A study by Faith (2015) indicated that organisational flaws that lead to accidents are highlighted by weak inspection procedures and training initiatives. Another author goes on to say that it is impossible to overestimate the value of thorough safety training courses since they provide employees the tools and information required to spot and reduce hazards (Cohen et al., 2016). Effective supervision is crucial in ensuring compliance with safety protocols and fostering a culture of safety on site.

Ten percent of managerial staff also contribute to accidents via poor planning since it might result in unanticipated hazards and higher risks. Sarshar et al. (2016) highlighted that the main contributing factor of accidents under organisational or managerial position in different industries starts in the planning and preparation stages up to miss communication of information during

execution of work. The need for effective communication between supervisors and workers is essential in addressing these issues, as highlighted by the findings of Shehu et al. (2023).

5.2.4 EXTERNAL FACTORS WHICH CAUSES WORKPLACE ACCIDENTS AT MBUDZI INTERCHANGE PROJECT

The shared use of roads with the public presents unique challenges for construction sites such as the increase of accidents with public transport, recurring the need for effective traffic management strategies to minimize risks (Hallowell and Gambatese, 2023). The research carried out by Hallowell and Gambatese is also demonstrated by the research carried out at Mbudzi Interchange 35 % of the respondents highlighted that public interference has a significant role in accident causing at the site. Accidents are often caused by public drivers who disregard construction site signage and safety rules. This issue is particularly prevalent among illegal public transport operators, commonly known as 'mushikashika,' who operate in Harare this was also highlighted during the interviews by supervisors. However this can be reduced by use of spotters for every machine or at busy roads.

The outcomes of the current study also show that adverse weather conditions, particularly during wet and windy seasons, can severely impact visibility and site safety causing accidents with 30 % of respondents reporting this issue. The SHEQ Officer indicated that most of the engineering safety measures during the rainy season does not work most of the drainages won't be working. This is in line with previous research. For instance a research carried out by Ahmed (2019) and discovered that natural occurrences such as rain and hot temperatures, which are classified as acts of God, can cause disruptions and increase the chances of accidents at sites. Furthermore an investigation carried out by Williams et al. (2018) found out that adverse weather especially during rain seasons can impact the safety of workers therefore workers must be excused from the site during this time.

In addition to adverse weather data also highlights that other significant causes of accidents at the site are unexpected site conditions 20%. Unexpected site conditions such as unstable ground can cause collapses and hidden hazardous obstacles such as unmarked obstacles can increases the chances of trip and fall. A study by Mohammed et al. (2020) on occupational safety and health in the construction sector in Saudi Arabia discovered that the geographical nature of the site can contribute to causes of accidents especially where there are compaction of high fills. Another

author concluded that there is a need for proper workplace assessments before operations is critical, as unexpected site conditions can lead to accidents (Chen et al., 2025).

5.3 COMPONENTS OF A FRAMEWORK TO MANAGE THE CAUSES OF WORKPLACE ACCIDENTS AT A CONSTRUCTION SITE.

The research conducted on the Mbudzi Interchange construction site shows the perceived importance of various components of a sustainable framework for managing accidents at construction sites. Risk assessment was considered the most critical component; during the data collection, employees highlighted that they do not carry out risk assessments properly every day, but on the days they conducted it, accidents were reduced, as they were proactive, so by improving risk assessment, accidents can be managed. This is in linked with the study that was conducted by Azuruole (2025); the researcher highlighted that understanding the proactive through risk assessment is of paramount importance in effective accident management. Following the risk assessment, safety policies and procedures and emergency preparedness were each identified by 15% of respondents. During the interview the project manager indicated that safety procedures are mainly exclusive to the SHEQ department. This joint emphasis the need for a structured safety system, which must be well known among all the employees, as this is the backbone of construction safety. Based on the research by Alqahtani et al. (2023), these recognised components are of great importance in understanding the causes of accidents and coming up with proactive measures, although it may be seen as an old-fashioned way. Moving from these core components, the results also show that employees perceive that by investing in their skills and knowledge through training and education, a construction site can manage accidents at construction sites. Training and education, identified by 10% of respondents, points to an awareness of the crucial role of worker competency in preventing accidents (Panda and Sharma, 2024). At the same time, 10% employee involvement shows that the importance of involving workers in safety decision-making has been acknowledged. By involving workers in decision-making, they can also be able to contribute in safety areas that affect them at the workplace. This is in line with the research by Khan and Ali (2023), which states that by involving the workforce in decision-making, it improves on-site hazard identification and fosters greater ownership, which in turn improves the practical application of safety measures. Despite the emphasis on these major significant components, several components critical for true sustainability and continuous improvement in accident management received notably lower recognition. Communication, monitoring and evaluation,

audits and inspections, and continuous improvement were each identified by only 5% of respondents, while safety culture garnered the lowest at 3%. These were overlooked but also play a great role in managing accidents at the workplace.

5.4 DEVELOPED SUSTAINABLE MANAGEMENT FRAMEWORK FOR MBUDZI INTERCHANGE.

The developed Sustainable Management Framework for Mbudzi Interchange construction site outlines a logical progression from identifying the causes of accidents to implementing mitigation ways and sustainable development outcomes within the construction industry. The framework group's accident causes on the site into unsafe acts, unsafe conditions, organisational factors and external factors, acknowledging accident causation is typically multifaceted.

To address these, the framework proposes key mitigation strategies including site planning and design, training and awareness, risk assessment, safety policies and procedures, audits and inspections and workers' involvement before a site is opened for operation. The framework targets the types of accidents that were identified at the site, which are vehicle-related accidents and machine-to-human collisions, but the framework can be adjusted to suit any construction site; it contains room for improvement. The framework, at the end of the day, links the desired outcomes of reduced workplace accidents and helps organisations to comply with legal regulations to the goal of sustainable construction, not neglecting the core component of safety first.

It is of great importance to note that the framework does not provide mitigation measures for construction sites but merely serves as a map or guideline in fighting against accidents at construction sites**.**

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6. INTRODUCTION

Construction sites are inherently hazardous environments, and effective safety management is critical to protecting workers and project outcomes. This study focuses on the Mbudzi Interchange construction site in Harare, Zimbabwe, where a growing number of accidents have raised concerns about workplace safety. The research aimed to identify the most common types of accidents occurring on-site, investigate their root causes, and develop practical strategies for reducing future incidents. By examining accident patterns and contributing factors, the study provides insight into how targeted interventions can improve safety performance in large-scale infrastructure projects.

6.1 CONCLUSION

The study discovered that machinery- and vehicle-related accidents were the most common type of accident at the Mbudzi Interchange construction site, indicating a significant number of major types of accidents that can result in serious injuries or even fatalities and property damage. Other types of accidents, such as slips, trips and falls and environmental-related accidents, were the least occurring at the site.

The research also revealed major causes of accidents at the site to fall under four categories: unsafe acts, unsafe conditions, organisational factors and external factors. Each category had its primary category cause of accident that was identified by the construction workers' production pressure being the primary cause of accidents under organisational factors. Public interface was the primary cause of accidents under external factors, failure to use PPE under unsafe acts and poor housekeeping under unsafe conditions.

In addition to the identification of types and causes of accidents at the site, a sustainable management framework for managing accidents was also developed, which can be used on different construction sites.

6.2 RECOMMENDATIONS

Based on the research outcomes, it is recommended that

- Training and education of employees on safety issues

- Adoptions of sustainable construction management frameworks
- Decentralisation of safety management systems across all departments, rather than relying solely on SHEQ departments, to foster a culture of shared responsibility and enhance overall safety performance.

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APPENDICES

APPENDIX 1: CLOSED ENDED QUESTIONNAIRE AND OPEN ENDED QUESTIONNAIRE

Research Questionnaire

Causes of accidents at Mbudzi Interchange construction site.

Thank you for taking the time to participate in this research study. This questionnaire aims to gather insights on the types and causes of accidents occurring at the Mbudzi construction site. Your responses are crucial in identifying risk factors and proposing effective measures to improve safety standards. Please answer all questions honestly and to the best of your knowledge.

Your responses to this questionnaire will be CONFIDENTIAL and not be shared with anyone else without your written consent.. Your honest and quick response will be mostly appreciated. Your contribution is greatly appreciated in making construction sites safer for everyone.

Section A: Demographic and Occupational Information

1. 1. Select your age group. Mark only one oval. 18-24 25-34 35-49 50 and old
2. Gender Tick all that apply. Male Female Prefer not to say
3. What is your occupation? Tick all that apply. Engineer - SHEQ Officer- Foreman Driver-Operator- General Hand - Artisan
4. 4. Years of experience in construction? Mark only one oval. less than a year - 1-3 years - 4-7 years - 8-15 years -16 and older
5. What is your highest level of education? Tick all that apply. Less than high school -High school diploma -Technical/vocational training -Bachelor's degree -Other (please specify): _____

Section 2: Types of Accidents

1. What types of accidents have you witnessed or experienced at Mbudzi construction site? (Check all that apply): Tick all that apply. Slips, trips and falls--Falling objects--Equipment-related accidents (e.g., machinery malfunctions)- Structural collapses or failures- Fire or explosions --Electrocution or electrical malfunctions --Chemical spills or hazardous substance exposure --Vehicle-related accidents (e.g., collisions or overturns)--Other (please specify): _____
2. . How often do accidents occur at this site?
   1. Never: No accidents have occurred at the site.
   2. Rarely: Accidents happen once a year or less.
   3. Occasionally: Accidents occur a few times a year.
   4. Often: Accidents happen on a monthly basis.
   5. Very often: Accidents occur weekly or more frequently.

3. In your opinion, which category of workers is most affected by accidents? Mark only one oval. Manual laborers --Machine operators --Supervisory staff --Drivers --Other (please specify): ____
4. Were injuries sustained in these accidents? Mark only one oval. Yes or No

Section C: Causes of Accidents at Mbudzi Interchange and components of sustainable framework management for managing accident at site.

5. What do you think are the primary causes of accidents at the Mbudzi construction site? (Select all that apply): Lack of proper training-- Equipment failure-- Unsafe working conditions-- Poor supervision or management --Human error or negligence --Fatigue or overwork-- Weather conditions (e.g., heavy rain, wind) ---Other (please specify): _____
6. Have you witnessed or been involved in an accident at Mbudzi Interchange? Yes or No. If yes, please answer the following questions from 7 to 8

7. Briefly describe the incident……...

8. What measures do you believe would be most effective in reducing accidents at this site…… ……..

9. 9. Do environmental factors (e.g., weather, dust, or noise) contribute to accidents at this site? Yes or No

10. Below are components that can be included in a sustainable framework for managing accidents at a construction site. Please tick one or more components that you believe will contribute to an effective accident management framework. (Risk assessment--safety policies and procedures-- training and education-- Communication--monitoring and evaluation--audits and inspections—other…….)

APPENDIX 2 INTERVIEW GUIDE FOR SUPERVISORS

Background Information (Approx. 5-10 minutes)

1. Can you briefly describe your current role and responsibilities at the Mbudzi Interchange construction site?
2. How long have you been working on this specific project? How long have you been in the construction industry in this capacity?
3. From your perspective, what are the main challenges or complexities of ensuring safety on a large-scale project like the Mbudzi Interchange?

Interview Questions

1. Define accident or incident.
2. Outline the types of accidents at Mbudzi Interchange construction workplace.
3. Outline the causes of accidents at Mbudzi Interchange a construction work place.
4. Highlight the mitigation measures that can help adopted to manage the causes of workplace accidents' at a construction site
5. Define what is meant by sustainable management framework for managing accidents in your own words.
6. Also can you provide us with sustainable management framework components for accident management that can help reduce the rate of accidents in construction sites?
7. outline the benefits that can come by adopting a framework to prevent the causes of accidents at a construction workplace.