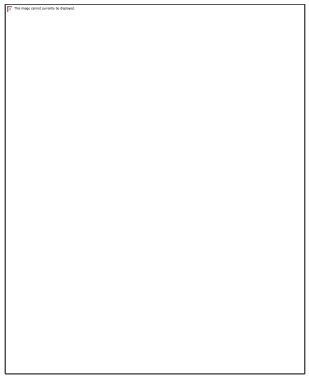
BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF ENVIRONMENTAL SCIENCES

TITLE: Development of a Risk Assessment Framework for Occupational Health and Safety in the Construction Industry (Case Study: Bindura University of Science Education)



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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS

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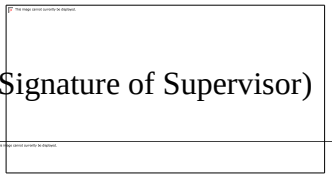
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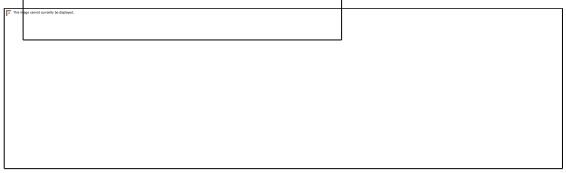
The undersigned confirm that they have examined in detail the dissertation entitled 'Development of a Risk Assessment System for Occupational Health and Safety in the Construction Industry: A Case Study of Bindura University of Science Education, ' by Wendy C. Mudziviri (B221746B). They suggest that Bindura University of Science Education accepts the said research work as one of the requirements for the Bachelor of Science Honours Degree in Safety, Health, and Environmental Management (BSc-SHEM).



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(Signature of Chairperson) Date

DECLARATION

My name is Wendy C. Mudziviri. I am writing to make clear that this dissertation is my very own original work and has not been taken anywhere else for a degree. I have acknowledged here all the sources of information used in the work.

Signed:  **Date:** ……/06/2026

This dissertation has been submitted with the approval of the academic supervisor.

Signed: …… **Date:** ……/06/2026

Supervisor

DEDICATION

I dedicate this work to my beloved family, whose unwavering support, encouragement and prayers sustained me throughout my studies.

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ABSTRACT

Construction workers are exposed to several occupational health and safety (OHS) hazards and risks, yet health and safety risk assessment systems are seldom introduced in a systematic way. The primary objective of this project was to design a simple OHS risk assessment setup for conduction construction activities at Bindura University of Science Education. This case study used a mixed method approach and data collection methods included questionnaires interviews observations and document reviews from different construction workers, supervisors and safety personnel. Results found that exposure to hazards such as dust, ergonomic stress, working at heights and falling objects was extremely high as 65% workers had sustained or almost sustained injuries in the past 12 months of the study period and that existing safety practices were ad hoc and inconsistent and were mostly inadequately documented. Finally, a simple construction OHS risk assessment system was developed based on International Safety Guide within the context of the local conditions and its implementation was expected to be a very important innovation in that it will strengthen construction safety management at the University.

Keywords: occupational health and safety, risk assessment, construction safety, hazard identification, Bindura University of Science Education.

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LIST OF ABBREVIATIONS

BSc-SHEM: Bachelor of Science in Safety, Health and Environmental Management

BUSE: Bindura University of Science Education

ILO: International Labour Organization

ISO: International Organization for Standardization

NSSA: National Social Security Authority

OHS: Occupational Health and Safety

PPE: Personal Protective Equipment

SPSS: Statistical Package for the Social Sciences

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

This first chapter offers the reader with a summary of the study and an idea of what is covered in the dissertation. It summarized the background to the research, problems statement, broad and specific objectives, research questions, justification for research, research assumptions, scope and limitation. In general, it introduces the concept and justification for the development of an occupational health and safety risk assessment system for construction works at Bindura University of Science Education. It is a guide to the dissertation.

1.2 Background to the Study

Construction has always been one of the most hazardous industries ever to have existed(often being reported as one of the most dangerous for safety in the workplace globally). Infrastructure workers are faced with all sorts of physical chemical ergonomic and locally related hazards every day whether that is working in close proximity to a crane, driving on vehicle mounted equipment, manually handling materials, or breathing in dust and toxic sources, (Pinto, Nunes and Ribeiro, 2011).Much work has been directed to improve levels of construction safety through regulation, competent training and by systematic management procedures for risk. The International Labour Organisation (ILO, 2022) still shows construction representing a significant proportion of global work related deaths.Though, even with these precautionary measures accidents continue to occur on construction sites, and tend to be most severe in countries with low per caput income, where the regulatory control is not always effective and resources are scarcer (Umeokafor, 2018). And, these struggles are exacerbated across Africa due to inadequate safety training, unavailability of PPE and lack of compliance with safety regulations. Research has found that up to 50% of workers on sites have little or no idea about what safety regulations require and that hazard identification and risk assessment techniques are implemented in an ad hoc manner, if at all (Nghitanwa & Zungu, 2017; Gervais, Mwanaumo & Thwala, 2022). Due to this, accidents have increased and locations are still unsafe.

Zimbabwe addresses occupational safety and health using many approaches such as the Zimbabwe National Occupational Safety and Health Policy (ZNOSHP, 2014), Factories and Works Act (Chapter 14:08) and accident prevention regulations by the National Social Security

Authority (NSSA). Though implementation of safety and health management systems is fuzzy because of just lack of awareness, failure to provide proper training and lack of documented safety management system (Mkungunugwa, Chikuni & Manjengwa, 2022).

widening the gap between policy and practice puts workers at risk from hazards, which could be avoided, and the same problems occur at institutional level whenever the university is engaged in Construction and infrastructural projects. Currently BUSE had a lot of ongoing development projects like new lecture theaters, student residency blocks and laboratory blocks.

Still, there is very little organized and well planned effort to identify and manage the operational health and safety hazards linked to construction works at the university. Construction safety - mostly the institutional construction safety, has being discussed, to some extent... Still, much lag behind the amount of work that might have gone into safety in Zimbabwean universities. This inadequately explored research area pave the way for the researcher a distinct opportunity to develop a practical occupational health and safety risk assessment setup for the Bindura University of Science Education construction works.

1.3 Statement of the Problem

The employees who are building the university worksites at BUSE are still being exposed to the occupational hazards. Besides that, the university doesn't have a well-documented, methodical, and formal system for assessing the health and safety risks connected to this type of work. During our visits to the ongoing sites, we have seen some unsafe practices being carried out: people working at heights without any fall protection, only helmets, gloves, and safety boots being used occasionally, and no written hazard identification procedure at any of the sites.,As Fung Tam Lo & Lu (2010), the most common types of injuries on construction sites result from slips and trips, falling materials and equipment, inhalation of dust, and strains to the body due to lifting and carrying. As the BUSE does not have a formal, centrally controlled system for record-keeping, near-misses and minor injuries generally go unrecorded, making it extremely hard to determine the actual extent of the problem. Though, the current records plus the unofficial accounts of the site managers and staff of the works department, point to Truth is unsafe conditions are prevailing and there is a lack of safety oversight.

The Zimbabwe National Occupational Safety and Health Policy (ZNOSHP, 2014) is a statute that mandates the implementation of periodic risk assessment. Yet, the implementation of

periodic risk assessments has been very insufficient (Mkungunugwa et al. 2022). Building sites at the university are mostly relying on impromptu and disorganized responses to hazards which in essence renders risk assessment ineffective and puts the safety of the workers at risk. The issue is most pronounced in institutions where not only are formal safety mechanisms absent but also the work is done on a sporadic basis by the University's own personnel as well as external contractors.

1.4 Aim of the Study

To develop a practical occupational health and safety risk assessment framework for construction activities at Bindura University of Science Education.

1.5 Objectives

1. To identify the occupational health and safety hazards present during construction activities at Bindura University of Science Education.
2. To assess the level of risk associated with the identified hazards.
3. To examine the existing occupational health and safety practices applied in construction activities at Bindura University of Science Education.
4. To develop an occupational health and safety risk assessment framework as a practical model for construction activities at Bindura University of Science Education.

1.6 Research Questions

The study is guided by the following research questions:

1. What are the occupational health and safety hazards present during construction activities at Bindura University of Science Education?
2. What is the level of risk associated with the identified hazards?
3. What occupational health and safety practices are currently applied in construction activities at Bindura University of Science Education?
4. What occupational health and safety risk assessment framework can be applied to construction activities at Bindura University of Science Education?

1.7 Justification of the Study

A major aim of this study is to explore how occupational health and safety are managed in Zimbabwe's institutional construction projects given that hardly any existing work has been focused on this issue. The research Mainly centres on creating an all-inclusive risk assessment instrument because of which it typically supports hazard recognition, risk evaluation and the implementation of relevant safety procedures Mainly in a university environment. The results of the research may help to turn Bindura University of Science Education into a safer place through fewer accidents and higher compliance with occupational health and safety standards. Besides, the research study will act as a pointer to safety in the construction knowledge base in Zimbabwe, Most of all for institutionally-based construction activities which have been largely neglected up to now.

Besides, the intended system may be implemented by other universities, government agencies as well as construction companies that aim at upgrading their occupational health and safety standards. On this, the research may attract the attention of other institutions besides the case institution at both institutional and national levels.

1.8 Assumptions of the Study

The study is based on certain assumptions. It is our belief that both construction workers and their supervisors will provide sincere answers to the questionnaires when we collect data. It is believed by some that construction work for the Bindura University of Science Education project entails occupational hazards that can be effectively assessed and evaluated through observations, interviews and questionnaires. We also assume that the participants in the study will be willing to cooperate.

1.9 Delimitations of the Study

Construction works at Bindura University of Science Education are the main focus of this study, which also focuses on occupational health and safety hazards and risk assessment methods in construction activities. The sample comprises of construction workers, site supervisors, project managers, safety officers, and works department employees who are directly involved in construction operations at the University. The study does not cover non-construction activities of the University or construction works at other institutions.

1.10 Limitations of the Study

Because this research was carried out in a single institution only, its findings might leave a bit to be desired when it comes to the generalizability of the conclusion to other places. Insufficiently detailed records of incidents at the University can work as a limitation about availability of previous safety data. Besides, a number of participants might have been reluctant to disclose unsafe behavior due to the fear of consequences. The study employs multiple data gathering methods to cross-verify the findings and offers participants with assurances of confidentiality and anonymity throughout the research process as measures to minimize the impact of these limitations.

1.11 Chapter Summary

This chapter has explored in detail the research background, the problem statement, main aim and specific objectives, the research questions, the justification for the study, the assumptions, as well as the delimitations and limitations of the research. The next chapter two will integrate the literature both theoretical and empirical on the topic of occupational health and safety risk assessment in construction industry.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The next chapter examines the existing knowledge about occupational health and safety (OHS) risk assessment in the construction industry. In fact, one of the reasons for writing this chapter is to lay out the conceptual and evidence-based grounds of the research. It consists of three segments: the theory background, the review of empirical studies, and the conceptual setup. The theory system discusses the major theories that underpin OHS risk assessment; the

empirical review is the portion of the work that thoughtfully evaluates the literature of previous studies; and the conceptual structure shows the links among the variables of the present study.

2.1 Theoretical Framework

Several theories support this study. These theories reveal the causes of occupational risks, how to handle those risks, and the functioning of safety systems in the construction industry. Four of these theories are presented here.

2.1.1 Risk Management Theory

Risk Management Theory describes the process by which organizations identify risks. First, they study them, then evaluate the risk connected to each, and finally decide on the best plan of action to achieve their objectives without failure. A number of international standards, Mainly ISO 31000 (International Organisation for Standardization, 2018), characterize risk as the effect of uncertainty on objective achievement and consider management as a logical chain of steps starting with identification, then analysis and evaluation, and finally treatment. Per Aven (2016) originally risk was only related to the aspect of probability but now, it also includes the factors of uncertainty and knowledge gaps.

Because of Truth is construction is highly changing, complex and dangerous work by nature, the need for risk management in the industry becomes very strong. In their work Sousa Almeida and Dias (2012) explain that the only way that risk management can be effective is if its implementation is based on a well-organized method that is combined with an organization's systems and decision-making processes. Such settings not only allow constant improvement, but also make it possible to hold individuals accountable and deal with risks before they manifest. The theory serves the purpose of this paper as it gives a structure for the orderly identification of hazards and risk evaluation of construction-related work at Bindura University of Science Education.

2.1.2 Occupational Health and Safety Risk Integration Theory

The neglect of occupational health and safety (OHS) in project management is generally a major contributory factor for the failure to make construction safer (Kaiser et al. 2004). Badri, Gbodossou and Nadeau (2012) states that "Really, in most industries and more More exactly the construction industry, the dangerous high-risk of OHS is seldomly integrated with project management processes. The consequence is a declining safety performance and increasing accident rates". Hazards are to be identified and taken into account as an integrant part in the project life starting from the planning design construction stage to the monitoring, and control stage; and this integration would not only curtail accidents to the lowest possible level but would also maximize the overall project performance. In such a situation, the theory would work as a guiding principle in suggesting the optimization of the structure allowing the seamless integration of occupational health and safety risk assessment for the construction works at Bindura University of Science Education.

2.1.3 Accident Causation Theory

Accident Causation Theory changes elaborates that the main reason of accidents is the coexistence of unsafe acts and unsafe conditions in a work environment. It coincides with Heinrich's domino theory and Reason's (1990) Swiss cheese model which demonstrate that every mistake/failure that leads to an accident can be at the organizational, supervisory or individual levels. As an example, the sequence of accidents/incidents at a construction site usually begins with untrained staff, lack of supervision, equipment failure and dangerous environment. By studying construction site accidents, Pinto et al. (2011) recognized the main causes as safety organization inefficiency, lack of communication among workers, inadequately trained personnel and weak safety culture. This theory is quite useful for the study as it points out the need for regular hazard identification and the elimination of chain causes with well-structured health and safety programs in the workplace.

2.1.4 Safety Systems Theory

The Safety Systems Theory outlines workplace safety due to various interconnected elements in a system like the working environment, management practices, equipment, and people (Leveson, 2011). On such a system level, it would be very difficult based on this theory to consider an accident mere fault of one part/mistake of one person; they reveal the interactions and inadequate controls in a larger socio-technical system (Reason, 1990; Leveson, 2011). Also, Hollnagel (2014) sees safety as a system feature and argues that to control it, the focus should be on how the different parts of an organization function together rather than separately.

For him the focus mostly system is also the hallmark of an occupational health and safety approach that rather than viewing hazards as isolated, looks at them in the whole system.

Apart from that, when it comes to construction, Zhou et. al (2015) have disclosed the same point of the theory from their study on the safety management which, as them, is a coordination of organizational, supervisory and technical elements. This is a very powerful reason for the implementation of safety measures which cover all work aspects of construction thoroughly.

2.1.5 Relevance of the Theoretical Framework to the Study

Suppose we put together all these theories; the research will stand on strong ground. Based on Risk Management Theory, risks have to be identified and evaluated thoroughly; OHS Risk Integration Theory points out the necessity of connecting safety aspects directly with construction work; Accident Causation Theory reveals the main reasons for accidents while Safety Systems Theory encourages taking an overall safety approach to the entire system. In combination, these theories form an essential part of designing a well-organized occupational health and safety risk assessment model for construction works at Bindura University of Science Education.

2.2 Empirical Review

This section reviews previous empirical studies in line with the research objectives of the study.

pational Health and Safety Hazards in Construction

On construction sites are diverse, complex sites filled with many occupational hazards, from falling from height, to contact with falling objects, contact with machinery, contact with pollutants and physical fatigue, amongst others. Fung et al (2010) identified the most common accidents on site as slips, trips and fall, injuries from tools and equipment, much of them attributed to inadequate safety measures and the lack of any systematic risk analysis. Referring to the construction industry in Ghana Kheni et al Gibb and Dainty (2008) found that small and medium enterprises in developing countries are more prone to health and safety problems as they are constrained by having inadequate resources and limited institutional support.

Okoye (2018) produced a similar result, attributing a significant proportion of the high accident rate in sub-Saharan Africa to laziness or low safety consciousness on the part of workers and weak enforcement. These papers collectively show that hazard recognition is a crucial element in safety performance improvement in the construction sites.

2.2.2 Risk Assessment in Construction

Without risk assessment, there is no effective way to manage risk in occupational health and safety; because the process of risk assessment in occupational health and safety involves hazard identification, risk analysis and risk control. Fung et al. (2010) have developed a RAM for predicting and ranking construction risks utilizing historical incident data. As a result, it can facilitate practitioners to identify the riskiest activities in construction projects and direct their efforts into the prevention of those riskiest activities.. Though, Pinto et al. (2011) believe the traditional risk assessment methods are limited by the significant uncertainties, absence of a generic approach, and the enormous task of constructively depicting the intricacy of a construction site. The recent research in this field by Zhou, Goh and Li (2015) indicates the tendency is now moving toward qualitative and semi-quantitative approaches that integrate hazards severity and probability and also function as a decision tool. In general, these researches clearly demonstrate the need for the enhancement of a more sophisticated, context-based risk assessment methods.

2.2.3 Existing Occupational Health and Safety Practices in Construction

Safe practice on construction site goes beyond providing and using PPE; it involves training supervising written policies and risk assessment...Although known by most, the extent of their implementation varies greatly. Badri et al. (2012) revealed that most organization do not perceive Occupational Health and Safety (OHS) risk management as integral element of their project management in a systematic manner; So, resulting in poor safety outcomes. Sousa et al. (2012) concur, identifying the main issues behind the non implementation of safety practices as lack of organisational support, a poor safety culture and inadequate resources. Based on Mwanaumo and Thwala (2019), the analysis done across the southern Africa region suggested that the client and senior managers in safety performance on projects do no simply limits themselves to the margins of Safety issues just projects or skewing management tied to them but ignore totally. For the same reason as these, the need is for a system that would enable the consistent and effective use of safety practices.

2.2.4 Development of Occupational Health and Safety Risk Assessment Frameworks

Very few studies have truly come up with innovative ideas to improve construction safety. Sousa et al. (2012) created a risk management system conforming to the ISO 31000 standards and mainly focused on linking risk management with business activities. Fung et al. (2010) came up with a safety risk ranking tool that assesses the risk of a safety issue by looking at both its probability and severity, thereby allowing the hazards to be ranked for safety decision-making. Manuele (2014) mentions that employing risk assessment instruments is only most effective when such instruments are tailored to the specific characteristics of the work environment. Still, these instruments are hardly employed in the formal construction sector, In particular in developing countries like Zimbabwe. Zimbabwe is Yes a great example of the gap that this study is trying to address.

2.2.5 Research Gap

When the literature was reviewed, only a few very significant gaps were discovered. Most importantly, occupational health and safety (OHS) studies in institutional construction environments of universities are almost non-existent. Secondly, Zimbabwe cannot claim to have well-organized and context-specific risk assessment systems. Thirdly, earlier studies have revealed that the extent of integration of risk assessment in construction project management is still very low. So, these are precisely the areas this research seeks to address while developing a construction OHS risk assessment system at Bindura University of Science Education.

2.3 Conceptual Framework

2.3.1 Description of Variables

The conceptual system is premised on In reality implementing occupational health and safety (OHS) systems can alter the safety consequences of construction projects. The independent factors were merely OHS. The dependent variables were simply the risk level and safe results. Among the intervention variables training supervision, safety culture, and adherence to rules that alter the link between IV and DV about strength.

2.3.2 Conceptual Framework Diagram

Figure 2.1 gives a visual representation of the relations between the variables. The diagram depicts occupational health and safety practices as an independent variable; level of risk and safety outcomes as the dependent variables; and training supervision safety culture, and regulatory compliance as the intervening variables which change the relationship between the independent and dependent variables. Besides, this figure 2.1 also demonstrates the interaction of these variables in the conceptual structure of the study.



Figure 2.1: Conceptual Framework of Occupational Health and Safety Risk Assessment

2.3.3 Explanation of the Conceptual Framework

The diagram shows how occupational health and safety practices can affect the effectiveness of hazard identification and risk assessment. Accurate identification of risks is only possible with good safety internal control(s) which will ultimately result in less risk and a safer working environment. But, various factors such as training level supervision safety culture(s), and compliance with regulations also (affect) this association. For example, it is mainly well-trained and well-supervised workers who (comply) with safety practices while (a) poor safety culture has a (negative) effect on it.

2.4 Chapter Summary

In this chapter, risk assessment for occupational health and safety in the construction sector was the main focus and literature review was also presented. Theoretical system is built on four major theories i.e. Risk Management Theory, the Occupational Health and Safety Risk Integration Theory, Accident Causation Theory and Safety Systems Theory. These theories jointly explains how risks are generated and managed in the construction industry. The review of the empirical literature included studies that corresponded to the research objectives and linked construction with different hazards such as, among others, fall injuries, machinery injuries and exposure to hazardous materials. Also, the findings of these studies indicate that even though risk assessment is a fundamental tool in safety management, the current risk assessment in practices are mostly informal, non-standard and inconsistent, whereas occupational health and safety practices tend to be poorly implemented due to, for instance, project management not strongly advocating safety, lack of adequate training and limited organizational support.

Besides that, the literature review identified a dearth of a study on structured and locally adapted occupational health and safety risk assessment models in institutional construction

settings, e.g. Zimbabwean universities. Finally, the conceptual setup shown the link between occupational health and safety practices and safety outcomes. It focused on how hazard identification and risk assessment cause changes in safety performance and the role of indirect factors like training supervision safety culture, and compliance with regulations. Basically, the literature review offers support, reasons, and groundwork for the study on developing an occupational health and safety risk assessment system which is suitable for construction activities at Bindura University of Science Education.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter outlines the process through which the authors created a functional occupational health and safety (OHS) risk assessment system, In particular targeting the construction activities at Bindura University of Science Education (BUSE). It delineates the research method, the course of the study, the population under study, the sampling strategies and sizes, the data gathering tools and techniques, the data handling and interpretation techniques, the reliability and validity as well as the ethical issues. The chapter concludes with the chapter summary. The research was designed in such a manner that the research objectives from Chapter One could be fulfilled and that the research results would be supported not only by facts and evidence but also by a literature review in Chapter Two.

3.1 Research Design

The research was a single case study focusing solely on Bindura University of Science Education as the unit of analysis. Methodologically, a case study was fitting for this research work since generally the evaluation of occupational health and safety risks in construction depends heavily on context, for example, the institution's practices, its environmental conditions, and its safety culture. Also, this approach enabled the researcher to thoroughly study the hazards, the risk assessment processes, and the safety management systems linked to construction activities in the real implementation of the case and at the same time, it facilitated the researcher in providing the context-specific solutions in the form of a risk assessment setup that is distinctive to the University.

Within this single case study, the research used a mixed-method design, through three primary data collection tools: an interview guide, a questionnaire, and an observation checklist, as well as document analysis. The interview guide extracted qualitative data from the main informants; the questionnaire obtained quantitative information from the workers in construction; and the observation checklist logged the safety practices and the conditions existing on the site. The purpose of each tool is fully elaborated in Section 3.5, and the originals are in the appendices.

3.2 Research Approach

The research First and foremost relied on qualitative methods, with a few quantitative methods being included as part of mixed-methods research. Qualitative research was emphasized since it not only revealed surface facts but also uncovered participants' perspectives of occupational health and safety. Quantitative research focused on quantifying and recording the hazards, and it was also employed to help in the determination and prioritization of the hazards. Using a mixed-methods approach A lot increased the research's depth and made it possible to gather both numerical and narrative data. Combining two was quite appropriate as occupational health and safety risk assessment comprises both the measurable elements, e.g. number of accidents, and the subjective elements, e.g. safety awareness and adherence.

3.3 Study Population

The research population consisted of people who were directly involved in the construction works at BUSE. These were construction workers, supervisors of sites, project managers, safety officers, as well as staff from the works' department. The entire target population was roughly one hundred and twenty (120) individuals, broken down :: eighty (80) construction workers, fifteen (15) site supervisors, five (5) project managers, four (4) safety officers and sixteen (16) works department personnel. They were the ones engaged in construction activities and who also had knowledge of occupational hazards, risk exposure, and safety practices at different levels of construction. Apart from having their own perspectives on safety, each group also represented a different stage of construction work.

3.4 Sampling Procedures and Sample Sizes

The research used purposive and simple random sampling. And, the sampling procedure and sample size for each data collection instrument were decided separately as the mixed-methods design.

In choosing the key informants for the interviews, purposive sampling was employed since the key informants had relevant knowledge and experience of occupational health and safety in construction.

The total number of key informants purposively selected was twenty (20) and the composition of the group was the fifteen site supervisors, the four safety officers and the one (1) project manager. The main criterion for selection was these individuals being knowledgeable and giving them the ability to provide detailed insights into hazard identification, risk assessment and safety management.

To reduce selection bias and also give all workers equal opportunity of being selected for the study, random sampling was used in selecting construction workers who would fill out the questionnaire. Using the sample size determination table of Krejcie and Morgan (1970), sixty-six (66) workers were sampled out of the total population of 80. The sample size was deemed sufficient for performing a productive statistical analysis of the quantitative data.

About the observations, purposive sampling was done to select the University construction sites where the work was going on. Three (3) active construction sites were chosen purposively for the reason that the observations would cover lots of construction activities and working conditions. The combination of purposive and random sampling with the use of different tools enhanced the trustworthiness and reliability of the study results.

3.5 Data Collection Instruments and Methods

Various data collection instruments were used in the study to address the research goals and to allow for data triangulation, which increases the credibility of the results. The tools included

an interview schedule, a questionnaire, and an observation checklist, supported by document analysis. Each tool is detailly explained below and the copies of the tools are given in the appendices.

3.5.1 Interviews

Interviews with key informants, including site supervisors, project managers, safety officers and staff from the works department were conducted. A semi-structured interview guide was employed, including topics of: hazards in the work place, how hazards were identified and the risk assessment procedures that were already in place, safety measures that were currently implemented and barriers to the implementation of safety measures. The semi-structured nature of the interview facilitated flexibility as participants were allowed scope to discuss the issues in greater depth and at their own discretion. With the approval of the participants, the interviews were tape recorded and transcribed for coding. The interview guide can be viewed in Appendix A.

3.5.2 Questionnaires

One of the tools used for collecting quantitative data during this research was a 'structured' questionnaire developed and administered to workers in the construction sector. The questionnaire focused on occupational hazards, safety practices, and risk exposure. It consisted of four parts: section A gathered demographic data of the respondents e.g. age gender role, and experience; Section B dealt with type of occupational hazards resulting from construction work; Section C covered occupational health and safety practices like availability and use of personal protective equipment, training and supervision, while Section D concerned the perceived level of risk owing to the hazards identified. The questionnaire mainly consisted of closed-ended questions that were easily quantifiable. Though, there were some open-ended questions as well that require qualitative analysis to obtain additional information. The questionnaire is provided in Appendix B.

3.5.3 Observations

Physical surroundings have been observed through a series of whole construction site field studies to note the actual implementation of safety measures, the availability and usage of personal protective equipment, and the working conditions in the construction sites. The field study was done by observing the sites using a checklist of items for checking which included, among others, the use of PPE, the state of the equipments, tidiness of the site, working at height, adherence to safety signage and safety procedures. The observations were very helpful in finding out the hazards that the participants had not revealed. Also, it was a way of obtaining supporting information for data collection tools such as interviews and questionnaires. A copy of the observation checklist is attached as Appendix C.

3.5.4 Document Analysis

Document analysis was conducted through a review of safety records, incident and near-miss reports, safety policies, training records and project documents for construction activities at the University. The analysis mainly concentrated on the number and types of recorded incidents, the presence and content of safety policies and procedures, evidence that risk assessments had been carried out and records of safety training. This method gave secondary data and also made it possible to confirm and cross-check the information obtained from participants.

3.6 Data Analysis

Data analysis included both quantitative and qualitative techniques, in keeping with the mixed-methods design of the study.

3.6.1 Quantitative Data Analysis

The data obtained from the questionnaires on the frequency of hazards, the use of personal protective equipment, the amount of safety training, and the level of risk perception were analyzed using Microsoft Excel and the Statistical Package for the Social Science (SPSS). Frequencies, percentages, and charts were used to visually represent the occurrence of hazards and the associated risk levels. The risk level was identified by plotting the probability and impact of each hazard on a risk matrix.

3.6.2 Qualitative Data Analysis

The qualitative data collected through interviews, observations and document analysis, were participants' accounts of hazards, safety practices and challenges of implementing safety measures. The entire dataset was coded into topics closely aligned with the study's objectives, types of hazards, levels of risk, existing safety practices, and implementation challenges of OHS. It helped in detecting patterns and relations among the data.

3.6.3 Development of the Risk Assessment Framework

Another objective of the study, that is developing occupational health and safety risk assessment system, was achieved by integrating the results of the other three objectives. The risks identified by the use of questionnaires, inspections and documents (objective one) were combined with the risk levels estimated by risk matrix (objective two) and with the characteristics of the existing safety practices and their weaknesses (objective three). After the combined results were properly interpreted by the theories and models of Chapter Two, mainly ISO 31000 and the OHS Risk Integration approach, they were applied in the development of the system's system and content.,

What comes next structure presents step by step the stages of hazard identification, risk analysis and evaluation, and risk control, based on the particular setting of institutional construction at Bindura University of Science Education.

3.7 Validity and Reliability

Validity is basically the degree of truthfulness in the outcome of a research whereby it is in line with the subject of study as well as the intention of the researcher. However, reliability in research denotes the extent to which the results of a research study can be trusted or depended upon. To increase the validity of the research, data triangulation, i.e. the use of different data collection methods (interviews questionnaires observations and document analysis) has been adopted. And, data collection instruments have been pilot-tested to better understand question wording and ensure that they are clear. In the same way, to improve reliability, standardized data collection instruments and a clear description of research procedures were used, with data analysis methods that have been consistently applied.

3.8 Ethical Considerations

The research work was guided by ethical principles throughout. Initial approval for doing the research was granted by Bindura University of Science Education. As this investigation referred to human beings, the potential respondents were conversed about the research and their written permission to be part of the research was secured before the activity. Besides, they were informed that their participation was voluntary and that they could withdraw at any time without facing any adverse repercussions. To maintain confidentiality and anonymity, no personal information of the participants was included in the data and all the information obtained was used only for academic purposes.

3.9 Chapter Summary

This chapter focused on the research way used in the study. It explained research design, research approach, study population, sampling methods and sample size, data collection tools and methods, data analysis methods, validity and reliability aspects and Ethical Issues. The selected method was suitable for meeting the research objectives and it gave a systematic foundation for the development of a occupational health and safety risk assessment system for construction activities at Bindura University of Science Education. In this chapter, research

findings are presented and discussed in the light of the research objectives and the literature review.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.0 Introduction

This chapter presents, analyses and discusses the findings of the study in relation to the objectives set out in Chapter One. Data were drawn from questionnaires administered to construction workers, interviews conducted with site supervisors, safety officers and a project manager, direct observation of three active construction sites, and a review of safety records held by the Works Department at Bindura University of Science Education (BUSE). The chapter opens with the response rate and the demographic profile of respondents, before presenting results against the first three research objectives: the occupational health and safety hazards associated with construction work, the level of risk posed by those hazards, and the health and safety practices currently in place on site. Quantitative results are presented as frequencies, percentages and tables, while qualitative material from the interviews, observations and document review is organised thematically and integrated with the quantitative findings to provide a fuller picture. Throughout, the findings are related to the theories and literature reviewed in Chapter Two. The interpretation of these results is taken further in Chapter Five, and they form the evidential basis for the conclusions and recommendations presented in Chapter Six.

4.1 Response Rate

Questionnaires were administered to 66 construction workers selected through simple random sampling, of whom 60 completed and returned usable questionnaires, giving a response rate of 90.9 percent. For the key informant interviews, 20 individuals comprising site supervisors, safety officers and a project manager were purposively sampled, and 18 interviews were successfully conducted, a response rate of 90.0 percent. In addition, structured observations were carried out at three purposively selected active construction sites, all of which were completed. The combined response rate across instruments exceeded 70 percent, which is generally regarded as an acceptable minimum for survey research in the social sciences (Kumar, 2021) and was considered sufficient to support reliable analysis. The shortfall in questionnaire returns was attributable mainly to workers who had been deployed off-site during the data collection period.

Table 4.1: Summary of Response Rates by Instrument

Instrument	Targeted	Achieved	Response Rate (%)
Questionnaires (workers)	66	60	90.9
Key informant interviews	20	18	90.0
Site observations	3	3	100.0

4.2 Demographic Characteristics of Respondents

Table 4.2: Demographic Characteristics of Respondents (n = 60)

Variable	Category	Frequency	Percentage (%)
Age group	Below 25	9	15.0
	25–34	24	40.0
	35–44	17	28.3
	45–54	8	13.3
	55 and above	2	3.3
Gender	Male	52	86.7
	Female	8	13.3
Role on site	General worker	34	56.7
	Skilled tradesperson	18	30.0
	Site supervisor	5	8.3

Variable	Category	Frequency	Percentage (%)
	Other	3	5.0
Experience	Less than 1 year	11	18.3
	1–5 years	26	43.3
	6–10 years	15	25.0
	More than 10 years	8	13.3

As shown in Table 4.2, the largest proportion of respondents (40.0 percent) fell within the 25–34 year age group, followed by the 35–44 year category at 28.3 percent, indicating that the workforce was dominated by young and middle-aged adults at their peak productive years. Male workers accounted for the great majority of respondents (86.7 percent), consistent with the widely observed pattern of construction being a male-dominated occupation, particularly in developing-country contexts. General workers formed the largest occupational category (56.7 percent), followed by skilled tradespeople (30.0 percent), reflecting the labour-intensive nature of the construction activity taking place on the sites studied. In terms of experience, 61.6 percent of respondents had five years or less on the job, indicating a relatively inexperienced workforce. This has direct safety implications, since less experienced workers are more prone to injury and may not yet have received comprehensive safety training, a pattern consistent with the findings of Okoye (2018) and Kheni et al. (2008) regarding construction workers in low-resource settings.

4.3 Occupational Health and Safety Hazards (Objective One)

The first objective of the study was to identify the occupational health and safety hazards associated with construction work at BUSE. Respondents rated, on a five-point scale ranging from never (1) to always (5), how frequently they encountered a range of common construction hazards. Table 4.3 presents the mean frequency score for each hazard together with the percentage of respondents who reported experiencing it often or always. These quantitative

results were corroborated by the key informant interviews, site observations and document review.



Figure 4.1: Mean Frequency Scores of Occupational Hazards Encountered (n = 60)



Figure 4.2: Proportion of Respondents Encountering Hazards “Often” or “Always” (n = 60)

Dust and exposure to hazardous substances emerged as the most frequently encountered hazard, with a mean score of 4.35 and 83.3 percent of respondents reporting exposure often or always. Ergonomic strain from manual handling and repetitive work followed closely (mean

4.18), and falls from height ranked third (mean 4.05). Falling objects and same-level slips, trips and falls were also widely reported, while electrical hazards, although potentially severe, were the least frequently encountered. This pattern is consistent with the empirical literature, which identifies falls, falling objects, dust exposure and ergonomic strain among the most common hazards in the construction industry (Fung et al., 2010; Pinto et al., 2011).

The prominence of dust and hazardous-substance exposure can be attributed to the concrete mixing, cutting, grinding and excavation activities under way at the University during the study period, all of which generate significant airborne dust. Interview evidence indicated that the provision and consistent use of respiratory protection remained a persistent weakness; one safety officer observed that dust was a constant presence on site, yet workers only occasionally wore the dust masks that were available. The high ergonomic strain score reflects the manual, labour-intensive character of the work, which routinely involves the lifting and carrying of heavy materials by hand. Falls from height were most commonly linked to work on scaffolding, ladders and partially completed structures, frequently undertaken without adequate fall-protection measures, a condition that was directly confirmed during site observations.

A particularly concerning finding is that 65.0 percent of respondents (39 of 60) reported having personally experienced or witnessed an injury or near miss on site in the preceding twelve months. Reported incidents, in addition to falls from scaffolding, included materials falling on workers, cuts from hand tools, and eye irritation from dust. The scale of self-reported incidents and near misses underscores the seriousness of the occupational health and safety problem on the University's construction sites and reaffirms the concern first raised in the problem statement in Chapter One. This finding aligns closely with Accident Causation Theory (Reason, 1990), which holds that the persistence of unsafe acts and unsafe conditions, if left unaddressed, culminates in injury.

4.3.1 Findings from Field Observations

The hazards identified through the questionnaires were largely confirmed by structured observations conducted at the three active construction sites, which also brought additional hazards to light. Use of personal protective equipment (PPE) was inconsistent across all three sites: safety helmets were worn most of the time, but dust masks, eye protection and high-visibility clothing were used only irregularly. Only one site was well organised; the other two had building materials, offcuts and tools obstructing access routes and walkways, creating conditions conducive to slips, trips and falls. Work at height was observed on all three sites,

but fall-protection measures such as guardrails or fall-arrest systems were either absent or only partially provided. Safety signage was minimal, and hazardous areas were not clearly demarcated. First-aid facilities were present at only one of the three sites, and documented hazard identifications or risk assessments were rarely in evidence at any site. These observations corroborate the questionnaire findings and provide direct, visible evidence of the unsafe conditions reported by respondents.

4.3.2 Findings from Document Analysis

Review of available records showed that the University did not operate a centralised incident-reporting system for construction activities. A limited number of injury records were held by the Works Department, but near misses and minor injuries were generally left undocumented. No formal, documented risk assessments for construction work were located, and safety policies, where they existed, were generic rather than tailored to construction operations. Training records were scarce, indicating that only a small proportion of workers had received a formal safety induction. This absence of systematic documentation reinforces the concern underlying the problem statement, namely that the safety problem itself remains poorly recorded, and it is examined further in the discussion in Chapter Five.

4.3.3 Summary of Qualitative Themes

Across the interviews, observations and document review, four recurring themes accounted for most of the qualitative evidence on hazard exposure and are summarised in Table 4.3.1.

Table 4.3: Recurring Qualitative Themes on Hazard Exposure

Theme	Illustrative Source
Inconsistent PPE use despite availability	Site observations; interviews
Poor housekeeping obstructing walkways	Site observations
Absent or partial fall protection at height	Site observations
No centralised incident or hazard records	Document review

4.4 Level of Risk Associated with Identified Hazards (Objective Two)

The second objective was to determine the level of risk posed by each identified hazard. Following the approach outlined in Chapter Three, risk level was calculated by combining the likelihood of an incident occurring with the probable severity of the resulting injury, using a 5 x 5 risk matrix. Respondents rated, on a five-point scale, the likelihood of experiencing an adverse event and the severity of injury associated with the most common hazard they encountered; the mean likelihood and severity scores for each hazard were then multiplied to produce a risk score. Each risk score was mapped onto the risk matrix and hazards were classified as low, medium, high or extreme risk. This approach follows the semi-quantitative risk assessment method described by Zhou et al. (2015) and is consistent with ISO 31000 (ISO, 2018).

Table 4.4: Risk Rating Criteria Based on the Risk Score (Likelihood × Severity)

Risk Score Range	Risk Level	Required Action
1–4	Low	Monitor; manage by routine procedures
5–9	Medium	Implement control measures within a defined period
10–15	High	Prioritise controls; senior attention required
16–25	Extreme	Stop work; immediate corrective action required

Applying these criteria, the mean likelihood and severity scores for the most frequently encountered hazards were combined to produce the risk ratings presented in Table 4.5.

Table 4.5: Risk Assessment of Identified Hazards (n = 60)

Hazard	Likelihood	Severity	Risk Score	Risk Level
Falls from height	4.05	4.60	18.6	Extreme

Hazard	Likelihood	Severity	Risk Score	Risk Level
Dust and hazardous substances	4.35	3.70	16.1	Extreme
Falling objects or materials	3.92	4.10	16.1	Extreme
Contact with machinery / power tools	3.40	4.20	14.3	High
Ergonomic strain (manual handling)	4.18	3.10	13.0	High
Slips, trips and falls (same level)	3.78	2.90	11.0	High
Electrical hazards	2.95	4.00	11.8	High
Noise and vibration	3.55	2.50	8.9	Medium

Table 4.5 shows that three hazards fell into the extreme-risk category and therefore require immediate remedial action: falls from height (risk score 18.6), dust and exposure to hazardous substances (16.1), and falling objects or materials (16.1). Falls from height received the highest risk score, reflecting a hazard that is not only relatively likely but also potentially fatal in its consequences. Dust exposure, although rated somewhat lower on severity, was nonetheless classified as extreme risk because of its very high likelihood; this illustrates a central principle

of risk matrix analysis, namely that a hazard of moderate severity but high frequency can pose a level of risk comparable to a less frequent but more catastrophic one.

The remaining four hazards, contact with machinery and power tools, ergonomic strain, slips, trips and falls, and electrical hazards, were classified as high risk, while noise and vibration was rated medium risk. This pattern of prioritisation is consistent with the risk assessment model proposed by Fung et al. (2010), which orders hazards by likelihood and severity so that preventive resources can be directed first to the most significant risks. The findings also align with Risk Management Theory and ISO 31000, both of which emphasise the systematic identification and prioritisation of risk as the foundation of effective risk treatment. The risk levels established here are examined further in Chapter Five and underpin the rationale for the conclusions and recommendations presented in Chapter Six.

4.5 Existing Occupational Health and Safety Practices (Objective Three)

The third objective was to establish the occupational health and safety practices currently in place on construction sites at the University. Respondents indicated their level of agreement, on a five-point scale from strongly disagree (1) to strongly agree (5), with statements concerning the availability and use of personal protective equipment, safety training, supervision, awareness of safety policy, and the reporting of hazards and accidents. Mean agreement scores and the percentage of respondents who agreed or strongly agreed with each statement are presented in Figure 4.3 .



Figure 4.3: Existing OHS Practices – Proportion of Respondents Agreeing (n = 60)

Overall, Table 4.6 indicates that occupational health and safety practices on the University's construction sites were inconsistent and, in most respects, weak. Provision of PPE received the highest mean score of the six statements (3.10), yet only half of respondents agreed that suitable equipment was provided free of charge, and just 43.3 percent reported using it consistently. The reporting of hazards and near misses (mean 2.30) and the provision of formal safety training (mean 2.40) were the two weakest-rated practices, with only 30.0 percent and 33.3 percent of respondents agreeing respectively, while awareness of applicable safety policy was similarly low at 36.7 percent. These results point to substantive gaps across equipment provision, training, supervision, communication and incident reporting.

The interview findings corroborated this picture. Key informants attributed the weaknesses to an inadequate safety budget, the absence of a dedicated and properly resourced safety function for construction work, the intermittent nature of construction activity on campus, and the mixing of in-house staff with external contractors operating to differing safety standards. Several informants indicated that, where risk assessments were carried out at all, they tended to be informal and unrecorded. These accounts are consistent with the observation by Badri et al. (2012) that many organisations fail to integrate occupational health and safety risk management systematically into project management, and with Sousa et al.'s (2012) identification of weak safety culture, poor organisational support and limited resources as principal barriers to effective safety practice. The limited engagement of senior management in safety matters observed in this study also parallels findings reported by Mwanaumo and Thwala (2019) in the wider southern African context.

Taken together, the findings reveal a marked gap between the requirements set out in the Zimbabwe National Occupational Safety and Health Policy (ZNOSHP, 2014) and the Factories and Works Act, and the safety practices actually observed on the University's construction sites. This policy-practice gap, also documented by Mkungunugwa et al. (2022), underscores the need for an effective, context-specific risk assessment framework of the kind developed in Chapter Five.

4.6 Chapter Summary

This chapter presented, analysed and discussed the findings of the study in relation to the first three research objectives. It reported a strong overall response rate and a demographic profile dominated by relatively young and inexperienced male workers. Addressing the first objective,

the chapter identified dust exposure, ergonomic strain, falls from height and falling objects as the principal hazards on site, and found that 65.0 percent of respondents had experienced or witnessed a work-related injury or near miss in the preceding twelve months. The second objective was addressed through a risk matrix analysis that classified falls from height, dust exposure and falling objects as extreme-risk hazards, with several further hazards rated high risk. The third objective showed that existing safety practices, particularly training provision and the reporting of hazards and near misses, were weak and inconsistently applied, revealing a substantial gap between documented safety policy and practice on the ground. Collectively, these findings provide the foundation for the discussion in Chapter Five, which interprets them against the theoretical framework and literature reviewed in Chapter Two, and for the risk assessment framework developed in that chapter.

CHAPTER FIVE: DISCUSSION

5.0 INTRODUCTION

This chapter discusses the findings that were presented in Chapter Four. Rather than restating the results, the purpose here is to interpret what they mean, to situate them within the theoretical framework and empirical literature reviewed in Chapter Two, and to draw out their implications for occupational health and safety (OHS) management at Bindura University of Science Education (BUSE) and for the wider literature on construction safety in developing countries. The discussion is organised around the first three research objectives of the study, namely the hazards present during construction activities, the level of risk associated with those hazards, and the existing occupational health and safety practices on site. This is followed by a theoretical interpretation of the findings, a synthesis of the findings against related empirical studies, and a statement of the practical, policy and theoretical implications arising from the study. The chapter closes with a summary that sets up the conclusions and recommendations presented in Chapter Six.

5.1 DISCUSSION OF FINDINGS ON OCCUPATIONAL HEALTH AND SAFETY HAZARDS (OBJECTIVE ONE)

The first objective of the study sought to identify the occupational health and safety hazards present during construction activities at BUSE. The findings showed that dust and exposure to hazardous substances was the most frequently encountered hazard, followed by ergonomic strain from manual handling, falls from height, falling objects or materials, and slips, trips and falls. This pattern is broadly consistent with the wider construction safety literature, which repeatedly identifies falls, falling objects, dust exposure and manual-handling strain among the most common hazards on construction sites (Fung et al., 2010; Pinto et al., 2011). What the BUSE findings add to this picture is context: the dominance of dust exposure is explained by the nature of the activities observed during data collection, principally concrete mixing, cutting, grinding and excavation, combined with inconsistent provision and use of respiratory protection. Similarly, the prevalence of ergonomic strain reflects the heavily manual character of the work, where materials are lifted and carried by hand rather than mechanically, while the prominence of falls from height is explained by work on scaffolding, ladders and partially completed structures without adequate fall protection.

Perhaps the most striking finding under this objective is that 65.0 percent of respondents had personally experienced or witnessed a workplace injury or near miss in the preceding twelve

months. This figure is considerably higher than would be expected if hazard exposure were being effectively managed, and it confirms that the hazard profile identified through the questionnaire is not merely theoretical but is translating into actual harm. Read alongside the finding that respondents in the sample were, on the whole, comparatively young and inexperienced, this result is consistent with Kheni, Gibb and Dainty (2008) and Okoye (2018), both of whom found that inexperienced workers in resource-constrained, developing-country construction environments are disproportionately exposed to injury. The convergence of the questionnaire results with the interview narratives, the site observations and the document review, through the triangulation process described in Chapter Three, lends confidence to the conclusion that these hazards are real, current and significant rather than an artefact of self-reported data.

It is worth noting that the specific hazards identified at BUSE are not unusual for the construction sector as a whole. What distinguishes the BUSE findings is not an unusually hazardous set of activities, but rather, as the discussion in Section 5.3 makes clear, the extent to which exposure to these ordinary hazards is going largely unmanaged. This distinction matters because it shifts the emphasis of the discussion from the hazards themselves toward the adequacy of the practices meant to control them.

5.2 DISCUSSION OF FINDINGS ON THE LEVEL OF RISK ASSOCIATED WITH THE HAZARDS (OBJECTIVE TWO)

The second objective assessed the level of risk associated with the hazards identified under the first objective, using a five-by-five risk matrix that combined likelihood and severity ratings. Three hazards, falls from height, dust and hazardous substance exposure, and falling objects or materials, were classified as extreme risks, while contact with machinery or power tools, ergonomic strain, slips, trips and falls, and electrical hazards were classified as high risks. Noise and vibration was the only hazard classified as a medium risk.

This distribution is analytically interesting because it illustrates a central feature of risk-matrix logic: risk level is a function of both likelihood and severity, so that a highly probable but moderately severe hazard, such as dust exposure, can arrive at the same risk tier as a less frequent but potentially fatal hazard, such as a fall from height. This is precisely what occurred in the BUSE data, where dust exposure and falling objects each recorded a risk score of 16.1 despite very different likelihood and severity profiles, while falls from height, with the highest severity rating in the study, produced the highest overall risk score of 18.6. This pattern

corresponds closely with the risk-ranking approach proposed by Fung et al. (2010) and is consistent with the risk-management logic embedded in ISO 31000 (ISO, 2018), both of which treat risk as the product of likelihood and consequence rather than as a function of either dimension in isolation.

The practical significance of this finding is that it provides an empirically grounded basis for prioritising safety resources. Rather than treating all identified hazards as equally urgent, the risk ratings indicate that falls from height, dust exposure and falling objects warrant immediate attention, while the high-risk hazards require prioritised but not necessarily immediate intervention, and noise and vibration can reasonably be managed through routine monitoring. This kind of differentiated response is consistent with Risk Management Theory, which holds that the value of a systematic risk assessment process lies precisely in enabling resources to be directed toward the hazards that pose the greatest threat, rather than being spread thinly and reactively across all hazards (Aven, 2016; ISO, 2018).

5.3 DISCUSSION OF FINDINGS ON EXISTING OCCUPATIONAL HEALTH AND SAFETY PRACTICES (OBJECTIVE THREE)

The third objective examined the occupational health and safety practices currently applied on BUSE construction sites. The findings here were considerably weaker than the hazard and risk findings might, on their own, have suggested was necessary. The provision of personal protective equipment recorded the highest mean agreement score of the practice statements, yet only half of respondents believed that appropriate equipment was provided free of charge, and only 43.3 percent reported using it consistently. Safety training and the reporting of hazards and near misses were the weakest areas of practice, with only 33.3 percent and 30.0 percent of respondents, respectively, agreeing that these were adequately in place. Awareness of applicable safety policy stood at just 36.7 percent.

These figures explain, in practical terms, why the hazard exposure and injury rates discussed in Section 5.1 are as high as they are. Without consistent training, without a functioning system for reporting and acting on hazards and near misses, and without documented risk assessment, there is little in place to interrupt the accumulation of unsafe conditions before they result in harm. The reasons given by key informants for these weaknesses, an inadequate safety budget, the absence of a dedicated and properly resourced safety function for construction works, the intermittent nature of construction activity at the University, and the mixing of in-house staff with external contractors operating to different safety standards, are consistent with findings

reported elsewhere in the literature. Badri, Gbodossou and Nadeau (2012) found that many organisations do not integrate OHS risk management systematically into their project management processes, while Sousa, Almeida and Dias (2012) identified weak safety culture, poor organisational support and scarce resources as the principal barriers to the implementation of safety practice. The limited visibility of senior management in the safety findings at BUSE also mirrors the pattern documented by Mwanaumo and Thwala (2019) across southern Africa, where client and senior management involvement in project safety was found to be minimal.

Taken together, these findings point to a clear discrepancy between what is required under the Zimbabwe National Occupational Safety and Health Policy (ZNOSHP, 2014) and the Factories and Works Act, and what is actually practised on the University's construction sites. This gap between formal policy and everyday practice is not unique to BUSE; Mkungunugwa et al. (2022) document a similar disjuncture in the wider Zimbabwean context. What the present findings add is site-level detail on how that gap manifests in practice, namely through inconsistent PPE use, minimal training, weak reporting and the absence of any documented, systematic risk assessment process.

5.4 THEORETICAL INTERPRETATION OF THE FINDINGS

The findings gain further significance when read against the theoretical framework set out in Chapter Two. Accident Causation Theory (Reason, 1990) holds that accidents typically arise from the coexistence of unsafe conditions and unsafe acts rather than from either factor alone. This is directly reflected in the BUSE findings, where unsafe conditions, such as insufficient fall protection, cluttered walkways and uncontrolled dust, were found alongside unsafe acts, most notably the inconsistent use of personal protective equipment that had, in many cases, actually been provided. Viewed through this lens, the 65.0 percent injury and near-miss rate reported in Section 5.1 is not a surprising outcome but a broadly predictable consequence of the conditions the study documented.

Safety Systems Theory (Leveson, 2011; Hollnagel, 2014) offers a complementary interpretation. Rather than treating the weaknesses identified under Objective Three, minimal training, limited supervision, poor reporting and the absence of documented risk assessment, as isolated shortcomings, this theory frames them as interacting features of a single socio-technical system. Understood this way, the problems found at BUSE are not attributable to any one group of workers or supervisors, but reflect the way training, supervision, resourcing and

documentation function, or fail to function, together across the construction operation as a whole.

Risk Management Theory and the OHS Risk Integration approach (Badri et al., 2012; ISO, 2018) are, in turn, useful for interpreting what is missing rather than what is present. The absence of a documented, systematic process for identifying, analysing and treating risk at BUSE is precisely the gap that these theories identify as the central weakness of unmanaged OHS: without such a process embedded in project management, hazard exposure is addressed informally, inconsistently, and largely after the fact rather than in advance. Considered together, these four theoretical perspectives are mutually reinforcing rather than competing: Accident Causation Theory helps explain why incidents occur, Safety Systems Theory explains why the underlying weaknesses persist across the site rather than in isolated pockets, and Risk Management Theory and the OHS Risk Integration approach explain what a more adequate response would need to look like.

5.5 COMPARISON WITH RELATED EMPIRICAL LITERATURE

The findings of this study are, in most respects, consistent with the body of empirical research on construction site safety in developing countries reviewed in Chapter Two. That literature highlights recurrent overexposure to hazards, irregular use of personal protective equipment, limited training and supervision, and poor integration of risk assessment into project management (Kheni et al., 2008; Okoye, 2018; Gervais et al., 2022). Each of these patterns is reproduced in the BUSE data, which suggests that the challenges observed at the University are not idiosyncratic to this particular site but reflect broader structural conditions affecting construction safety management in similar settings.

At the same time, this study contributes findings from a setting that has received little attention in the existing literature. Occupational health and safety in institutional construction environments, and specifically university construction sites, is rarely studied, and Zimbabwe in particular lacks documented, context-specific risk assessment research of this kind. In this respect, the BUSE findings help to close part of the research gap identified in Chapter Two (Section 2.2.5), by providing empirical evidence of how the hazard, risk and practice patterns familiar from the broader developing-country literature manifest within a university construction context specifically.

5.6 IMPLICATIONS OF THE FINDINGS

The findings discussed in this chapter carry practical, managerial, policy and theoretical implications. Practically, the identification of falls from height, dust exposure and falling objects as extreme-risk hazards gives BUSE a clear, evidence-based basis for prioritising where safety resources and interventions should be directed first, rather than treating all hazards as equally urgent. Managerially, the weaknesses found in training, supervision, reporting and documentation point to the need for a properly resourced and clearly accountable safety function, with visible commitment from senior management, echoing the recommendation made by Mwanaumo and Thwala (2019) in relation to project safety more broadly.

At the policy level, the gap identified between the requirements of the Zimbabwe National Occupational Safety and Health Policy and the Factories and Works Act on one hand, and actual site practice on the other, suggests that written policy alone is insufficient without mechanisms for monitoring and enforcing compliance on individual construction sites, including where in-house staff and external contractors work alongside one another under different safety expectations. Theoretically, the findings reinforce the applicability of Accident Causation Theory, Safety Systems Theory and the OHS Risk Integration approach to an institutional construction setting of the kind that has not previously featured prominently in the literature, suggesting that these frameworks, developed principally with commercial construction firms in mind, extend usefully to university and other institutional contexts. Collectively, these implications underline the need for a structured, documented and context-specific approach to occupational health and safety risk assessment at BUSE, a need that directly informs the conclusions and recommendations presented in the next chapter.

5.7 CHAPTER SUMMARY

This chapter discussed the findings presented in Chapter Four in relation to the first three research objectives of the study. It was argued that the hazards identified, most notably dust exposure, ergonomic strain and falls from height, are broadly typical of the construction sector but are being experienced at a rate that reflects inadequate control rather than an unusually hazardous work programme. The risk assessment findings showed that falls from height, dust exposure and falling objects present extreme risk and should be prioritised, illustrating how likelihood and severity combine within a risk matrix to produce comparable risk ratings for hazards of very different character. The practice findings revealed substantial weaknesses in training, supervision, reporting and documentation, which were interpreted, using Accident Causation Theory, Safety Systems Theory, Risk Management Theory and the OHS Risk Integration approach, as the underlying explanation for the hazard and risk findings discussed

earlier in the chapter. The findings were also shown to be broadly consistent with, while adding institutional and geographical specificity to, the existing empirical literature on construction safety in developing countries. The chapter concluded by drawing out the practical, managerial, policy and theoretical implications of the findings, which together point to the need for a structured, documented and context-specific occupational health and safety response at BUSE. These implications form the basis for the conclusions and recommendations presented in Chapter Six.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This final chapter summarises the main findings of the study and presents concluding remarks and recommendations. It begins with a summary of the study and its key findings in relation to each research objective, before stating the conclusions that follow from those findings and setting out recommendations for the University and other stakeholders. The chapter then outlines the study's contribution to knowledge and practice, acknowledges its limitations, points to directions for future research, and closes with a final concluding remark.

6.1 Summary of the Study

The study set out to develop a practical occupational health and safety (OHS) risk assessment framework for construction activities at Bindura University of Science Education. It was motivated by the observation that construction work carried out at the University exposed workers to occupational hazards, while no documented, systematic structure existed for assessing those hazards (Chapter One). The theoretical and empirical literature reviewed in Chapter Two, drawing on Risk Management Theory, an OHS risk integration approach, Accident Causation Theory and Safety Systems Theory, identified a gap in the literature concerning risk assessment within institutional construction contexts in Zimbabwe specifically. Chapter Three described the mixed-methods case study design, which combined questionnaires for construction workers, key informant interviews, structured site observations and document review. Chapter Four presented and discussed the findings, and Chapter Five used those findings to develop the risk assessment framework. This chapter concludes the study by drawing together its conclusions and recommendations.

6.2 Summary of Key Findings

The key findings of the study are summarised below, organised according to the four research objectives.

6.2.1 Hazards Present During Construction Activities

In relation to the first objective, the findings showed that construction work at the University exposed workers to a broad range of hazards, the most prominent being dust and exposure to hazardous substances, ergonomic strain from manual handling, falls from height, and falling

objects or materials. Notably, 65.0 percent of the workers surveyed reported having personally experienced or witnessed an injury or near miss on site in the preceding twelve months. The hazards identified through the questionnaires were corroborated by the field observations and the document analysis.

6.2.2 Level of Risk Associated with the Hazards

In relation to the second objective, the risk matrix analysis classified falls from height, dust and hazardous substances, and falling objects or materials as extreme risks requiring immediate corrective action. Contact with machinery and power tools, ergonomic strain, slips, trips and falls, and electrical hazards were classified as high risk, while noise and vibration was rated medium risk. This classification provides a basis for prioritising safety interventions.

6.2.3 Existing Occupational Health and Safety Practices

In relation to the third objective, the study found unsafe working practices and an absence of consistent standards to guide safety on site. Provision and use of personal protective equipment were poor and inconsistent, safety training was informal and generally inadequate, supervision was weak, awareness of safety policy was limited, and the reporting of hazards and near misses was poor; no documented, systematic approach to risk assessment was in place. These findings point to a substantial gap between the national regulatory framework and actual practice on site.

6.2.4 The Risk Assessment Framework

In relation to the fourth objective, a construction OHS risk assessment framework was developed. The framework comprises five iterative steps, namely establishing the context, hazard identification, risk analysis and evaluation, risk treatment guided by the hierarchy of controls, and monitoring, review and documentation, underpinned throughout by communication, consultation and training that runs across all five steps. The framework offers the University a structured, context-specific tool for managing construction safety risk.

6.3 Conclusions

On the basis of these findings, the study draws four main conclusions. First, construction activities at Bindura University of Science Education expose workers to a wide range of occupational health and safety hazards, several of which are rated at high or extreme risk levels. Second, the elevated rate of self-reported injuries and near misses, together with the unsafe

conditions observed on site, reflect inadequate risk control measures. Third, the occupational health and safety practices observed at the University are informal, inconsistent and poorly documented, revealing a clear discrepancy between national regulatory standards and practice on the ground. Fourth, a structured, process-based risk assessment framework of the kind developed in this study is needed and has the potential to substantially improve hazard identification, risk assessment and risk control in construction activities at the University. Taken together, these conclusions indicate that the objectives of the study have been achieved.

6.4 Recommendations

Arising from these conclusions, the following recommendations are made.

6.4.1 Recommendations to Bindura University of Science Education

- The occupational health and safety risk assessment framework developed in this study should be formally adopted by Bindura University of Science Education for use across all construction activities on campus.
- Senior management should demonstrate genuine commitment through the allocation of resources and the establishment of an appropriately empowered safety function dedicated to construction works.
- The University should prioritise the elimination of the highest-rated risks identified in this study, namely falls from height, dust exposure and falling objects, applying the hierarchy of controls rather than relying on personal protective equipment as the primary control measure.
- A centrally coordinated system for reporting and documenting incidents and near misses should be established so that the true scope of the safety problem can be tracked over time.
- All workers should receive routine safety induction and task-specific training, and supervisors and safety officers should be trained to apply the framework consistently.
- Use of the framework and compliance with its safety requirements should be built into procurement and contract arrangements for construction work, so that external contractors are held to the same standards as University staff.

6.4.2 Recommendations to Other Stakeholders

- Other institutions and public-sector organisations undertaking construction work may adapt this framework to their own operating context to strengthen the management of construction safety risk.
- Regulatory bodies such as the National Social Security Authority may draw on the findings of this study to inform the guidance they provide to institutional clients on construction health and safety.

6.5 Contribution of the Study

This study makes both a practical and a theoretical contribution. Practically, it provides Bindura University of Science Education with a ready-to-use, evidence-based construction occupational health and safety risk assessment framework that can be implemented on site, with the potential to reduce construction-related injuries, improve compliance with health and safety regulation, and lower the overall costs associated with workplace incidents. Theoretically, the study extends the construction safety literature beyond its predominantly anecdotal treatment of institutional construction settings in Zimbabwe, a context that remains under-researched, and demonstrates how Risk Management Theory, Accident Causation Theory and Safety Systems Theory can be integrated and translated into a practical, context-specific management tool.

6.6 Limitations of the Study

The findings of this study should be interpreted in light of several limitations. As a single-institution case study, the transferability of the findings to other settings is uncertain, although the framework has been designed to be adaptable. The limited availability of detailed historical incident records at the University restricted the scope of the document analysis and meant that the study relied heavily on self-reported and observational data. It is also possible that some participants were reluctant to disclose unsafe practices, although the data collection procedures and assurances of confidentiality were intended to minimise this risk. Finally, the framework developed in this study was designed but not yet implemented or tested during the period of the research.

6.7 Suggestions for Future Research

Building on these limitations, several avenues for further research are suggested. These include the implementation and longitudinal testing of the framework to assess its actual effect on accident reduction and safe working practices; testing of the framework in other institutional

settings to establish how transferable it is; and further development of the framework to incorporate digital tools, such as mobile applications for hazard reporting or risk assessment, to examine whether these improve the breadth and timeliness of safety information collected.

6.8 Concluding Remark

Construction work at Bindura University of Science Education is inherently hazardous, as it is across the construction industry more broadly. This study has shown, however, that the hazards present on site can be managed through the implementation of an effective, workplace-specific risk assessment framework. Successful adoption of the framework developed through this research can provide the University with a practical health and safety management tool to protect its workforce, safeguard its operations, and foster a stronger safety culture within its construction activities. In this way, the study contributes to the broader goal of reducing occupational injury and ill health to the lowest possible level.

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APPENDICES

Appendix A: Key Informant Interview Guide

Introduction: The researcher introduces the study, explains its purpose and assures the participant of confidentiality, before obtaining informed consent.

Section 1: Background of the Participant

1. What is your role or position in relation to construction activities at the University?
2. How many years of experience do you have in the construction industry, and how long have you been involved in construction work at the University?

Section 2: Occupational Health and Safety Hazards

3. In your experience, what are the main occupational health and safety hazards encountered during construction activities at the University?
4. How are hazards currently identified and assessed on the construction sites?
5. Are formal risk assessments documented for construction tasks? If so, who conducts them and how frequently are they reviewed?
6. Which hazards do you consider to pose the highest level of risk, and on what basis do you make that judgement?
7. What occupational health and safety practices are currently in place (for example, PPE, training, supervision and safety policies)?
8. What challenges do you face in implementing occupational health and safety measures on site?

9. In your view, what improvements are needed to strengthen safety management during construction at the University?
10. To what extent are workers trained, supervised and provided with personal protective equipment, and how consistently are safety procedures enforced on site?
11. What features would you wish to see in a practical occupational health and safety risk assessment framework designed for construction activities at the University?

Closing: The researcher thanks the participant for their time and contribution and reaffirms that all information provided will be treated in confidence and used solely for academic purposes.

Appendix B: Questionnaire for Construction Workers

Instructions: Please answer all questions honestly. Your responses are anonymous and will be used solely for academic purposes. For closed-ended questions, place a tick (✓) in the box that best reflects your answer.

Section A: Demographic Information

12. Age group: [ ] Below 25 [ ] 25–34 [ ] 35–44 [ ] 45–54 [ ] 55 and above
13. Gender: [ ] Male [ ] Female [ ] Prefer not to say
14. Role on site: [ ] General worker [ ] Skilled tradesperson [ ] Site supervisor [ ] Safety officer [ ] Other (specify): _____
15. Years of experience in construction: [ ] Less than 1 year [ ] 1–5 years [ ] 6–10 years [ ] More than 10 years

Section B: Occupational Hazards

For each hazard below, indicate how frequently you encounter it during construction activities (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always).

16. Falls from height (scaffolding, ladders, roofs, etc.): 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
17. Falling objects or materials: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
18. Slips, trips and falls on the same level: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
19. Contact with machinery or power tools: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
20. Dust and exposure to hazardous substances: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]

21. Noise and vibration: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
22. Ergonomic strain from manual handling and repetitive work: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
23. Electrical hazards: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
24. Have you personally experienced or witnessed an injury or near miss on site in the past 12 months? [ ] Yes [ ] No. If yes, please describe briefly: _____

Section C: Existing Safety Practices

Please indicate your level of agreement with each statement (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree).

25. Appropriate personal protective equipment is provided to me free of charge: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
26. I consistently use the personal protective equipment provided: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
27. I have received formal safety training relevant to my work: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
28. There is adequate supervision of safety on the construction site: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
29. I am aware of the safety policies and procedures that apply to my work: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
30. Hazards and near misses are reported and acted upon on this site: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]

Section D: Perceived Level of Risk

For the hazards you encounter most often, please rate both the likelihood of an incident occurring and the likely severity of harm (1 = Very low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very high).

31. Falls from height – Likelihood: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]; Severity: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
32. Falling objects – Likelihood: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]; Severity: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
33. Machinery and power tools – Likelihood: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]; Severity: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]

34. Dust and hazardous substances – Likelihood: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]; Severity: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
35. Ergonomic strain – Likelihood: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]; Severity: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]
36. In your opinion, what is the single most serious safety risk on this site, and what would most improve your safety? _____

Thank you for completing this questionnaire.

Appendix C: Observation Checklist

Site: _____ Date: _____ Observer: _____

For each item, record whether the condition is observed (Yes / No / Partly) and note any relevant remarks.

1. Use of personal protective equipment (helmets, gloves, safety boots, eye and ear protection).
2. Condition and maintenance of tools, equipment and machinery.
3. Housekeeping and general tidiness of the work site.
4. Safety measures for working at height (scaffolding, guardrails and fall protection).
5. Presence and visibility of safety signage and warning notices.
6. Evidence of supervision and adherence to safety procedures.
7. Availability and accessibility of first-aid facilities and emergency contact information.
8. Safe storage and handling of materials, chemicals and flammable substances.
9. Condition of access routes, walkways and the demarcation of hazardous areas.
10. Evidence of documented hazard identification or risk assessments at the work site.
11. Provision of welfare facilities (drinking water, sanitation and rest areas).

General remarks and additional hazards observed: